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An economic analysis of the impact of agricultural loans and agricultural subsidies on agricultural labor productivity in Iraq for the period (2000-2023)

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Abstract

The study aims to knowing the impact of economic variables regarding to (agricultural loans, agricultural subsidies, planting lands, and the numbers of agricultural labor force) on agricultural labor productivity. The data collected from secondary sources for the period (2000-2023). The study conducted stationarity of the time series via using augmented Dickey-Fuller test to estimate the parameters of the model by using ARDL model to determine impact of independent economic variables on agricultural labor productivity. The study conclude that the influence of agricultural loans and numbers of agricultural labor force were inverse with agricultural labor productivity, whereas agricultural subsidies and planting lands were have positive relation with agricultural labor productivity. The study recommended to encouraging policy of agricultural loans and providing the subsidies to the farmers, as well as focusing on extension programs and the agricultural labor force in terms of numbers, skills and education.

Keywords: agricultural subsidies, agricultural productivity, agricultural labor force, ARDL model.

Introduction

The agricultural sector is one of the most important productive sectors in Iraq after the extractive industries sector. In recent decades, the agricultural sector has faced several problems and challenges that have

affected agricultural production and, consequently, agricultural productivity, including agricultural labor productivity. Agricultural productivity plays a significant role in achieving economic and social well-being, as agricultural labor productivity has a significant and positive impact on household consumption growth. Agricultural productivity also positively related to labor and farm inputs (Amare, 2017: 4). Agricultural productivity refers to the ratio of agricultural outputs to agricultural inputs, with agricultural productivity rising or falling depending on the quality of management of the ratio of agricultural outputs to inputs. Agricultural productivity (including agricultural labor productivity), being one of the most important components of agricultural production, reflects the efficiency with which agricultural economic activities transform inputs into outputs, thus providing a more comprehensive representation of the economic efficiency of agricultural production (Ball et al., 1997:1045-1047). In the agricultural field, agricultural labor productivity measures the extent to which farmers and agribusinesses combine inputs to produce output (Ogbeide, 2015:2). The most common method for measuring agricultural labor productivity is the Total Factor Productivity (TFP) method, sometimes called "Specific Factor Productivity".

Research Methodology

1-Research Problem: Fluctuations in agricultural labor productivity in Iraq are among the most prominent challenges facing farmers, resulting in a decline in overall agricultural production. This is due to a number of factors, including the limited amounts disbursed for agricultural loans, farmers' lack of full government support, the distribution of the agricultural labor force, and their level of education and skills.

2- The importance of the research: The importance of the research comes from the importance of agricultural productivity, especially the productivity of agricultural labor in Iraq, as economists in the field of agriculture focus on increasing agricultural production and increasing agricultural productivity and the factors affecting it. Therefore, this study came to identify the factors that affect the productivity of

agricultural labor and to identify their effects.

3- Research objective: To identify the most important economic factors affecting agricultural labor productivity (agricultural loans, agricultural support amounts, cultivated lands, agricultural labor force) and to find appropriate solutions to increase agricultural labor productivity.

4- Research hypothesis: The research based on the hypothesis that the factors represented by (agricultural loans, agricultural support amounts, cultivated lands, and the labor force) affect the productivity of agricultural labor in Iraq, either negatively or positively.

5. Data Sources and Analysis Method: The study relied on a set of data obtained from secondary sources, including published studies and research, local official offices, and international organization websites, as follows:

1. Ministry of Agriculture, Agricultural Statistics Division.

2. Ministry of Planning, Central Statistical Organization.

3. Agricultural Cooperative Bank.

4. Food and Agriculture Organization of the United Nations (FAO) website.

As for the analytical method, descriptive and quantitative methods used, using the E-views 10 statistical program and the Autoregressive Distributed Lag (ARDL) model.

Model used:

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

-Y is the productivity of the agricultural worker (dinars), which is the dependent factor.
The independent factors are:
1-logX1 is the natural logarithm of the agricultural loans (million dinars).
2-logX2 is the natural logarithm of agricultural support amounts (million dinars).
3-logX3 is the natural logarithm of cultivated land (million dunams).
4-logX4 is the natural logarithm of the agricultural labor force (thousand workers).

Materials and Methods

Time series analyzed using the Autoregressive Distributed Lag (ARDL) model, which combines endogenous (independent) variables with an exogenous (dependent) variable that

affected by the model. The variables must be stable at the level or after taking the first difference, and the stability of the variables rejected at the second difference.

