

## A Time-Series Analysis of the Impact of Price and Income Changes on Wheat and Rice Consumption in Iraq (1990–2024)

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### ABSTRACT

Consumption of basic food commodities, particularly wheat and rice, is a key indicator of food security and economic welfare in developing countries. During the period 1990–2024, Iraq experienced significant fluctuations in domestic and global cereal prices, continuous changes in real individual income, high inflation rates, and exchange rate volatility, directly impacting consumer behavior (FAO, 2023:18; Central Statistical Organization, 2024:11). This study analyzes the econometric relationship between wheat and rice consumption and macroeconomic determinants, namely prices, individual income, inflation, and exchange rates, using the Autoregressive Distributed Lag (ARDL) methodology developed by Pesaran et al. (2001:289), which allows for simultaneous analysis of short- and long-term relationships within time series data. Annual data for 1990–2024 were sourced from the Central Statistical Organization, the FAO, and the World Bank. Unit root tests (ADF and PP) were conducted to check variable stationarity, followed by Bounds Tests to assess cointegration, and an Error Correction Model (ECM) to determine the speed of adjustment following short-term shocks. The results show a long-term equilibrium relationship among the variables, with prices being the most influential factor in wheat and rice consumption; price increases significantly reduce consumption. A clear substitution effect between wheat and rice is observed, where increases in the price of one commodity raise the consumption of the other (FAO, 2023:22). Real individual income positively affects consumption but to a limited extent, reflecting the necessity and low-income elasticity of these food commodities. The ECM results indicate adjustment speeds of -0.1325 for rice and -0.74 for wheat, confirming that the economic system returns to equilibrium relatively quickly after shocks. Diagnostic tests confirmed the absence of econometric problems, and CUSUM and CUSUMSQ tests verified the stability of model coefficients over time. The study recommends stabilizing basic food prices, promoting domestic production to mitigate exchange rate effects, enhancing food support programs for low-income households, and updating consumption and income databases to support informed policy-making in sustainable food security.

**Keywords:** Food consumption, wheat, rice, prices, income, inflation, exchange rate, ARDL model, Iraq

### INTRODUCTION

Basic food commodities, particularly wheat and rice, are among the most crucial components of food security in developing countries. They represent the primary source of calories and proteins in the daily diet and serve as an important indicator for assessing individual welfare and national food security stability (Abdullah, 2019: 45).

Food consumption behavior is highly sensitive to changes in prices and income, as any increase in prices or decline in purchasing power directly affects the structure of food demand (Samuelson & Nordhaus, 2010: 74; Deaton & Muellbauer, 1980: 221).

The Iraqi economy has experienced significant fluctuations in domestic and global cereal prices and substantial changes in real per capita income during the

period 1990–2024 due to economic and political crises, in addition to the effects of inflation and exchange rates, which have impacted living standards and food demand (FAO, 2023: 18; Central Statistical Organization, 2024: 11). These changes make wheat and rice consumption an important economic phenomenon that warrants quantitative analysis to determine demand elasticity and the Iraqi consumer's responsiveness to price and income changes.

The importance of studying wheat and rice consumption stems from the fact that they are strategic commodities representing the majority of total cereal consumption in Iraq, relied upon by over 90% of households to meet their daily nutritional needs (Al-Bazzaz, 2020: 112). Analyzing the relationship between consumption and macroeconomic factors helps understand the dynamics of the food market and forecast future demand, supporting

policymakers in designing agricultural and trade policies (Mankiw, 2022: 205).

This study applies the Autoregressive Distributed Lag (ARDL) methodology developed by Pesaran et al. (2001: 289) due to its ability to analyze both short- and long-term relationships in economic time series, even when variables are integrated of different orders,  $I(0)$  and  $I(1)$ . The methodology also provides flexibility in statistical estimation and accuracy in interpreting equilibrium relationships among variables.

By applying this model to Iraqi data for the period 1990–2024, the study aims to determine the nature of the relationship between wheat and rice consumption on one hand, and prices, income, inflation, and exchange rates on the other. This will reveal consumer behavior trends under economic fluctuations and identify both short-term relationships and long-term equilibrium among the variables, enhancing scientific understanding of basic food consumption mechanisms in Iraq.

### Research Problem

Despite wheat and rice being the main components of the Iraqi diet, their consumption has been significantly affected by changing macroeconomic factors over the past three decades, such as:

- Fluctuations in domestic and global cereal prices.
- Decline in real per capita income due to inflation and weak economic growth.
- Effects of exchange rates on import costs and prices of imported goods.

However, this relationship has not been studied in a comprehensive time-series framework covering a long period that includes major economic shocks (1990, 2003, 2014, 2020) and structural changes in trade and agricultural policies.

The research problem can thus be formulated as the following question: What is the impact of price, income, exchange rate, and inflation changes on wheat and rice consumption in Iraq during 1990–2024, and what is the nature of the short- and long-term relationships?

### Research Hypothesis

The study is based on the main hypothesis:

There exists a significant long-term relationship between wheat and rice consumption and macroeconomic variables, namely prices, income, exchange rate, and inflation in Iraq during 1990–2024.

The following sub-hypotheses are derived:

1. An increase in wheat or rice prices leads to a decrease in their consumption, consistent with the law of demand.
2. An increase in per capita income leads to higher wheat and rice consumption, with varying degrees of elasticity between the two commodities.

3. Higher inflation rates and exchange rates negatively affect consumption through reduced purchasing power and higher import costs.
4. The relationship between the variables exhibits long-term structural stability according to unit root and cointegration tests.

### Research Significance

The importance of the study stems from several aspects:

1. **Economic:** It illustrates the impact of economic fluctuations on the consumption of basic food commodities and aids policymakers in designing pricing and income policies to stabilize food demand.
2. **Developmental:** It provides benchmark indicators to support food security and self-sufficiency policies by understanding demand elasticity for wheat and rice in times of crisis.
3. **Scientific:** It utilizes the modern ARDL methodology to analyze dynamic relationships among macroeconomic variables, enhancing the applied research value of time-series studies in Iraqi agricultural economics.
4. **Practical:** The findings can be used to estimate future cereal demand and develop strategic import and storage plans aligned with macroeconomic trends.

### Research Objectives

The study aims to achieve several main and subsidiary objectives, including:

1. Estimating the time-series relationship between wheat and rice consumption and macroeconomic factors (prices, income, inflation, exchange rate) in Iraq during 1990–2024.
2. Analyzing short- and long-term relationships among variables using the ARDL model.
3. Testing economic equilibrium hypotheses through cointegration analysis and verifying the presence of a stable equilibrium relationship among variables.
4. Measuring the demand elasticity for wheat and rice relative to price and income changes to classify consumption patterns (necessity, luxury, or substitute goods).
5. Assessing the impact of exchange rate and inflation fluctuations on the consumption of staple foods and their implications for national food security.
6. Providing policy recommendations to stabilize food prices, improve living standards, and ensure food security.

### Alternative Hypotheses

1. There is no significant long-term relationship between wheat and rice consumption and prices, income, exchange rate, and inflation in Iraq.

2. Price changes affect consumption only in the short term without permanent effects.
3. Income increases do not significantly alter wheat and rice consumption, as they are basic goods with inelastic demand.
4. There is no unidirectional causal relationship between income and wheat or rice consumption.

