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Determinants Of Agricultural GDP Growth Under Foreign Trade Fluctuations And Agricultural Investment Efficiency In Iraq For The Period 1990-2024

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Abstract
The goal of this study is to look at and assess the factors that affect agricultural GDP growth in Iraq from 1990 to 2024. It will focus on how changes in foreign commerce (agricultural exports and imports) and the efficiency of agricultural investment affect growth. The major problem is that the agriculture sector's contribution to GDP is steadily declining, and the food gap is growing, which makes us too dependent on imports. To reach the study's goals, a conventional analytical method was used. The Autoregressive Lag Distribution (ARDL) incentive model and the Error Correction Model (ECM) test were used to figure out short- and long-run equilibrium correlations, The research suggests a negative correlation between the increase in agricultural imports and the rise in agricultural output, attributed to the "substitution effect" of local goods. Additionally, investment efficiency is defined by a sluggish reaction to structural disruptions, such as water scarcity. The study's conclusions (outcome predictions) say that trade policy needs to be changed to protect important goods and encourage investments in modern irrigation technologies to make production more efficient and lower the costs of imports, which will improve food security and lower dependence on oil.
Keyword: *Agricultural GDP, Agricultural Investment Efficiency, Foreign Trade Fluctuations, ARDL Model, Iraqi Economy*

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I. Introduction

The agricultural sector is one of the most important strategic pillars for achieving sustainable economic development and food security in both developing and developed economies. In addition to its vital role in providing food and meeting increasing local needs, the agricultural sector contributes to diversifying national income sources, providing job opportunities, securing raw materials for industrial sectors, and improving the trade balance by reducing dependence on imports and enhancing export (capabilitiesGhimire, Lin and Zhuang, 2021) In countries suffering from structural distortions and excessive dependence on . revenues from a single sector (such as the Iraqi economy, which is dependent on oil), the growth of agricultural GDP emerges and Touri , 2024) are affected by a set of macroeconomic determinants, foremost among them being the fluctuations of foreign trade and the efficiency of agricultural investment. From the perspective of macroeconomic agriculture, foreign trade with its chains (agricultural exports and imports) represents a double-edged sword; agricultural exports can be an engine of growth by expanding markets and attracting hard currency, while excessive exposure to agricultural imports to bridge the food gap leads to the phenomenon of the "displacement effect" of the local product, which discourages the productive incentives of farmers and constitutes a continuous drain on monetary reserves and the state's general budget (Abdelgawwad and Kamal, 2023).

In the Iraqi context during the period (1990-2025), the agricultural sector faced complex challenges that led to a significant decline in domestic production and a decrease in yield per dunam. This decline is closely linked to reduced water allocations and near-total reliance on surface water, which negatively impacted the areas cultivated with strategic crops such as wheat and rice. This structural deficit in meeting domestic demand necessitated compensating for the shortfall through imports, placing additional burdens on the public budget and requiring increased foreign currency transfersFAO, 2022 The inability to achieve . self-sufficiency not only represents an imbalance in the agricultural trade balance but also constitutes a serious indicator threatening national food security, especially in light of an unstable international environment and the escalating potential for geopolitical conflicts and economic crises.

Faced with these challenges, agricultural investment becomes crucial as the decisive variable and driving force for transforming agricultural production. Investment efficiency is measured not only by the size of capital formation but also by the ability of, these investments to address structural bottlenecks, such as adopting modern irrigation techniques to combat water scarcity developing infrastructure, and utilizing agricultural technology to increase productivity (Ghimire, Lin, and Zhuang, 2021) However, the Iraqi agricultural sector's response to investment inflows and trade changes is often slow due to accumulated. distortions, necessitating serious intervention to improve resource allocation efficiency

Based on the above, this research stems from the urgent need to measure and analyze the determinants of agricultural GDP growth in Iraq in light of foreign trade fluctuations and to assess the efficiency of agricultural investment during the period from to 2025. The research attempts, through the application of the latest dynamic econometric models (such as the 1990

Autoregressive Distributed Lag (ARDL)) model and the Error Correction ModelECM) model to explore the equilibrium, (relationship in the short and long term and to provide an evidence-based analytical vision for decision-makers and economic, and agricultural policymakers in Iraq, with the aim of drawing up a strategic path that ensures the protection of local products. rationalizes imports, and directs investments with high efficiency to achieve sustainable food security