1. Unit Root Test (Stability of Variables): This is a modern method for determining stationarity, as the roots of stationary time series lie outside the unit circle (Al-Kalabi, 2018: 30). When conducting the Augmented Dickey-Fuller (ADF) test, the variables must be stationary at the level or stable after taking the first difference. The stationarity of the time series tested by plotting the variables at their level.

2. Determining the Lag Period(VAR): Before estimating the ARDL model, the optimal number of lag periods must be determined according to the five most accurate criteria used: LR, AIC, SC, FPE, and HQ.

3- Bounds Test: Also known as the co-integration test, it used to determine whether there is a long-run equilibrium relationship between variables using the Fisher's (F) test. If the calculated F value is greater than the upper bound value, the null hypothesis stating that there is no co-integration between the variables rejected. This means that there is a co-integration relationship between them. However, if the calculated F value is less than the lower bound value, the null hypothesis stating that there is no co-integration between the variables cannot be rejected. This means that there is no long-run equilibrium relationship between the variables (Hassan and Ali, 2019, 30).

4- Estimating (ARDL) Distributed Lag Model: ARDL model is one of the most important econometric models. It is widely used to distinguish between explanatory variables and dependent variables (Nouri, 2019: 105). This model applied after verifying the stability of the variables at the first difference (Hassan and Al-Badri, 163:2024). Optimal lag periods are determined when using ARDL model, so that time series variables, whether dependent or independent, affected by optimal lag periods (Al-Attabi, 94:2019).

5- Estimating the long-run equation: The long-run equation between the dependent variable and the independent variables is estimated to demonstrate the significance of the model.

6- Conducting econometric diagnostic tests: This is a set of tests conducted when constructing any econometric

model to detect standard problems (Ben Issa, 71:2020). These tests include:

A. The problem of Autocorrelation: To detect this problem, h-test, Durbin-Watson test, and LM test (Lagrange multiplier) are performed (Ben Issa, 2020: 73). It can be concluded that the model is good and free of autocorrelation problems when the significance level is greater than (0.05), i.e., the null hypothesis is accepted and the alternative hypothesis is rejected.

B. The problem of Heteroscedasticity: There are several methods for detecting this problem, the most important of which are Coldfield-Quandt test, Brush-Bagan-Godfrey test, White test, Harrison-McCabe test, and NCV test (Abdullah, 2018: 32-36). If the significance is greater than (0.05), this means that there is no problem of heteroscedasticity. Thus, the null hypothesis is accepted and the alternative hypothesis rejected. The F test used to determine the presence or absence of this problem (Hassan and Al-Badri, 2024: 163).

C. Multicollinearity: This is one of the econometric problems that plague multivariate models, not simple models (Al-Aithari, 2018: 2). To detect this problem, there are several methods, including the coefficient of determination (R^2) and the variance inflation factor (VIF). If the result is greater than (0.05), this indicates the presence of a problem of multicollinearity between the variables.

D. Model stability test (The structural stability): To ensure that the model is free of structural changes, we use the following two tests: the cumulative sum of recurring residuals and the cumulative sum of squared recurring residuals (Jamal, 2015: 143). The structural stability of the data verified through the graph, where stability achieved if the graph is within the confidence interval.

E. Partial Correlation Function and Autocorrelation Function: To determine the validity of the results we obtained, we test the partial correlation function and the autocorrelation function of the residuals, as well as to ensure that all variables fall within the limits (Salem, 2018: 110-111).

F. Normal Distribution Test of Residuals: This test depends on the sample size. If the sample size is small, i.e., less than (30) observations,

we use the Fisher and Student test. However, if the sample size is larger than (30) observations, we use graphical and computational methods such as (Skewness Kurtosis and Jarque-Bera tests) (Salami and Hijab, 2015: 47-49).

Theoretical Framework

1- Agricultural Loans: The agricultural sector occupies a significant position in the Iraq's economic structure. In order to stimulate this sector, emphasis been placed on one means of promoting the agricultural sector it is (agricultural loans). These loans are crucial to the growth of the agricultural sector and serve an important purpose. They are a tool used by the state to guide the development policies to some sectors in order to generate returns (Amin et al., 2024:539). Furthermore, agricultural loans granted to farmers to assist them in planting, harvesting, and livestock care. Agricultural loans are provided from many different sources, and the provision of this type of loan has proven its impact on agricultural investments and, consequently, on the productivity of agricultural labor and agricultural production (Muhammad, 2018:324-326).