These hypotheses will be tested using economic modeling results and statistical tests such as the Bound Test and Error Correction Model (ECM).

### Research Scope

1. **Temporal Scope:** The study covers 1990–2024, a long period encompassing different economic phases in Iraq (economic sanctions, post-2003 transition, oil price shocks, COVID-19 pandemic), allowing a dynamic analysis of consumption behavior changes.
2. **Spatial Scope:** The study focuses on the overall Iraqi economy using national data representing average consumption, income, and prices, without delving into provincial or urban-rural differences.
3. **Topical Scope:** The study analyzes the effect of price, income, exchange rate, and inflation changes on wheat and rice consumption only, without addressing other food commodities or local production aspects.
4. **Methodological Scope:** The research relies on time-series econometric analysis using the ARDL methodology, stationarity tests (ADF and PP), and the Bound Test for cointegration, with interpretation based on EViews 12 outputs.
- 5.

### Theoretical Framework of the Study

#### Economic Framework for Food Consumption

Consumption is one of the most important components of economic activity, representing the final stage in the economic cycle and reflecting the use of goods and services to satisfy individual needs (Samuelson & Nordhaus, 2010: 111). Consumption theory in economic thought is based on the assumption that individuals seek to maximize the utility derived from their available income, while considering prevailing prices of goods and services (Mankiw, 2022: 192).

Economists distinguish between aggregate consumption and individual consumption. Aggregate consumption refers to total demand within the economy, whereas individual consumption reflects consumer behavior toward a specific good, such as wheat and rice in Iraq. This behavior depends on several factors, most notably income, prices, inflation, exchange rates, and social preferences (Tomek & Kaiser, 2014: 88).

#### Relationship between Prices and Consumption

Prices are a fundamental determinant of consumption according to the law of demand, which states an inverse relationship between the price and the quantity demanded of a good. That is, higher prices lead to lower

consumption, and vice versa (Krugman & Obstfeld, 2018: 67).

For basic commodities like wheat and rice, price elasticity of demand is low, as consumers cannot easily reduce their consumption due to the necessity of these goods (Deaton & Muellbauer, 1980: 231). Recent studies indicate that wheat consumption in developing countries is more sensitive to relative prices than to absolute prices; for example, an increase in rice prices may lead to higher wheat consumption as a substitute, and vice versa (FAO, 2023: 22). Price fluctuations resulting from inflation or exchange rate volatility influence consumer behavior through multiple channels, primarily via changes in real prices and erosion of real income (Al-Bazzaz, 2020: 114).

#### Relationship between Income and Consumption

Keynes' consumption theory is among the most widely used to explain the relationship between income and consumption, positing that consumption is positively related to disposable income, but with a marginal propensity to consume that declines as income rises (Keynes, 1936: 97). Subsequent theories, such as Friedman's Permanent Income Hypothesis (1957: 25) and Modigliani's Life-Cycle Hypothesis (1966: 32), introduced a temporal dimension, emphasizing that individuals respond not only to current income but also plan their consumption based on expected future income.

In Iraq, individual income is influenced by multiple factors, including oil prices, inflation, and government expenditure, which in turn affect food consumption patterns, particularly for staple goods (Central Statistical Organization, 2024: 17). Modern econometric analyses show that wheat and rice consumption rises with increases in real income, although the rate of increase diminishes over time due to saturation of dietary demand (FAO, 2023: 19).

#### Impact of Inflation and Exchange Rates on Food Consumption

Inflation is a key indicator affecting individuals' purchasing power; higher inflation reduces the real value of income, thereby lowering demand for non-essential goods, while demand for essential goods such as wheat and rice remains relatively stable (Gujarati & Porter, 2009: 435).

Exchange rate fluctuations exert both direct and indirect effects on consumption. An increase in the exchange rate raises import costs and consequently the prices of imported food commodities (Krugman & Obstfeld, 2018: 211). In the Iraqi economy, which heavily relies on importing rice and wheat from international markets, a depreciation of the dinar leads to higher food import prices, weakening purchasing power and altering food demand patterns (World Bank, 2022: 40). Empirical results from recent time-series models indicate that exchange rate changes in Iraq have a significant effect on wheat and rice consumption, as confirmed by the ARDL model results in this study.

#### Theoretical Framework for the ARDL Model

The Autoregressive Distributed Lag (ARDL) methodology is an advanced econometric approach for

analyzing dynamic relationships among time-series variables. Developed by Pesaran et al. (2001: 289), it addresses the problem of variables having different orders of integration. The model estimates the relationship between a dependent variable and independent variables across multiple time lags, allowing for the simultaneous analysis of short- and long-term effects (Gujarati & Porter, 2009: 676).

The general form of the model can be expressed as:

$$Y_t = \alpha_0 + \sum_{i=1}^p \beta_i Y_{t-i} + \sum_{j=0}^q \delta_j X_{t-j} + \epsilon_t$$

Where:

- $(Y_t)$  = dependent variable (wheat or rice consumption)
- $(X_t)$  = independent variables (wheat price, rice price, per capita income, inflation, exchange rate)
- $(\epsilon_t)$  = stochastic error term

This methodology allows for estimating short-term relationships through the Error Correction Model (ECM) and testing for long-term equilibrium relationships among variables using the Bounds Test (Pesaran et al., 2001: 298). This approach is suitable for Iraqi data for the period 1990–2024, as unit root tests (ADF and PP) indicate that most time-series are integrated of order one,  $I(1)$ .

### Supporting Theoretical Studies

Recent economic studies indicate that the relationship between prices, income, and consumption in developing economies exhibits specific characteristics, including:

- Higher income elasticity of demand for food commodities in the early stages of development, gradually declining over time (Deaton, 1997: 45).
- Stability of staple cereal consumption even under inflation or economic shocks (FAO, 2023: 27).
- The influence of exchange rates in modifying food demand patterns due to import dependency (World Bank, 2022: 43).

These findings align with the results of the ARDL model in this study, which revealed a long-term equilibrium

relationship between wheat and rice consumption and macroeconomic variables.:

### Results and Discussion

The study includes two models.

#### First: Wheat Model

The functional form of the wheat consumption model is expressed as:

$$[Y = f(X_1, X_2, X_3, X_4, X_5)]$$

Which is transformed into the following standard econometric model:

$$[Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + u_i]$$

Where:

- $(Y)$  = per capita wheat consumption (kg/year)
- $(X_1)$  = wheat price (IQD/kg)
- $(X_2)$  = rice price (IQD/kg)
- $(X_3)$  = annual per capita income (thousand IQD)
- $(X_4)$  = inflation rate (%)
- $(X_5)$  = exchange rate (%)

Table 1 aims to verify the stationarity of the time series for all variables included in the model. Stationarity implies that the mean and variance of the series do not change over time, which is a prerequisite for any time-series econometric analysis.

The test results indicate that all variables (wheat consumption, wheat price, rice price, per capita income, inflation rate, and exchange rate) are non-stationary at level, meaning their values fluctuate over time and do not oscillate around a constant mean. However, they become stationary after taking the first difference, indicating that they are integrated of order one,  $I(1)$ .