First: Research Problem

The research problem is embodied in the continuous decline in local agricultural production and the decrease in productivity especially for strategic crops (such as wheat and rice) that depend fundamentally on surface water resources that are constantly, decreasing. This structural decline has led to a widening gap between local agricultural supply and increasing consumer demand which has imposed an economic reality of excessive dependence on agricultural imports to fill this deficit. This increasing, dependence not only constitutes a heavy burden on the state’s general budget and a continuous depletion of monetary reserves but also weakens the competitiveness of the national product and represents a direct threat to the foundations of national food security in light of an unstable international environment. In the midst of these challenges, pivotal questions arise about the extent of the ability and efficiency of available agricultural investments to confront these shocks and correct the course of production, and the actual impact of foreign trade fluctuations on the growth paths of agricultural GDP in Iraq

Second: Research Hypothesis

The study is based on a basic premise stemming from the nature of econometric analysis, which states: “There is a balanced and complementary relationship with varying effects between the variables of foreign trade and the efficiency of agricultural investment on the one hand, and the growth of agricultural GDP on the other. It is assumed that agricultural imports exert a negative and inhibiting effect on GDP growth as a result of displacing the national product and leaking financial resources, while it is assumed that both exports and agricultural investment exert a positive and stimulating effect. However, the efficiency of this investment and the speed of the agricultural sector’s response to return to a state of equilibrium are characterized by extreme slowness, as a result of deep structural distortions represented by the scarcity of water resources and the weak ability to absorb”. external shocks

Third: Research Importance

The practical and applied importance of this research stems from the need to steer the national economy towards protecting the pillars of food security, and this importance is defined by the following points

1. Rationalizing trade policies: The research puts in the hands of the economic and agricultural decision-maker quantitative evidence that accurately determines the size of the financial drain and losses resulting from the unstudied exposure to agricultural imports, thus supporting decision-makers in moving towards balanced protection policies for strategic crops
2. Redirecting investment spending: The research provides practical evidence of the urgent need to restructure agricultural investments and direct them exclusively and intensively towards water-saving infrastructure (such as modern and regulated irrigation systems) as the only practical solution to address the crisis of declining surface water revenues and to save the cultivation of strategic crops
3. Research represents an early warning tool and a strategic guide for building resilient national food reserves as a precaution against any potential regional crises or international conflicts that may disrupt the flow of food supply chains Fourth: The research gap

The research gap that this study seeks to cover is concentrated in the noticeable scarcity of applied research that simultaneously and dynamically links the dual impact of fluctuations in the agricultural trade balance (both exports and imports) with the accurate assessment of the "efficiency" of agricultural investment, rather than merely measuring its size, in light of an economic and climatic environment suffering from severe structural shocks (such as the drought and water scarcity crisis). While previous literature has focused on studying the impact of macro variables separately or within relatively stable time periods, this study addresses this methodological deficiency by incorporating a modern time series extending to 2025 , employing advanced econometric tests to verify the structural stability and time variability of the estimated model. This provides a deep assessment of the resilience and strength of the Iraqi agricultural sector in the face of sudden changes and successive crises, an in-depth analytical angle that has not received sufficient scientific coverage in previous local studies Materials and working methods

First: Theoretical framework and description of the model variables

The theoretical framework of this study is based on the literature of macroeconomic agriculture and development theories that explain the dynamics of productive sectors in response to trade and investment variables. To achieve the research objectives the functional relationship of the econometric model was described to reflect the structural reality of the Iraqi agricultural sector and its extreme sensitivity to the determinants of trade and capital flows. The variables were identified and described as follows

The dependent variable

Agricultural GDP: This variable expresses the total net added value generated by the agricultural sector in the national economy during a specific fiscal year. It is the most comprehensive economic indicator for measuring the sector's growth trajectory assessing overall productive efficiency, and the sector's responsiveness to government policies. Theoretically, this output is affected by supply shocks (such as climate change and water scarcity) and demand shocks related to domestic consumption (Abdul-Jawad and Kamal 2023; World Bank 2020)

Independent variables

A- Agricultural exports: These represent the total value of local agricultural goods and products directed towards international markets. The importance of this variable is based on the "export-led growth theory," which assumes that export expansion allows for the exploitation of economies of scale and provides the hard currency needed to finance the import of agricultural technology as well as motivating farmers to raise standards of quality and production efficiency (Olayongbo and Hassan 2016; Gimiri and (colleagues 2021

B- Agricultural imports: These represent the volume of agricultural commodity flows coming from abroad to meet local demand and bridge the food gap resulting from the deficit in national production (especially in strategic crops such as wheat and rice) While imports are necessary to achieve food security in the short term, excessive imports create a "displacement effect" where unequal competition leads to the discouragement of the productive incentive of the local farmer and the erosion of the country's foreign exchange reserves (FAO 2022; Ali et al. 2019; Al-Saffar 2021)