2- Agricultural support: It is one of the most important policies pursued by the state to advance the agricultural sector. Agricultural support defined as financial assistance provided by the state, directly or indirectly, to benefit recipients, either fully or partially. The support policy is of great importance, whether it is direct financial support, such as supports and subsidies, or in-kind support through the provision of a service or commodity. This importance lies in achieving numerous economic and social goals, including securing food, utilizing modern technologies in agriculture, achieving social development, and reducing production costs for agricultural producers, which affects their competitiveness (Lalla and Aisha, 2021: 9-7).

3- Cultivated land: Agricultural land is one of the natural resources upon which agricultural production depends, and it is an important productive resource. Agricultural production can increase through the horizontal and vertical expansion of cultivated land (Al-Hasani, 2008: 75). Identifying cultivated land is not limited to highlighting its importance and impact on the agricultural sector,

but also highlights the obstacles facing the agricultural sector in the country (Al-Janabi, 2013: 30). Cultivated land in Iraq been exposed to many problems that have led to a decline in its area, the most important of which is water scarcity. The water crisis has left behind a series of problems, beginning with financial losses for farmers and ending with them abandoning their lands (Naïf, 2024: 88).

4- Agricultural labor force: The labor element is one of the important elements that affect agricultural production and is the greatest influencer on the productivity of agricultural labor. This influence takes two sides, either a negative or a positive effect. The nature of the labor force and their numbers follow the development of the country. In developed countries, we find that the labor force is smaller in number than the labor force in less developed countries due to the developed countries' reliance on modern technological means in agriculture compared to less developed countries. However, in recent years, the number of labor forces in less developed countries has begun to decline due to the weak financial return provided by the agricultural sector compared to other sectors (Al-Shibawe, 2021: 54).

Table (1) Economic factors affecting agricultural labor productivity in the agricultural sector in Iraq for the period (2000-2023)

Year	Agricultural worker productivity Dinar (Y)	Agricultural Loans (Million Dinar) (X1)	Annual support amounts ((Million Dinar (X2)	Cultivated land (million dunums) (X3)	Agricultural labor force (thousand workers) (X4)

2000	2292883.3	652143.7	107859.0	14.5	1015
2001	2656303.3	811220.2	206491.5	14.0	1078
2002	3147543.0	959631.0	244070.0	13.5	1116
2003	2084539.0	722265.8	322356.0	12.7	1193
2004	3005506.9	734626.3	187334.0	13.7	1229
2005	4000124.8	1243804.2	154133.4	14.7	1266
2006	4270694.0	2353682.7	289472.0	14.1	1304
2007	4090999.3	3002137.9	392636.0	14.3	1343
2008	4187122.0	4587454.0	1059680.0	14.2	1443
2009	4705614.3	51761907.0	864529.0	13.0	1452
2010	5668178.9	51512441.0	1361003.0	12.0	1476
2011	6788717.3	59376537.0	917714.0	13.0	1461
2012	697439.5	72612878.0	1120608.0	12.7	1504
2013	8373463.4	83619037.0	1566785.0	14.5	1558
2014	8293507.3	85031460.0	1551216.0	15.5	1583
2015	5028200.2	75277.8	1148708.0	13.0	1623
2016	4784389.7	51997.8	279641.0	11.9	1637
2017	4011175.7	4954.5	447061.8	12.6	1645
2018	4399921.6	5760.5	451748.8	11.21	1721
2019	5780774.0	10210.6	451748.8	15.6	1801
2020	7352142.8	4315.0	451748.8	14.6	1786
2021	7176396.4	350.4	263231.0	12.5	1660
2022	9102323.3	377.6	263231.0	11.2	1200
2023	7744731.3	2769.4	1000000.0	12.7	1548

Source: Ministry of Agriculture - Central Statistics Organization - Agricultural Cooperative Bank, (2000-2023), published data.