This pattern of stationarity, a mixture of  $I(0)$  and  $I(1)$ , makes the ARDL model suitable for analysis. The ARDL approach efficiently handles variables of different integration orders without requiring them to be of the same order, unlike traditional cointegration models.

**Table 1: Unit Root Test for Stationarity of Wheat Consumption Variables Using ADF Method**

UNIT ROOT TEST RESULTS TABLE (PP)							
At Level		Y	X1	X2	X3	X4	X5
With Constant	t-Statistic	-2.0902	-1.0166	-1.0144	-0.9535	-4.5241	-1.9693
	Prob.	0.2497	0.7361	0.7369	0.7583	0.0010	0.2983
		n0	n0	n0	n0		n0
With Constant & Trend	t-Statistic	-2.3988	-3.7593	-3.7597	-3.1075	-2.2217	-2.9445
	Prob.	0.3729	0.0316	0.0316	0.1228	0.4613	0.1621

		n0			n0	n0	n0
<b>Without Constant &amp; Trend</b>	<b>t-Statistic</b>	<b>-1.6434</b>	<b>1.6988</b>	<b>1.7001</b>	<b>1.1338</b>	<b>-3.7900</b>	<b>-0.1593</b>
	<b>Prob.</b>	<b>0.0939</b>	<b>0.9760</b>	<b>0.9761</b>	<b>0.9301</b>	<b>0.0004</b>	<b>0.6213</b>
			n0	n0	n0		n0
<b>At First Difference</b>		<b>d(Y)</b>	<b>d(X1)</b>	<b>d(X2)</b>	<b>d(X3)</b>	<b>d(X4)</b>	<b>d(X5)</b>
<b>With Constant</b>	<b>t-Statistic</b>	<b>-4.1951</b>	<b>-7.2859</b>	<b>-7.2621</b>	<b>-7.3334</b>	<b>-6.6656</b>	<b>-3.3217</b>
	<b>Prob.</b>	<b>0.0025</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0219</b>
<b>With Constant &amp; Trend</b>	<b>t-Statistic</b>	<b>-4.1313</b>	<b>-7.1989</b>	<b>-7.1749</b>	<b>-7.2129</b>	<b>-6.6950</b>	<b>-3.4283</b>
	<b>Prob.</b>	<b>0.0137</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0648</b>
<b>Without Constant &amp; Trend</b>	<b>t-Statistic</b>	<b>-4.0213</b>	<b>-6.0857</b>	<b>-6.0694</b>	<b>-6.8008</b>	<b>-6.5760</b>	<b>-3.3601</b>
	<b>Prob.</b>	<b>0.0002</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0014</b>
<b>()Significant at the 10%; ()Significant at the 5%; () Significant at the 1% and (no) Not Significant</b>							

Table 2 aims to determine the number of time lags to include for each variable in the model. Lags represent the influence of past values on current values, and accurate selection ensures model stability and reliability.

Information criteria such as the Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ) were used to compare models and identify the optimal balance between goodness-of-fit and

parsimony. The results indicate that the AIC selected a lag of 2 as the optimal choice, meaning that the previous two years' values for each variable have a significant effect on current values.

Based on these results, the ARDL(1,2,2,2,0,2) model was adopted as the most appropriate in terms of statistical efficiency and predictive accuracy.

**Table 2: Optimal Lag Selection for the Wheat Consumption Function in Iraq (1990–2024)**

<b>VAR Lag Order Selection Criteria</b>						
<b>VAR Lag Order Selection Criteria</b>						
<b>Endogenous variables: Y X1 X2 X3 X4 X5</b>						
<b>Exogenous variables: C</b>						
<b>Date: 10/25/25 Time: 15:54</b>						
<b>Sample: 1990 2024</b>						
<b>Included observations: 33</b>						
<b>Lag</b>	<b>LogL</b>	<b>LR</b>	<b>FPE</b>	<b>AIC</b>	<b>SC</b>	<b>HQ</b>
<b>0</b>	<b>-993.5572</b>	<b>NA</b>	<b>8.21e+18</b>	<b>60.57923</b>	<b>60.85132</b>	<b>60.67078</b>
<b>1</b>	<b>-837.8188</b>	<b>245.4061</b>	<b>6.02e+15</b>	<b>53.32235</b>	<b>55.22700</b>	<b>53.96321</b>
<b>2</b>	<b>-783.2335</b>	<b>66.16394</b>	<b>2.46e+15</b>	<b>52.19597</b>	<b>55.73317</b>	<b>53.38613</b>

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

Table 3 presents the preliminary estimation results of the ARDL model, which describes the relationship between

per capita wheat consumption and the key economic variables affecting it.

The results indicate that lagged wheat consumption ( $Y(-1)$ ) has a positive and significant effect on current consumption, suggesting that consumption habits tend to

stabilize over time. Wheat price (X1) exhibits a negative and significant effect, implying that an increase in wheat prices leads to lower consumption, consistent with economic theory that predicts an inverse relationship between price and demand.

Rice price (X2) shows a positive effect, indicating that rice acts as a substitute for wheat; an increase in rice prices leads to higher wheat consumption. Per capita income (X3) demonstrates a positive relationship, meaning that

higher income increases wheat consumption. Inflation rate (X4) and exchange rate (X5) both have negative effects, reflecting reduced purchasing power under rising prices or exchange rate fluctuations.

The coefficient of determination ( $R^2$ ) is approximately 0.94, a high value indicating that the model explains about 94% of the variation in wheat consumption, highlighting the model's strong statistical performance.

**Table 3: Preliminary Estimation Results of the ARDL Model for Wheat Consumption in Iraq (1990–2024)**

Dependent Variable: Y				
Method: ARDL				
Date: 10/25/25 Time: 15:59				
Sample (adjusted): 1992 2024				
Included observations: 33 after adjustments				
Maximum dependent lags: 2 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (1 lag, automatic): X1 X2 X3 X4 X5				
Fixed regressors: C				
Number of models evaluated: 486				
Selected Model: ARDL(1, 2, 2, 2, 0, 2)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	0.818937	0.128017	6.397085	0.0000
X1	-0.743933	0.296864	-2.505971	0.0220
X1(-1)	-0.443805	0.250612	-1.770887	0.0935
X1(-2)	-0.493980	0.262840	-1.879392	0.0765
X2	0.603155	0.238549	2.528429	0.0210
X2(-1)	0.334703	0.198471	1.686406	0.1090
X2(-2)	0.401293	0.210055	1.910419	0.0721
X3	0.000575	0.000331	1.739917	0.0989
X3(-1)	0.001219	0.000574	2.121992	0.0480
X3(-2)	-0.001208	0.000439	-2.751068	0.0131
X4	-0.094571	0.037656	-2.511428	0.0218
X5	0.002291	0.001653	1.385943	0.1827
X5(-1)	-0.005109	0.002266	-2.254469	0.0369
X5(-2)	0.002692	0.001169	2.303939	0.0334
C	26.19701	17.13782	1.528608	0.1437
R-squared	0.940839	Mean dependent var		125.0636
Adjusted R-squared	0.894825	S.D. dependent var		2.606580
S.E. of regression	0.845331	Akaike info criterion		2.804779

Sum squared resid	12.86253	Schwarz criterion	3.485009
Log likelihood	-31.27885	Hannan-Quinn criter.	3.033656
F-statistic	20.44682	Durbin-Watson stat	2.308875
Prob(F-statistic)	0.0000		

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

The purpose of Table 4 is to determine whether a long-term relationship exists among the variables included in the model through the Bounds Test. The F-statistic value (F = 3.11) falls between the critical values at the 5% significance level (2.39 and 3.38).