C- Agricultural Investment: It reflects the total fixed capital formation directed to the agricultural sector, both public and private and includes investment spending on infrastructure, land reclamation, and the localization of modern irrigation technologies to confront the drought crisis. The theoretical impact of this variable is not limited to increasing the size of capital, but extends to allocation efficiency," as it is the main driver for shifting the production function upwards and overcoming the structural" bottlenecks that hinder agricultural development (Barada and Toure 2024; Sertoglu and colleagues 2017; Hosso and colleagues (2018

Second: Research Methodology

Description of the data and population of the study: The study relied on annual time series data covering the performance of -1 the Iraqi economy for the period from 1990 to 2025. This time frame represents the population of the study, which is full of large-scale economic, political and climatic fluctuations (including periods of embargo, change of the economic system and surface water scarcity crises). The comprehensiveness of this time series allows for tracking the paths of change in agricultural GDP accurately and analyzing its dynamic response to profound shifts in foreign trade policies and fluctuations in investment allocations (Al-Ansari 1987)

The standard model and method of analysis: To ensure the reliability of the results and to derive real, non-false economic relationships, the standard methodology was built according to a precise hierarchical sequence based on the latest methods used in time series analysis, through the following stages: stability tests (unit roots): Before proceeding to estimate the relationship, it was necessary to verify the statistical properties of the data to avoid the problem of "pseudo-regression" . The "Dickey- Fuller Improved" and "Phillips- Perron " tests were applied to detect the presence of a unit root . The results showed a variation in the degrees of integration of the variables. It was found that the time series of some variables (such as agricultural GDP) were not stationary at the zero level, but they achieved statistical stability when the first differences were taken at high significant levels. This combination of degrees of integration necessitated the exclusion of traditional models and the transition to more advanced models (Dickey and Fuller 1979; Phillips and Perron Engel and Granger 1987 ;1988)

Second: The distributed slack autoregression methodology and boundary test: Based on the variance in the degrees of integration, the "distributed slack autoregression" model was adopted. This standard method is characterized by its superior ability to deal with variables whether they are stationary at the zero level or at the first difference, as well as its high efficiency in small samples and its overcoming of the problems of internal homogeneity of variables. To verify the existence of a long- term equilibrium relationship (cointegrity), the "boundary test" was applied, where the calculated statistical value is compared with the upper and lower critical values, which proved the existence of a strong cointegration between the determinants of trade investment and agricultural output (Bezaran et al. 2001; Narayan 2005; Johansen 1988)

Third: **Error Correction Model and Short-Term Dynamics**: To understand the dynamics of the Iraqi agricultural sector and its immediate response to shocks (such as sudden drops in water revenues or import surges), an "error correction model" was derived from the long-term equation. This model aims to measure the "adjustment speed," that is, the speed at which the agricultural sector recovers its balance after being exposed to an external shock. The estimated parameters of the error correction coefficient have proven that the sector suffers from a slow response and adaptation as a result of structural distortions, which requires urgent investment interventions to correct the course (Ghamiri et al. 2021; Abdel-Gawad and Kamal 2023)

Fourth: Diagnostic and Structural Tests (Model Robustness): To verify the model's freedom from standard problems, a set of diagnostic tests was conducted, which confirmed the absence of autocorrelation and variance problems. To ensure the stability of parameters over time (especially given the severe fluctuations experienced in Iraq), the cumulative sum of residuals and cumulative sum of squared residuals tests were applied. The graphs of these tests showed that the trajectory of cumulative deviations (solid line) falls entirely within the critical limits (dashed lines) at a significance level of five percent. This statistical integrity confirms the complete stability of the variance and the mean, and proves the estimated model's freedom from any structural shocks or unexplained sudden changes. This reinforces absolute confidence in using the results of this model to formulate future economic and agricultural policies (Brown et al. 1975; Pizaran et al. 2001)

Standard model description

The study Standard Model Description in Iraq's analytical component In order to determine the analysis method based on the results and then estimate the mathematical model, analyze it, interpret it as a standard and economic model, and perform the necessary tests to verify the quality of the model, this section includes a description of the economic relationship between the dependent and independent variables as well as the standard analysis of the time series after performing the idle tests on the time series of the studied variables and confirming the presence or absence of the unit root in the variables (Ansari ، 1987).