Results and Discussion:

1- Unit Root Test:

Table (2) Results of the Stationarity Test (Augmented Dickey-Fuller Test)

Variables test	Sig.	y	X1	X2	X3	X4
At level						
With Constant	t-statistic	-2.92260	-1.672730	-1.952272	-0.604061	-3.063146

	Prob.	**0.0581**	**0.4311**	**0.3042**	**0.8466**	**0.0469**
		*	no	no	no	**
With Constant&Trend	**t-statistic**	**-4.7283370**	**-1.610971**	**-1.913845**	**-4.561350**	**-1.716347**
	Prob.	**0.0052**	**0.7568**	**0.6149**	**0.0095**	**0.7093**
		**	no	no	*	No
None	**t-statistic**	**0.730142**	**-1.442071**	**-0.685652**	**-1.378941**	**0.520666**
	Prob.	**0.8648**	**0.1356**	**0.4088**	**0.1502**	**0.8206**
		no	no	no	no	No
At first difference						
With Constant	**t-statistic**	**-5.705722**	**-4.377106**	**-4.353175**	**-6.582808**	**-3.621232**
	Prob.	**0.0001**	**0.0026**	**0.0027**	**0.0000**	**0.0148**
		***	**	**	***	**
With Constant&Trend	**t-statistic**	**-5.568502**	**-4.349119**	**-4.178056**	**-6.288101**	**-4.489205**
	Prob.	**0.0011**	**0.0121**	**0.0171**	**0.0004**	**0.0109**
		**	**	**	***	**
None	**t-statistic**	**-5.568264**	**-4.485186**	**-4.427076**	**-6.237807**	**-4.982298**
	Prob.	**0.0000**	**0.0001**	**0.0001**	**0.0000**	**0.0000**
		***	***	***	***	***

Source: Eviews10 statistical program outputs.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

No: Not significant.

Table 2 shows the results of the stability of the time series using the ADF test, where we find that the time series were stable after taking their first difference.

2- Determine the deceleration period:

Table (3) VAR deceleration period

VAR Lag Order Selection Criteria
Endogenous variables: LOGY LOGX1 LOGX2 LOGX3 LOGX4
Exogenous variables: C
Date: 04/10/25 Time: 01:12
Sample: 2000 2023
Included observations: 23

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-57.12756	NA	0.000153	5.402397	5.649243	5.464478
1	-9.770786	70.00567*	2.32e-05*	3.458329*	4.939409*	3.830817*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Eviews10 statistical program outputs.

Table (3) shows that the most appropriate lagged period is (1) according to the five criteria.

3- Boundary Test:

Table (4) Boundary Test for Independent and Dependent Variables

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.775542	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
			Finite Sample:	
Actual Sample Size	23		n=35	
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
			Finite Sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Source: Eviews10 statistical program outputs.

Table (4) shows the presence of a long-term equilibrium relationship at the four levels: 1%, 2.5%, 5%, and 10%, as the (F) value was greater than the upper limit for all four levels. Note that the test includes two limits: An upper limit and a lower limit. The calculated (F) value was greater than the upper limit in the tables included in the test, reaching (4.77) at a significance level of (1%) of (4.37). Therefore, the null hypothesis rejected and the alternative hypothesis, indicating the presence of a long-term equilibrium relationship between the independent and dependent variables, is accepted.

4- Estimation of the distributed lag model (ARDL)

Table (5) Autoregressive distributed lag model

Dependent Variable: Y
Method: ARDL
Date: 04/10/25 Time: 22:22
Sample (adjusted): 2001 2023
Included observations: 23 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): LOGX1 LOGX2 LOGX3 LOGX4
Fixed regressors: C
Number of models evaluated: 16
Selected Model: ARDL(1, 1, 1, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y(-1)	-0.044733	0.223995	-0.199704	0.8446
LOGX1	-115060.6	248718.4	-0.462614	0.6507
LOGX1(-1)	-482485.6	223734.6	-2.156509	0.0489
LOGX2	2114351.	903498.0	2.340184	0.0346
LOGX2(-1)	1625167.	1071532.	1.516676	0.1516
LOGX3	11396739	4646333.	2.452846	0.0279
LOGX4	-14634005	5467125.	-2.676728	0.0181
LOGX4(-1)	8701598.	4560070.	1.908216	0.0771
C	-21943176	24278831	-0.903799	0.3814

R-squared	0.658942	Mean dependent var	5102166.
Adjusted R-squared	0.464052	S.D. dependent var	2187566.
S.E. of regression	1601483.	Akaike info criterion	31.69693
Sum squared resid	3.59E+13	Schwarz criterion	32.14125
Log likelihood	-355.5147	Hannan-Quinn criter.	31.80868
F-statistic	3.381098	Durbin-Watson stat	2.309188
Prob(F-statistic)	0.022439		

*Note: p-values and any subsequent tests do not account for model selection.

Source: Eviews10 statistical program outputs.