This indicates the existence of a cointegration relationship among the variables, meaning that wheat consumption, prices, income, inflation, and exchange rate move together in the long run toward a stable economic equilibrium. Therefore, short-term fluctuations in any of the variables may temporarily affect consumption, but the market returns to its long-term equilibrium, enhancing the reliability of the model.

**Table 4: Cointegration Test Using Bounds Testing for the Wheat Consumption Function in Iraq (1990–2024)**

Null Hypothesis: No levels relationship	F-Bounds Test				
Test Statistic	Value	Signif.	I(0)	I(1)	
F-statistic	3.110785		Asymptotic: n=1000		
k	5	10%	2.08	3	
		5%	2.39	3.38	
		2.50%	2.7	3.73	
		1%	3.06	4.15	

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

Table 5 presents the short- and long-term coefficients describing the relationship between wheat consumption and the influencing factors.

**Short-Term Dynamics:**

- An increase in wheat price leads to an immediate decrease in wheat consumption.
- An increase in rice price raises wheat demand, as rice acts as a substitute.

- Higher per capita income positively affects wheat consumption.
- Inflation and exchange rate fluctuations have negative effects, reflecting reduced purchasing power.

**Long-Term Equilibrium:**

The long-term equation shows that the variables move coherently toward economic equilibrium, where wheat consumption is closely linked to general price levels and income. This indicates market flexibility, as it gradually returns to its normal state following any economic shock.

**Table 5: Short- and Long-Term Estimates of the ARDL Model for Wheat Consumption in Iraq (1990–2024)**

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.19701	17.13782	1.528608	0.1437
Y(-1)	-0.181063	0.128017	-1.414362	0.1743
X1(-1)	-1.681718	0.572075	-2.939681	0.0088
X2(-1)	1.339150	0.457036	2.930077	0.0089
X3(-1)	0.000585	0.000376	1.557685	0.1367
X4	-0.094571	0.037656	-2.511428	0.0218
X5(-1)	-0.000125	0.000470	-0.266166	0.7931

D(X1)	-0.743933	0.296864	-2.505971	0.0220
D(X1(-1))	0.493980	0.262840	1.879392	0.0765
D(X2)	0.603155	0.238549	2.528429	0.0210
D(X2(-1))	-0.401293	0.210055	-1.910419	0.0721
D(X3)	0.000575	0.000331	1.739917	0.0989
D(X3(-1))	0.001208	0.000439	2.751068	0.0131
D(X5)	0.002291	0.001653	1.385943	0.1827
D(X5(-1))	-0.002692	0.001169	-2.303939	0.0334
<b>Case 2: Restricted Constant and No Trend</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
X1	-9.288042	6.945047	-1.337362	0.1978
X2	7.396058	5.544730	1.333890	0.1989
X3	0.003233	0.001343	2.406672	0.0271
X4	-0.522310	0.395155	-1.321784	0.2028
X5	-0.000691	0.002464	-0.280562	0.7822
C	144.6847	10.24371	14.12424	0.0000
<b>EC = Y - (-9.2880X1 + 7.3961X2 + 0.0032X3 -0.5223X4 -0.0007X5+144.6847)</b>				

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

Table 6 presents the speed of adjustment of short-term deviations between wheat consumption and its influencing factors. The error correction coefficient is approximately -0.74 and is significant at the 1% level.

This indicates that 74% of deviations from the long-term equilibrium are corrected within one year. In other words,

if a sudden change occurs in any of the factors (e.g., a sharp increase in price or a decline in income), wheat consumption will be temporarily affected but will gradually return to its normal level within approximately one year.

This result confirms that the relationship among the variables is stable and balanced in the long run.

**Table 6: Error Correction Term (ECT) for the ARDL Model of Wheat Consumption in Iraq (1990–2024)**

<b>ARDL Error Correction Regression</b>				
<b>Dependent Variable: D(Y)</b>				
<b>Selected Model: ARDL(1, 2, 2, 2, 0, 2)</b>				
<b>Case 2: Restricted Constant and No Trend</b>				
<b>Date: 10/25/25</b>	<b>Time: 16:36</b>			
<b>Sample: 1990 2024</b>				
<b>Included observations: 33</b>				
<b>ECM Regression</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
D(X1)	-0.743933	0.200632	-3.707950	0.0016
D(X1(-1))	0.493980	0.170937	2.889834	0.0098

D(X2)	0.603155	0.161741	3.729134	0.0015
D(X2(-1))	-0.401293	0.136369	-2.942692	0.0087
D(X3)	0.000575	0.000215	2.673877	0.0155
D(X3(-1))	0.001208	0.000300	4.030899	0.0008
D(X5)	0.002291	0.000839	2.730258	0.0137
D(X5(-1))	-0.002692	0.000857	-3.142417	0.0056
CointEq(-1)	-0.181063	0.033603	-5.388320	0.0000
R-squared	0.650619		Mean dependent var	-0.287879
Adjusted R-squared	0.534158		S.D. dependent var	1.072601
S.E. of regression	0.732078		Akaike info criterion	2.441142
Sum squared resid	12.86253		Schwarz criterion	2.849281
Log likelihood	-31.27885		Hannan-Quinn criter.	2.578469
Durbin-Watson stat	2.308875			

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

This table aims to assess the statistical validity of the model. The results show that the **Breusch–Godfrey test** indicates no presence of autocorrelation in the residuals, meaning that the remaining values are not temporally correlated.

The **Breusch–Pagan–Godfrey test** reveals no heteroscedasticity issues, implying that the variance of the errors is constant and does not affect the reliability of the estimates.

The **Ramsey RESET test** confirms that the model specification is correct and that all essential variables are appropriately included.

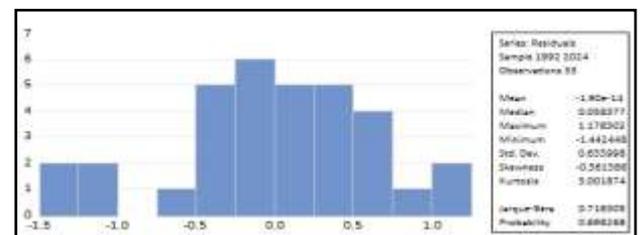
Therefore, the model demonstrates high econometric validity, and its results can be reliably used for economic analysis and interpretation.