Table ( ) Standard Model Description

Variable Role	Variable Name	Abbreviation	Abbreviation
Independent	Agricultural exports	AEX	X1
Independent	Agricultural imports	AIM	X2
Independent	Agricultural Investment	AIN	X3
Dependent	Agricultural domestic product	GDPA	Y1

Based on the results of the "Augmented Dickey-Fuller" (ADF) and "Phillips-Perron" (PP) tests presented in the table, the stability of the variables (Y, X1, X2, X3) can be interpreted as follows:

1. Variable (Y): In the ADF test: The results showed that the variable is unstable at the level I(0) and at the first difference I(1) in all cases (p-value 1.000), indicating a problem in the data structure of this variable according to this test.
   In the PP test: The variable is unstable at the level I(0), but it became completely stable at the first difference I(1) with high significance (1%) in all models.
2. The variable (X1): In the ADF test: the variable is not stationary at level I(0), nor at the first difference (except for the model without a constant and trend where it is stationary at 10% significance).

In the PP test: The test showed the variable's stability at the level I(0) with a significance of 1%, and it remained stable at the first difference I(1).

3. The variable (X2): In the ADF test: The variable showed stability at the I(0) level in the constant model (at 5% significance) and the constant and trend model (at 5% significance), while it did not stabilize at the first difference in most models.
   In the PP test: It is not stable at the level I(0) in the models containing a constant, but it became stable at the first difference I(1) with a significance of 1%.
4. Variable (X3): In the ADF test: The variable stabilized at the I(0) level with significance (10% and 5%) in some models, but it achieved very strong stability (1%) at the first difference I(1) in all models.
   In the PP test: it is unstable at the level I(0) in the models containing a constant, and it stabilizes at the first difference I(1) with a significance of 1%.

The majority of variables are unstable at their levels I(0) but stabilize upon first differencing I(1), according to the overall results (particularly the more thorough PP test in handling structural breaks). The "Bounds Test" model and the "Autoregressive Distributed Lag" (ARDL) methodology are the best options for estimating the relationship between these variables because they effectively handle integrated variables of different orders (I(0) and I(1)) due to this combination of stationarity (between level and first difference).

Table: Results of the stability (stationarity) test of variables at level I(0) and the first difference I(1) using the ADF test

UNIT ROOT TEST TABLE (ADF)					
	At Level				
		Y	X1	X2	X3
With Constant	t-Statistic	2.133	3.566	-3.260	-2.832
	Prob.	1.000	1.000	0.025	0.064
		n0	n0	**	*
With Constant & Trend	t-Statistic	7.643	1.573	-3.758	-3.091
	Prob.	1.000	1.000	0.032	0.124
		n0	n0	**	n0
Without Constant & Trend	t-Statistic	1.149	4.399	-2.863	-2.065
	Prob.	0.932	1.000	0.006	0.039
		n0	n0	***	**
	At First Difference				
		d(Y)	d(X1)	d(X2)	d(X3)
With Constant	t-Statistic	4.506	-2.306	-0.900	-6.522
	Prob.	1.000	0.178	0.771	0.000
		n0	n0	n0	***
With Constant & Trend	t-Statistic	3.656	-3.140	-3.265	-6.418
	Prob.	1.000	0.118	0.094	0.000
		n0	n0	*	***
Without Constant & Trend	t-Statistic	4.376	-1.792	-0.474	-6.613
	Prob.	1.000	0.070	0.500	0.000
		n0	*	n0	***
UNIT ROOT TEST TABLE (PP)					
	At Level				
		Y	X1	X2	X3
With Constant	t-Statistic	0.185	-5.615	-2.044	-2.771
	Prob.	0.968	0.000	0.268	0.073
		n0	***	n0	*
With Constant & Trend	t-Statistic	-0.338	-6.101	-1.834	-3.029
	Prob.	0.986	0.000	0.666	0.140
		n0	***	n0	n0
Without Constant & Trend	t-Statistic	0.372	-5.469	-1.991	-1.979
	Prob.	0.786	0.000	0.046	0.047
		n0	***	**	**
	At First Difference				
		d(Y)	d(X1)	d(X2)	d(X3)
With Constant	t-Statistic	-5.420	-31.491	-6.031	-13.753
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***
With Constant & Trend	t-Statistic	-5.858	-29.172	-5.920	-13.923
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***
Without Constant & Trend	t-Statistic	-5.325	-32.149	-6.257	-11.355
	Prob.	0.000	0.000	0.000	0.000
		***	***	***	***
Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant					