Table (5) shows the results of estimating the independent variables on the dependent variable. These results obtained through ARDL model, where we note that R-squared value reached (0.65). This means that (%65) of the fluctuations in the dependent variable (agricultural worker productivity) were caused by the independent variables in the model,

and (%35) of the fluctuations were for variables that were not included in the model, or the random variable absorbed their effect. The value of the F statistic reached (3.38), which is significant at the (5%) level. This means that there is a significant relationship between the independent variables and the dependent variable. The value of Durbin Watson (D-W) reached (2.30).

5- Error Correction Model

Table (6) Error Correction Model ECM

ARDL Error Correction Regression
Dependent Variable: D(Y)
Selected Model: ARDL(1, 1, 1, 0, 1)
Case 2: Restricted Constant and No Trend
Date: 04/11/25 Time: 00:40
Sample: 2000 2023
Included observations: 23

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGX1)	-115060.6	183790.5	-0.626042	0.5414
D(LOGX2)	2114351.	663694.0	3.185732	0.0066
D(LOGX4)	-14634005	3709779.	0.000000	0.0000
CointEq(-1)*	-1.044733	0.167535	-6.235909	0.0000

R-squared	0.705866	Mean dependent var	237036.9
Adjusted R-squared	0.659424	S.D. dependent var	2355606.
S.E. of regression	1374705.	Akaike info criterion	31.26215
Sum squared resid	3.59E+13	Schwarz criterion	31.45962
Log likelihood	-355.5147	Hannan-Quinn criter.	31.31181
Durbin-Watson stat	2.309188		

* P-value incompatible with t-Bounds distribution.

Source: Eviews10 statistical program outputs.

Table 6 shows that the independent variable parameter D (LOGX1) (agricultural loans) was negative and insignificant. The negative sign here means that granting agricultural loans leads to a decrease in the productivity of the agricultural worker, which is contrary to economic logic. However, it can interpreted as agricultural loans used to purchase agricultural machinery and equipment, which increases the productivity of mechanical labor and

reduces the use of human agricultural labor. As for the variable parameter D (LOGX2) (agricultural support amounts), its sign was positive and significant. The positive sign here means that increasing the agricultural support amounts leads to an increase in the productivity of the agricultural worker, which is consistent with economic logic. As for the variable parameter D (LOGX3), it did not appear in the ECM model. As for the independent variable parameter D (LOGX4) (agricultural labor force), its sign was negative and significant. The negative sign here means that increasing the number of the agricultural labor force leads to a decrease in the productivity of the agricultural worker, which is consistent with economic logic, because the agricultural sector in Iraq suffers from disguised and seasonal unemployment. The value of R^2 reached (0.70), which means that (70%) of the changes in the dependent variable in the short term were explained by the independent variables, and (30%) of the changes were not included in the model or their effect was absorbed by the random variable. As for the value of (CointEq), it reached (-1.0447339), which is significant at the (1%) level, and it met the necessary and sufficient conditions (negative and significant). Here, the period is calculated through (1 ÷ 1.044) = 0.957. This value is multiplied by 12, meaning that (0.957 x 12) = 11.484 months, so we need (11.5) months to make the required correction. From these results, it is clear that (1.04%) of the errors will be corrected in the long term. Note that some independent variables added at the beginning, but they deleted due to their negative impact on the significance of the model, namely (inflation rate).

6- Estimating the long-term equation

EC = Y - (-571960.8109*LOGX1 + 3579401.8362*LOGX2 +10908760.4726 *LOGX3 -5678396.7782*LOGX4 - 21003626.2479)

Table (7) Long-run equation or co- integration

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGX1	-571960.8	176085.1	-3.248207	0.0058
LOGX2	3579402.	1083465.	3.303663	0.0052
LOGX3	10908760	4844505.	2.251780	0.0409
LOGX4	-5678397.	4687910.	-1.211285	0.2458

Source: Eviews10 statistical program outputs.

Table (7) shows that logx1 has a negative sign and significant. This means that the relationship between agricultural loans and the productivity of the agricultural worker is inverse, i.e., agricultural loans lead to a decrease in the productivity of the agricultural worker, which is contrary to economic logic. This relationship corrected in the long run, and this relationship continued from the short run, where the negative sign was justified. As for logx2, the sign is positive and significant. This means that there is a direct relationship between the amounts of agricultural support and the productivity of the agricultural worker, i.e., the amounts of support provided to the agricultural sector increase the productivity of the agricultural worker, and this is consistent with economic logic. As for logx3, its sign is positive and significant. This means that there is a direct relationship between the cultivated land and the productivity of the agricultural worker. Increasing the area of cultivated land leads to an increase in the value of agricultural production and thus an increase in the productivity of the agricultural worker, and this is consistent with economic logic. As for logx4, its sign is negative and insignificant, meaning that there is an inverse relationship between the number of the agricultural labor force and the productivity of the agricultural worker. This means that an increase in the agricultural labor force leads to a decrease in the productivity of the agricultural worker due to the reality of employment in the agricultural sector in Iraq, which explained previously.