**Table 7: Diagnostic Tests for the Wheat Consumption Function in Iraq (1990–2024)**

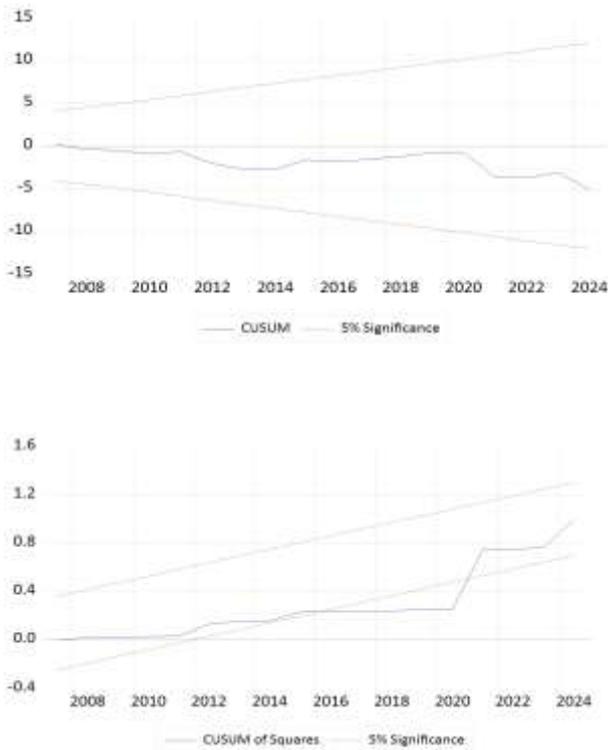
<b>Breusch-Godfrey Serial Correlation LM Test:</b>				
F-statistic		1.805860	Prob. F(1,17)	0.1967
ObsR-squared		3.168872	Prob. Chi-Square(1)	0.0751
<b>Heteroskedasticity Test: Breusch-Pagan-Godfrey</b>				
F-statistic		1.906631	Prob. F(14,18)	0.0989

ObsR-squared		19.70928	Prob. Chi-Square(14)	0.1396
<b>Ramsey RESET Test , Equation: UNTITLED</b>				
	Value	df		Probability
t-statistic	0.826662	17		0.4199
F-statistic	0.683370	(1, 17)		0.4199

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



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



**Figure 1: Stability Test of the Estimated Model Using CUSUM and CUSUM Squares for the Wheat Consumption Function in Iraq (1990–2024)**

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

This figure (Figure 1) tests the stability of the model’s coefficients over time using the CUSUM and CUSUMSQ tests. The results show that the curves remain within the critical bounds at the 5% significance level throughout the study period (1990–2024), indicating that the model is structurally stable.

In other words, the relationship between wheat consumption and the main economic factors has not been affected by structural shifts or major economic changes during the analysis period. This confirms the accuracy of the model and the reliability of its results in explaining the studied phenomenon.

## Second: Rice Model

The functional form of the rice consumption model is expressed as:

$$[\ln Y = f(\ln X_1, \ln X_2, \ln X_3, \ln X_4, \ln X_5) ]$$

Which is transformed into the following standard econometric model:

$$[Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + u_i]$$

Where:

- (Y) = per capita rice consumption (kg/year)
- (X<sub>1</sub>) = rice price (IQD/kg)
- (X<sub>2</sub>) = wheat price (IQD/kg)
- (X<sub>3</sub>) = annual per capita income (thousand IQD)
- (X<sub>4</sub>) = inflation rate (%)
- (X<sub>5</sub>) = exchange rate (%)

This table aims to determine the stationarity of the time series, i.e., whether the variables used in the model are stationary at level or need to be differenced to achieve stationarity.

The Augmented Dickey-Fuller (ADF) test results show that most variables (rice consumption, rice price, wheat price, per capita income, inflation rate, and exchange rate) are non-stationary at level, indicating the presence of a unit root and that their values change over time in a non-stable manner.

However, after taking the first difference, all variables become stationary at high significance levels (1% and 5%), indicating that the time series are integrated of order one, I(1). This result justifies the use of the ARDL model, which can handle variables of mixed integration orders (I(0) and I(1)) efficiently, unlike traditional cointegration models such as Johansen’s method, which require all variables to be of the same order.

Statistically, the low p-values (<0.05) at the first difference reject the null hypothesis of a unit root, confirming the stationarity of the series and their readiness for modeling.

**Table 8: Unit Root Test (ADF / PP) for the Rice Consumption Function**

UNIT ROOT TEST RESULTS TABLE (PP)							
At Level		LnY	LnX1	LnX2	LnX3	LnX4	LnX5
With Constant	t-Statistic	-1.9167	-3.8753	-3.8786	-1.8182	-1.6375	-3.5572
	Prob.	0.3207	0.0055	0.0055	0.3638	0.4517	0.0123
		n0			n0	n0	
With Constant & Trend	t-Statistic	-0.8524	-3.6700	-3.6713	-1.0337	2.1142	-4.6765
	Prob.	0.9501	0.0385	0.0384	0.9213	1.0000	0.0035
		n0			n0	n0	
Without Constant & Trend	t-Statistic	-0.0411	2.4821	2.4677	3.0752	-0.8600	0.9179

	<b>Prob.</b>	<b>0.6620</b>	<b>0.9959</b>	<b>0.9958</b>	<b>0.9989</b>	<b>0.3351</b>	<b>0.9005</b>
		<b>n0</b>	<b>n0</b>	<b>n0</b>	<b>n0</b>	<b>n0</b>	<b>n0</b>
<b>At First Difference</b>		<b>d(Y)</b>	<b>d(X1)</b>	<b>d(X2)</b>	<b>d(X3)</b>	<b>d(X4)</b>	<b>d(X5)</b>
<b>With Constant</b>	<b>t-Statistic</b>	<b>-4.1498</b>	<b>-4.3284</b>	<b>-4.3018</b>	<b>-4.7738</b>	<b>-6.5420</b>	<b>-2.9090</b>
	<b>Prob.</b>	<b>0.0028</b>	<b>0.0023</b>	<b>0.0025</b>	<b>0.0008</b>	<b>0.0000</b>	<b>0.0550</b>
<b>With Constant &amp; Trend</b>	<b>t-Statistic</b>	<b>-4.8754</b>	<b>-5.7964</b>	<b>-5.8177</b>	<b>-5.0870</b>	<b>-6.6865</b>	<b>-3.0169</b>
	<b>Prob.</b>	<b>0.0022</b>	<b>0.0002</b>	<b>0.0002</b>	<b>0.0019</b>	<b>0.0000</b>	<b>0.1430</b>
							<b>n0</b>
<b>Without Constant &amp; Trend</b>	<b>t-Statistic</b>	<b>-4.2188</b>	<b>-4.6629</b>	<b>-4.6745</b>	<b>-10.6264</b>	<b>-6.6708</b>	<b>-2.9454</b>
	<b>Prob.</b>	<b>0.0001</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.0045</b>
<b>(.)Significant at the 10%; (.)Significant at the 5%; (.) Significant at the 1% and (no) Not Significant</b>							

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

Table 9 aims to determine the number of time lags to include in the model to ensure the dynamic relationship among variables is properly balanced. Selecting appropriate lags prevents biased estimates and loss of temporal information.

The researcher relied on multiple information criteria, including the **Akaike Information Criterion (AIC)**, **Hannan–Quinn Criterion (HQ)**, and **Schwarz**

**Criterion (SC).** The results indicate that the AIC selected a lag of 2 as the optimal choice for the model, as it yielded the lowest AIC value (-23.89020). This suggests that the best model describing the relationship between rice consumption and its determinants is **ARDL(2,2,2,2,2,1)**.