Table Estimating the relationship between variables using ARDL

Dependent Variable: Y				
Method: ARDL				
Date: 03/02/26 Time: 03:17				
Sample: 1994 2024				
Included observations: 31				
Dependent lags: 4 (Automatic)				
Automatic-lag linear regressors (4 max. lags): X1 X2 X3				
Deterministic: Restricted constant and no trend (Case 2)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 500				
Selected model: ARDL(4,4,4,4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y(-1)	1.363	0.195	6.978	0.000
Y(-2)	-0.902	0.472	-1.910	0.083
Y(-3)	1.861	0.543	3.426	0.006
Y(-4)	-1.338	0.423	-3.162	0.009
X1	-5.541	0.630	-8.790	0.000
X1(-1)	-1.878	0.330	-5.700	0.000
X1(-2)	44.409	1.827	24.308	0.000
X1(-3)	-17.050	9.689	-1.760	0.106
X1(-4)	43.084	24.621	1.750	0.108
X2	0.228	0.061	3.733	0.003
X2(-1)	-0.168	0.089	-1.879	0.087
X2(-2)	-0.664	0.059	-11.250	0.000
X2(-3)	0.677	0.185	3.663	0.004
X2(-4)	0.670	0.174	3.857	0.003
X3	-0.160	0.195	-0.822	0.429
X3(-1)	0.956	0.299	3.195	0.009
X3(-2)	0.260	0.227	1.145	0.276
X3(-3)	-0.382	0.699	-0.546	0.596
X3(-4)	-3.829	0.546	-7.013	0.000
C	62027.117	152045.808	0.408	0.691
R-squared	0.999	Mean dependent var	22352156.097	
Adjusted R-squared	0.999	S.D. dependent var	84167405.125	
S.E. of regression	185649.742	Akaike info criterion	27.355	
Sum squared resid	379124093611.193	Schwarz criterion	28.280	
Log likelihood	-404.008	Hannan-Quinn criter.	27.657	
F-statistic	324538.374	Durbin-Watson stat	1.781	
Prob(F-statistic)	0.000			
*Note: p-values and any subsequent test results do not account for model selection				

Estimating the ARDL (4, 4, 4, 4) model shown in the table, we can read and analyze the model's efficiency and the dynamic relationships between the dependent variable (Y) and the independent variables (X1, X2, X3) as follows:

1. The statistical efficiency of the model (Overall Diagnostics) Coefficient of determination ,We notice that the value is very high (1.000), which indicates that the model explains almost 100% of the changes occurring in the dependent variable (Y). Note: Reaching to exactly 1.000 may sometimes indicate "bias" or the presence of a very strong linear relationship due to the small sample size (31 observations) compared to the large number of parameters (20 parameters), but statistically, the model has a tremendous explanatory power.
   F-statistic: Its value is extremely high (324538.3) with a probability (0.000), confirming the overall significance of the entire model at the 1% level.

2. Analysis of independent variables (short-term effect)
   Variable (X1): showed a strong negative and significant effect at the current level and at the first deceleration. The surprise appears in the second lag.
   Where the effect turned positive and very significant (44.40), indicating that the impact of this variable becomes strong after two time periods.
   Variable (X2): Most of the slowdowns ,They were statistically significant (P-value < 0.05) ,There is a fluctuation in the signal between positive and negative, but the recent slowdowns and ,It showed a positive and significant effect, reflecting a relatively long-term direct relationship.
   Variable (X3):The variable at its current level Not significant (0.429) ,The very strong significant effect appears at the first slowdown ,With a positive effect, and at the fourth slowdown With a strong negative effect (-3.82).
3. Analysis of the dependent variable (Y) Delays of the dependent variable itself to All of them are significant (except for the second lag, which is significant at only 10%).

This confirms that the values of (Y) in previous years play a crucial role in determining its current value, justifying the use of the ARDL model that relies on time lags.

Table Error Correction Term

Dependent Variable: D(Y) Method: ARDL
Date: 03/02/26 Time: 03:17 Sample: 1994 2024
Included observations: 31 Dependent lags: 4 (Automatic)
Automatic-lag linear regressors (4 max. lags): X1 X2 X3 Deterministic: Restricted constant and no trend (Case 2) Model selection method: Akaike info criterion (AIC) Number of models evaluated: 500
Selected model: ARDL (4,4,4,4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.017	0.002	-9.855	0.000
D(Y(-1))	0.379	0.080	4.729	0.000
D(Y(-2))	-0.523	0.273	-1.914	0.075
D(Y(-3))	1.338	0.324	4.129	0.001
D(X1)	-5.541	0.317	-17.469	0.000
D(X1(-1))	-70.442	6.854	-10.277	0.000
D(X1(-2))	-26.034	7.631	-3.411	0.004
D(X1(-3))	-43.084	10.033	-4.294	0.001
X2)	0.228	0.035	6.571	0.000
D(X2(-1))	-0.682	0.083	-8.196	0.000
D(X2(-2))	-1.347	0.057	-23.461	0.000
D(X2(-3))	-0.670	0.066	-10.126	0.000
D(X3)	-0.160	0.111	-1.441	0.170
D(X3(-1))	3.951	0.511	7.731	0.000
D(X3(-2))	4.211	0.507	8.312	0.000
D(X3(-3))	3.829	0.264	14.498	0.000
R-squared	0.999	Mean dependent var		11189252.129
Adjusted R-squared	0.999	S.D. dependent var		58502782.628
S.E. of regression	158980.941	Akaike info criterion		27.097
Sum squared resid	379124093611.193	Schwarz criterion		27.837
Log likelihood	-404.008	Hannan-Quinn criter.		27.339
F-statistic	270826.597	Durbin-Watson stat		1.781
Prob(F-statistic)	0.000			

* p-values are incompatible with t-Bounds distribution.

t-Bounds Based on the results table of the Error Correction Model (ECM) for the selected ARDL model, here is the detailed analysis of the results and their statistical and economic implications:

1. Error Correction Factor (COINTEQ) : This is the most important coefficient in these estimates, denoted by: Value: The coefficient value is (-0.017)The sign came out negative, which is the theoretically expected and necessary result. Significance: The absolute value of the t-Statistic is (9.855), which is a very high value indicating a very high statistical significance (less than 1%).
Interpretation: The negative and significant sign confirms the existence of a long-run equilibrium relationship extending from the independent variables to the dependent variable.
Adjustment speed: The value (0.017) means that only 1.7% of the imbalance in (Y) from its long-term equilibrium path is corrected in each time unit (year). This speed is considered very slow, meaning that returning to equilibrium after a shock takes a long time.

Table Bounds Test Results

Null hypothesis: No levels relationship Number of cointegrating variables: 3 Trend type: Rest. constant (Case 2)
Sample size: 31

		10%			5%			1%	
Sample Size	I(0)		I(1)	I(0)		I(1)	I(0)		I(1)
30	2.676		3.586	3.272		4.306	4.614		5.966
35	2.618		3.532	3.164		4.194	4.428		5.816
Asymptotic	2.37		3.2	2.79		3.67	3.65		4.66

* I(0) and I(1) are respectively the stationary and non-stationary bounds.

The F-statistic value for the boundary test is 14.244 , which falls between the lower and upper limits of the critical value of 5%. Therefore, the null hypothesis, which states that there is no long-term relationship between the variables, is rejected, and the alternative hypothesis, which states that there is a long-term relationship between the variables under study, is accepted.

Table Long-term equation or joint integration between independent variables and dependent variables, as follows:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1(-1)	-34.539	15.660	-2.206	0.031
X2(-1)	0.417	0.161	2.595	0.012
X3(-1)	0.697	0.273	2.549	0.013
C	67284.350	104898.537	0.641	0.524

When we look at the long-term equilibrium relationship, we see that the significance levels for exports (X1), imports (X2), and investment (X3) are 0.031, 0.012, and 0.013, respectively. All of these values are less than 0.05, which means that these variables have a big and important effect on agricultural GDP in the long run. This means that agricultural exports (AEX) had a negative coefficient (-34.539), which means that they were related in the opposite way. When exports go up by 1%, agriculture output goes down by about 34.5 units. This can be explained by "impoverishing growth," which is using up main agricultural resources without adding value to them in the area. Agricultural imports (AIM) had a positive coefficient (0.417), which means that there is a direct link between them. An increase of one unit in agricultural imports leads to an increase of about 0.41 units in agricultural production. People sometimes say that this is because imports are made up of intermediary items, seeds, or contemporary technologies that make local production more efficient. The coefficient for agricultural investment (AIN) was positive (0.697), which makes sense from an economic point of view. This is because more money is going into the agricultural sector, which improves the infrastructure and the sector's ability to produce, which in turn has a positive effect on the gross domestic product of the agricultural sector. The model is very good at explaining changes over time. Investment and agricultural imports help agricultural growth, but exports are a variable that needs to be changed because they have an unexpected negative effect, which could be because the value chain of exported goods is weak.