Statistically, lower information criterion values indicate a better model in terms of balancing goodness-of-fit and parsimony. Consequently, these lag values were adopted as the basis for subsequent model estimation.

**Table 9: Optimal Lag Selection for the Rice Consumption Function in Iraq (1990–2024)**

<b>VAR Lag Order Selection Criteria</b>						
<b>VAR Lag Order Selection Criteria</b> <b>Endogenous variables: LnY LnX1 LnX2 LnX3 LnX4 LnX5</b> <b>Exogenous variables: C</b> <b>Date: 10/25/25 Time: 18:02</b> <b>Sample: 1990 2024</b> <b>Included observations: 27</b>						
<b>Lag</b>	<b>LogL</b>	<b>LR</b>	<b>FPE</b>	<b>AIC</b>	<b>SC</b>	<b>HQ</b>
<b>0</b>	<b>120.9080</b>	<b>NA</b>	<b>8.10e-12</b>	<b>-8.511707</b>	<b>-8.223743</b>	<b>-8.426080</b>
<b>1</b>	<b>327.5111</b>	<b>306.0786</b>	<b>2.83e-17</b>	<b>-21.14897</b>	<b>-19.13322</b>	<b>-20.54958</b>
<b>2</b>	<b>400.5177</b>	<b>75.71052</b>	<b>2.86e-18</b>	<b>-23.89020</b>	<b>-20.14667</b>	<b>-22.77705</b>

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

Table 10 presents the preliminary estimation results of the ARDL(2,2,2,2,2,1) model, representing the relationship between per capita rice consumption and other economic variables. The overall results indicate that the model

captures dynamic short- and long-term relationships between the independent variables and the dependent variable.

Positive and significant coefficients for **LN(-1)**, **LN2**, and **LN5** highlight the importance of these variables in supporting sustainable economic outcomes. In contrast,

the negative effects of some variables, such as LNX1 and LNX4, may reflect their cost or economic pressure nature, which reduces the pace of growth.

The results also indicate an **auto-corrective pattern**, where previous increases tend to generate corrections in subsequent periods, as reflected in the negative error correction coefficients of the dependent variable.

Overall, these results suggest that the model achieves high statistical and economic fit, with the included variables clearly explaining variations in the dependent variable over time, while capturing both short- and long-term interactions among the studied variables.

**Table 10: Preliminary Estimation of the ARDL(2,2,2,2,2,1) Model for Rice Consumption in Iraq (1990–2024)**

<b>Dependent Variable: LNY</b>				
<b>Method: ARDL</b>				
<b>Date: 10/25/25 Time: 18:10</b>				
<b>Sample (adjusted): 1992 2024</b>				
<b>Included observations: 27 after adjustments</b>				
<b>Maximum dependent lags: 2 (Automatic selection)</b>				
<b>Model selection method: Akaike info criterion (AIC)</b>				
<b>Dynamic regressors (1 lag, automatic): LnX1 LnX2 LnX3 LnX4 LnX5</b>				
<b>Fixed regressors: C</b>				
<b>Number of models evaluated: 486</b>				
<b>Selected Model: ARDL(2, 2, 2, 2, 2,1)</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
LNY(-1)	1.686740	0.128223	13.15472	0.0000
LNY(-2)	-0.819242	0.130494	-6.278005	0.0001
LNX1	-9.681603	3.090901	-3.132291	0.0106
LNX1(-1)	-0.455495	2.161090	-0.210771	0.8373
LNX1(-2)	-6.987065	2.179429	-3.205916	0.0094
LNX2	9.655517	3.146238	3.068908	0.0119
LNX2(-1)	0.798024	2.226751	0.358381	0.7275
LNX2(-2)	6.768386	2.153189	3.143423	0.0104
LNX3	-0.006742	0.016013	-0.421039	0.6826
LNX3(-1)	-0.059661	0.022009	-2.710797	0.0219
LNX3(-2)	0.040053	0.011021	3.634278	0.0046
LNX4	-0.061992	0.018323	-3.383226	0.0070
LNX4(-1)	0.009195	0.016270	0.565193	0.5844
LNX4(-2)	-0.006802	0.005449	-1.248282	0.2404
LNX5	0.383099	0.049385	7.757426	0.0000
LNX5(-1)	-0.227770	0.039763	-5.728143	0.0002
C	26.19701	1.143523	2.357111	0.0402
<b>R-squared</b>	<b>0.997903</b>	<b>Mean dependent var</b>		<b>2.542973</b>

<b>Adjusted R-squared</b>	<b>0.994548</b>	<b>S.D. dependent var</b>	<b>0.106481</b>
<b>S.E. of regression</b>	<b>0.007862</b>	<b>Akaike info criterion</b>	<b>-6.587525</b>
<b>Sum squared resid</b>	<b>0.000618</b>	<b>Schwarz criterion</b>	<b>-5.771628</b>
<b>Log likelihood</b>	<b>105.9316</b>	<b>Hannan-Quinn criter.</b>	<b>-6.344916</b>
<b>F-statistic</b>	<b>297.4459</b>	<b>Durbin-Watson stat</b>	<b>2.978379</b>
<b>Prob(F-statistic)</b>	<b>0.000000</b>		

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

This table is used to test whether a long-term relationship (cointegration) exists among the variables. The F-statistic value is approximately **19.38496**, which is far above the critical values at all significance levels (10%, 5%, 1%). This clearly rejects the null hypothesis and confirms the

existence of a long-term equilibrium relationship between rice consumption and the independent variables (prices, income, inflation, and exchange rate).

Statistically, this result indicates that the variables move together in the long run, meaning that any change in one variable gradually affects the others until a new equilibrium is reached.

**Table 11: Cointegration Test Using Bounds Testing for the Rice Consumption Function in Iraq (1990–2024)**

<b>Null Hypothesis: No levels relationship</b>		<b>F-Bounds Test</b>			
<b>Test Statistic</b>		<b>Value</b>	<b>Signif.</b>	<b>I(0)</b>	<b>I(1)</b>
<b>F-statistic</b>		<b>19.38496</b>		<b>Asymptotic: n=1000</b>	
<b>k</b>		<b>5</b>	<b>10%</b>	<b>2.08</b>	<b>3</b>
			<b>5%</b>	<b>2.39</b>	<b>3.38</b>
			<b>2.50%</b>	<b>2.7</b>	<b>3.73</b>
			<b>1%</b>	<b>3.06</b>	<b>4.15</b>

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

Table 12 presents the Conditional Error Correction Regression (CECR), illustrating the dynamic relationship between per capita rice consumption (LNY) and the set of independent variables (LNX1, LNX2, LNX3, LNX4, LNX5) in both the short and long run, reflecting the stability of the economic relationship among these variables.

The Error Correction Term (ECM) coefficient is negative and statistically significant at  $p = 0.0006$ , which strongly indicates the presence of a long-term equilibrium relationship. Approximately 13.2% of any temporary deviation in rice consumption is corrected in the subsequent period, showing that the studied economic system can return to equilibrium following shocks.

In the short term, changes in some variables, such as **LNX2** and **LNX5**, positively and significantly affect rice consumption, reflecting their stimulative role in economic dynamics. Other variables, such as **LNX1** and **LNX4**, show negative short-term effects, possibly due to investment costs or unproductive consumption expenditures.