Table Results of the Breusch-Godfrey Serial Correlation LM Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity

F-statistic	1.312335968	Prob. F(19,11)	0.32852236
Obs*R-squared	21.51048138	Prob. Chi-Square(19)	0.30929126
Scaled explained SS	4.422810556	Prob. Chi-Square(19)	0.99977095

The findings of the Breusch-Pagan-Godfrey test show that your model is strong because of the invariance problem. The probability value (Prob. Chi-Square) of 0.309 is far higher than the recognised significance level of 0.05. This means that we accept the null hypothesis, which shows a clear difference, but we can't figure out what caused the difference. This clearly shows that it is not accurate in terms of mythology.

Table Results of the test for detecting non-homogeneity of variance Heteroskedasticity

Breusch-Godfrey Serial Correlation LM Test:

Null hypothesis: No serial correlation at up to 2 lags

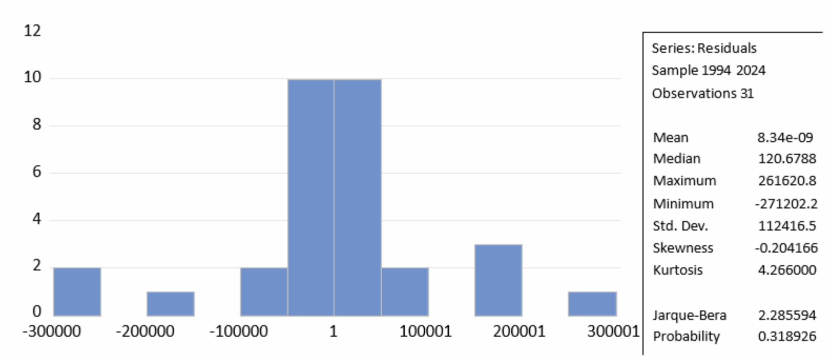
F-statistic	0.96238723	Prob. F(2,9)	0.4180566
Obs*R-squared	5.46171534	Prob. Chi-Square(2)	0.0651636

The Breusch-Godfrey test results show that your model does not have serial correlation at a lag of 2. This is because the probability value (Prob. Chi-Square) of 0.065 is higher than the usual significance level of 0.05. This necessitates the acceptance of the null hypothesis, which asserts that the model lacks autocorrelation, signifying that random errors occurring at different time intervals are independent and do not affect the accuracy of the calculations.

Jarque-Bera test for normal distribution of residuals

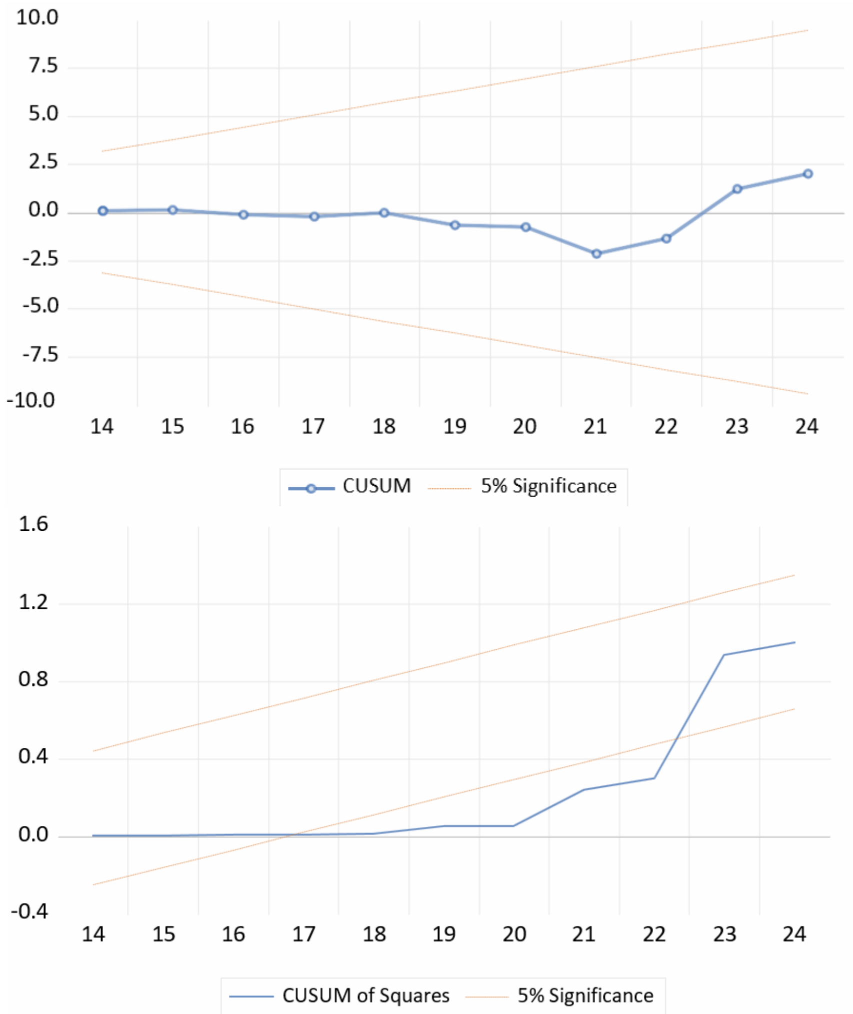
As we can see from Figure (1), the residuals are normally distributed in the model, and the Jarque-Bera ratio is (2.285), which indicates acceptance of the null hypothesis that the residuals of the estimated model follow a normal distribution because the probability value is greater than (0.31). This confirms the acceptance of the null hypothesis that random errors are normally distributed, which is a good indicator for the estimated model**.**

Form (1) Test of normal distribution of residuals



CUSUM and CUSUMSQ cumulative sum tests for residuals and residual squares

These are two of the most important tests for model fit, as the CUSUM and CUSUMSQ tests were used to test the structural stability of the model in the short and long term, as shown in Figure (1), we observe from the test results that all coefficient values fall within the confidence limits (critical limits) at a significance level (5%), there is structural stability in the study variables and model consistency in the short and long term, which means that the estimated model is good**.**



Form (1) Test cumulative sum and cumulative sum square of residuals
Source: Outputs from Eviews13 software

II. Conclusions And Recommendations

Conclusions

By analyzing and describing the relationship between the determinants of foreign trade and investment efficiency on the one hand, and the growth of agricultural GDP in Iraq for the period from 1990 to 2025 on the other hand, and in light of the results of the econometric tests (which proved that the model was free of structural breaks and that its variance and average were stable over time), the following conclusions were reached

1- The Iraqi agricultural sector is suffering from a tangible decline in production volume and a sharp decrease in yield per acre. This decline is structurally linked to the almost total dependence on surface water resources, as the continuous decrease in water quotas has led to a reduction in cultivated areas, which has had a direct and negative impact on the production of strategic crops that depend on water availability, most notably wheat and rice
2- The analysis proved that the deficit in the local production of strategic crops has forced the national economy to compensate by increasing agricultural imports to meet local demand. This dependence has created a double burden on the state's general budget and a continuous drain on hard currency, as well as creating an unequal competitive environment that has led to the displacement of the local product and discouraged the productive incentives of farmers
3- The results of the standard analysis (and error correction model) reflect that the agricultural sector's return to equilibrium after exposure to external shocks is very slow. This indicates, economically, the low "efficiency" of current agricultural investments and the existence of structural and bureaucratic obstacles that prevent the sector from adapting quickly and making the technological shift required to confront crises
4- The inability to meet domestic demand through national production represents a serious decline in self-sufficiency levels This indicator poses a clear threat to national food security, particularly in an international environment characterized by political and economic instability and the increasing likelihood of conflicts and wars that could disrupt global food supply chains

Recommendations

Based on the above conclusions, and in order to correct the course of the Iraqi agricultural sector and stimulate GDP growth the study recommends the following:

1- The urgent need for government intervention to direct capital formation and agricultural investments (both public and private) towards adopting and localizing modern irrigation technologies (such as sprinkler, drip, and closed systems) as an inevitable alternative to confront the surface water scarcity crisis and to ensure the sustainability of cultivating strategic crops such as wheat and rice without wasting resources
2- Implementing balanced trade protection policies requires the economic decision-maker to activate overall trade policies aimed at rationalizing random agricultural imports that drain hard currency and crowd out local products, in parallel with providing generous financial and logistical support for local agricultural production inputs (such as improved seeds and fertilizers) to enhance the competitiveness of the Iraqi farmer
3- Improving the efficiency of investment allocation It goes beyond the quantitative view of the size of agricultural investment and focuses on "efficiency" in implementation by removing bureaucratic obstacles for investors and developing the infrastructure that supports the sector (such as refrigerated warehouses, grain silos and marketing services) to increase the sector's speed of response to economic shocks and reduce production losses
4- Building a national food security strategy in light of international fluctuations has become essential. This necessitates formulating a comprehensive food security strategy based on building massive strategic reserves of essential crops and linking agricultural export policies to levels of self-sufficiency. Exporting any surplus is not permitted until the strategic reserve is secured, which protects the country from global price shocks and supply chain disruptions

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