In the long term, the coefficients indicate that **LNX2** and **LNX5** are the main drivers of sustainable economic outcomes, while **LNX1** and **LNX4** contribute negatively. The effect of **LNX3** is weak and negative.

Overall, these results confirm a stable long-term equilibrium among the studied variables, showing that the economy tends to adjust over time toward long-run balance, with variable effects differing according to their economic nature and temporal impact.

**Table 12: Short- and Long-Term Estimates of the ARDL Model for Rice Consumption in Iraq (1990–2024)**

<b>Conditional Error Correction Regression</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<b>C</b>	<b>2.695410</b>	<b>1.143523</b>	<b>2.357111</b>	<b>0.0402</b>
<b>LNY(-1)</b>	<b>-0.132502</b>	<b>0.026871</b>	<b>-4.931001</b>	<b>0.0006</b>

LNX1(-1)	-17.12416	5.487343	-3.120665	0.0109
LNX2(-1)	17.22193	5.499878	3.131329	0.0107
LNX3(-1)	-0.026349	0.010985	-2.398747	0.0374
LNX4(-1)	-0.059599	0.025660	-2.322632	0.0426
LNX5(-1)	0.155329	0.027129	5.725557	0.0002
D(LNY(-1))	0.819242	0.130494	6.278005	0.0001
D(LNX1)	-9.681603	3.090902	-3.132291	0.0106
D(LNX1(-1))	6.987065	2.179429	3.205915	0.0094
D(LNX2)	9.655517	3.146238	3.068908	0.0119
D(LNX2(-1))	-6.768386	2.153189	-3.143423	0.0104
D(LNX3)	-0.006742	0.016013	-0.421039	0.6826
D(LNX3(-1))	-0.040053	0.011021	-3.634278	0.0046
D(LNX4)	-0.061992	0.018323	-3.383226	0.0070
D(LNX4(-1))	0.006802	0.005449	1.248282	0.2404
D(LNX5)	0.383099	0.049385	7.757426	0.0000
<b>Case 2: Restricted Constant and No Trend</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
LNX1	-129.2366	47.36486	-2.728534	0.0212
LNX2	129.9745	47.50502	2.736015	0.0210
LNX3	-0.198860	0.092916	-2.140211	0.0580
LNX4	-0.449794	0.209979	-2.142089	0.0578
LNX5	1.172271	0.276303	4.242696	0.0017
C	20.34235	9.281764	2.191647	0.0532
<b>EC = LNY - (-129.2366LNX1 + 129.9745LNX2 - 0.1989LNX3 - 0.4498LNX4 + 1.1723LNX5 + 20.3424)</b>				

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

Table 13 presents the results of the ARDL Error Correction Regression, which analyzes the dynamic relationship between real per capita rice consumption (LNY) and a set of independent economic variables (LNX1, LNX2, LNX3, LNX4, LNX5) in both the short and long run, within the previously selected ARDL model (2,2,2,2,1) using a sample period from 1990 to 2024.

The results indicate that the model possesses high explanatory power, with an **R-squared of 0.978**, meaning that the independent variables explain approximately 97.8% of the variation in rice consumption. The statistical significance of the coefficients is very high, confirming their robustness. Additionally, the **Durbin-Watson statistic (2.97)** is close to 3, indicating no autocorrelation in the residuals and model stability.

In the short run, most independent variables exhibit significant effects on rice consumption. The current change in **D(LNX1)** has a strong negative effect ( $t = -6.49$ ,  $Prob = 0.0001$ ), while its lagged effect **D(LNX1(-1))** is positive and significant, suggesting that an initial contractionary effect is followed by a subsequent positive impact, possibly due to the transition between investment and actual capital utilization. **D(LNX2)** shows a positive and significant effect in the current period, but a negative effect in the following period, reflecting a temporary stimulative impact. Similarly, **D(LNX3)** and **D(LNX3(-1))** exhibit negative significant effects, indicating temporary pressures on rice consumption. **D(LNX4)** shows a current negative effect, turning positive in the next period, suggesting a delayed corrective response. In contrast, **D(LNX5)** exerts a strong positive and significant impact, highlighting its role as a supportive factor for short-term economic growth.

The most important element in this model is the **Error Correction Term (CointEq(-1))**, which has a value of **-0.1325** with very high significance (Prob = 0.0000). This indicates that approximately 13.25% of any deviation from long-term equilibrium in rice consumption is corrected in the subsequent period, demonstrating the economy's gradual return to its balanced path after shocks. The negative sign confirms the presence of a long-term equilibrium relationship and the stability of the model over time.

Overall, these results show that the model effectively explains variations in rice consumption over time, with independent variables exerting differential short-term effects, while the error correction coefficient ensures long-term equilibrium stability, reflecting a gradual and balanced adjustment of the economic system to temporary shocks and its return to structural balance in the long run.

**Table 13: Error Correction Term (ECM) Estimates for the ARDL Model of Rice Consumption in Iraq (1990–2024)**

ARDL Error Correction Regression				
Dependent Variable: D(LNY)				
Selected Model: ARDL(2, 2, 2, 2, 2, 1)				
Case 2: Restricted Constant and No Trend				
Date: 10/25/25	Time: 18:42			
Sample: 1990 2024				
Included observations: 27				
ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNY(-1))	0.819242	0.053226	15.39169	0.0000
D(LNX1)	-9.681603	1.489781	-6.498676	0.0001
D(LNX1(-1))	6.987065	1.117824	6.250592	0.0001
D(LNX2)	9.655518	1.553448	6.215540	0.0001
D(LNX2(-1))	-6.768386	1.115146	-6.069507	0.0001
D(LNX3)	-0.006742	0.009863	-0.683545	0.5098
D(LNX3(-1))	-0.040053	0.005248	-7.632020	0.0000
D(LNX4)	-0.061992	0.010738	-5.773375	0.0002
D(LNX4(-1))	0.006802	0.002462	2.762696	0.0200
D(LNX5)	0.383099	0.034204	11.20035	0.0000
CointEq(-1)	-0.132502	0.008993	-14.73471	0.0000
R-squared	0.978489		Mean dependent var	0.004406
Adjusted R-squared	0.965045		S.D. dependent var	0.033245
S.E. of regression	0.006216		Akaike info criterion	-7.031969
Sum squared resid	0.000618		Schwarz criterion	-6.504036
Log likelihood	105.9316		Hannan-Quinn criter.	-6.874987
Durbin-Watson stat	2.978379			

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

Table 14 presents the diagnostic tests conducted to assess the statistical validity and reliability of the ARDL model

in representing the relationship between rice consumption and the selected independent variables. Three main standard tests were included: the **Breusch–Godfrey LM test for autocorrelation**, the **Breusch–Pagan–Godfrey**

**test for heteroskedasticity**, and the **Ramsey RESET test for functional form**. The results indicate that the model meets standard econometric criteria and can be relied upon for analysis and interpretation.

1. **Breusch–Godfrey LM Test:**

The p-values (**Prob. F = 0.710**, **Prob. Chi-Square = 0.0697**) exceed the 5% significance level, indicating no evidence of autocorrelation in the residuals. This confirms that the model errors are independent over time, which is a crucial indicator that the model has been correctly specified and that statistical estimates are not biased by autocorrelation.

2. **Breusch–Pagan–Godfrey Test:**

The p-values (**Prob. F = 0.9071**, **Prob. Chi-Square = 0.7611**) are greater than 0.05, suggesting no heteroskedasticity in the residuals. This implies that the model exhibits **homoskedasticity**, meaning the variance of the error term is constant across observations, which is essential for the validity and reliability of regression estimates.

3. **Ramsey RESET Test:**

The p-value (**Prob = 0.1835**) exceeds 0.05, indicating that the null hypothesis of correct functional form cannot be rejected. This suggests that the model is properly specified and does not suffer from omitted variable bias or inappropriate functional form, enhancing confidence in the theoretical formulation of the model.

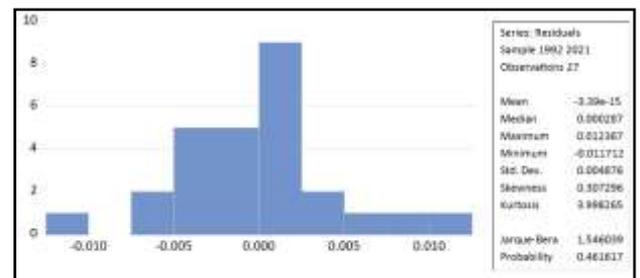
Overall, these diagnostic results indicate that the estimated model is statistically robust and well-specified, with no issues of autocorrelation, heteroskedasticity, or misspecification. Therefore, the ARDL estimates are reliable and can be confidently used for economic analysis and deriving conclusions about short- and long-term relationships among the studied variables.

**Table 14: Diagnostic Tests for the ARDL Model of Rice Consumption in Iraq (1990–2024)**

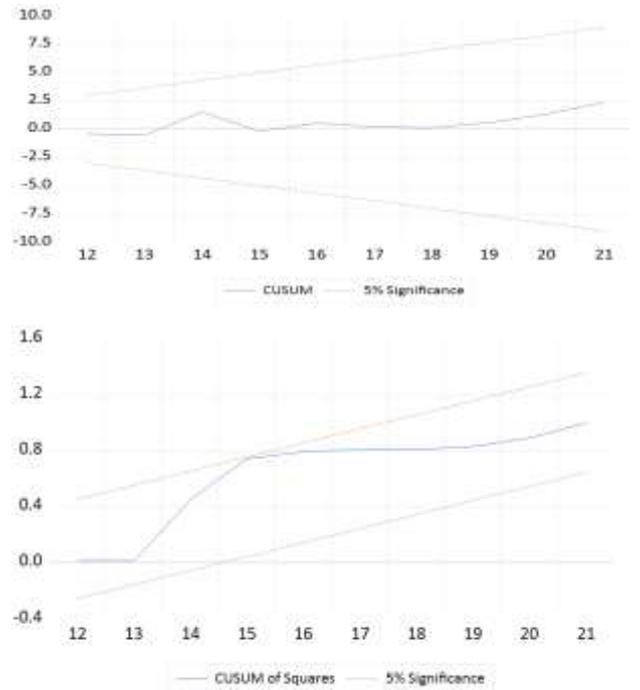
Breusch-Godfrey Serial Correlation LM Test:					
F-statistic		0.710198	Prob. F(4,6)		0.6139
ObsR-squared		8.675852	Prob. Chi-Square(4)		0.0697
Heteroskedasticity Test: Breusch-Pagan-Godfrey					
F-statistic		0.481496	Prob. F(16,10)		0.9071
ObsR-squared		11.74915	Prob. Chi-Square(16)		0.7611
Ramsey RESET Test, Equation: UNTITLED					
	Value	df			Probability

t-statistic	1.440970	9			0.1835
F-statistic	2.076394	(1, 9)			0.1835

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



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



**Figure 2: Stability Tests of the Estimated ARDL Model for Rice Consumption in Iraq (1990–2024) Using CUSUM and CUSUM of Squares**

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

This test measures the stability of the model’s coefficients over time. The results indicate that the test plots remain entirely within the critical bounds at the 5% significance level, suggesting that the model’s coefficients are stable. Consequently, the relationship between rice consumption and the economic determinants has not been affected by structural or fundamental changes during the analysis period (1990–2024). Therefore, the model can be confidently relied upon for future forecasts and for interpreting consumer behavior regarding rice.

Overall, the results of all tables demonstrate that rice consumption in Iraq is primarily influenced by its own price, the price of wheat, income, and the exchange rate, with a long-term stable equilibrium relationship. Additionally, the statistical tests confirm that the model is valid and consistent with Iraq's economic reality during the study period, with its accuracy supported by highly significant and robust stability tests.

### Conclusions

1. There exists a long-term equilibrium relationship between wheat and rice consumption and macroeconomic factors. The Bounds Test results were highly statistically significant, supporting the hypothesis of cointegration and indicating that the variables move together in the long run.
2. Prices are the most influential factor on consumption. The results indicate that increases in the prices of wheat or rice significantly reduce consumption, consistent with the economic theory of demand.
3. The substitution relationship between wheat and rice is evident in both models; an increase in the price of wheat leads to higher rice consumption and vice versa, confirming that the two commodities act as substitutes.
4. Real individual income positively affects wheat and rice consumption; however, the magnitude of this effect diminishes over time, indicating that these staples are necessities with low income elasticity.
5. Inflation and exchange rate fluctuations have a weak short-term effect on consumption but become more pronounced in the long run by influencing general food prices, particularly imported goods.
6. The ECM model results indicate a relatively high speed of adjustment toward equilibrium, with an error correction coefficient of -0.1325 for the rice model and -0.74 for the wheat model, implying that the economic system returns to equilibrium shortly after shocks.

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7. Diagnostic tests (Breusch–Godfrey, Breusch–Pagan, Ramsey RESET) confirmed the models' validity and the absence of autocorrelation or heteroskedasticity, enhancing the reliability of the econometric results.
8. CUSUM and CUSUMSQ tests indicate the stability of the model coefficients over time, demonstrating that the relationships between variables were not affected by major structural shifts during the period 1990–2024, making the models suitable for future forecasting

### Recommendations

1. Adopt a stable food pricing policy that accounts for the limited demand elasticity for wheat and rice to avoid price shocks affecting low-income households.
2. Encourage increased domestic production of wheat and rice to reduce import dependence and mitigate exchange rate volatility impacts on local food prices.
3. Strengthen social protection and food support programs, such as ration cards or cash transfers, particularly for vulnerable groups during periods of inflation or currency depreciation.
4. Redirect agricultural subsidies toward improving productivity and efficiency rather than direct price support, to reduce market distortions and enhance sustainable food security.
5. Manage the exchange rate and monetary policy effectively to ensure stable domestic prices for basic food commodities and prevent exchange rate volatility from being transmitted to consumers.
6. Update consumption, income, and price databases annually to improve the quality of future econometric models and develop more accurate food demand forecasting tools.
7. Encourage applied research in food economics using modern methodologies such as VAR, VECM, and multi-equation ARDL models to deepen understanding of food consumption dynamics in Iraq.

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