7 - Conducting econometric diagnostic tests

A. Autocorrelation test:

Table (8) Lagrange multiplier LM test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	**2.062607**	**Prob. F(2,12)**	**0.1698**
Obs*R-squared	**5.883948**	**Prob. Chi-Square(2)**	**0.0528**

Source: Eviews10 statistical program outputs.

Table (8) shows the Lagrange multiplier LM test through which the linear correlation problem is determined.

B. Non-constancy of homogeneity of variance (Heteroscedasticity):

Table (9) Testing the problem of non-constancy of homogeneity of variance

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	**0.851089**	**Prob. F(8,14)**	**0.5760**
Obs*R-squared	**7.525711**	**Prob. Chi-Square(8)**	**0.4811**

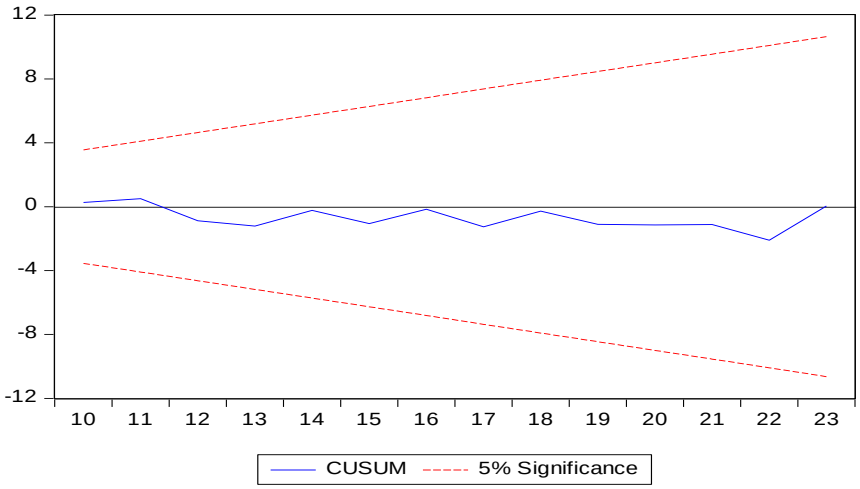
Scaled explained SS	**3.366517**	**Prob. Chi-Square(8)**	**0.9093**

Source: Eviews10 statistical program outputs.

Table (9) shows the calculated F value, where the value (0.85) appeared with a significance of (0.57) and this value is greater than (5%), which means that the model does not contain the problem of instability of variance homogeneity, and thus the null hypothesis is accepted and the alternative hypothesis rejected.

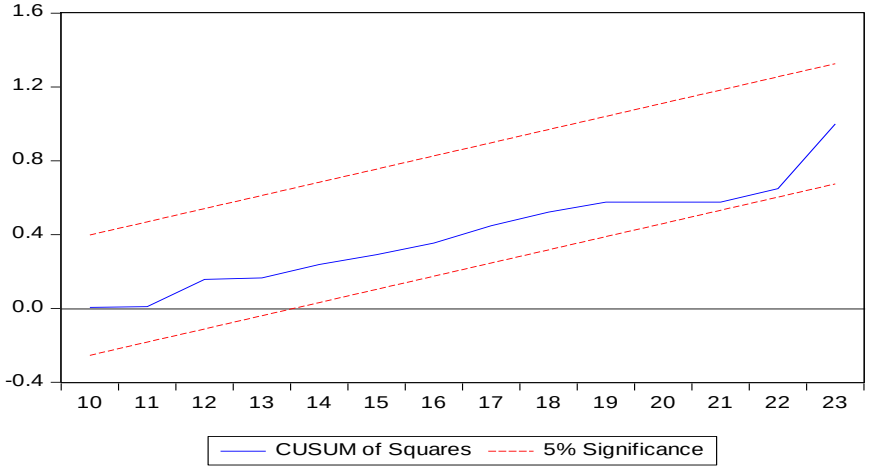
C. Cusum, Cusum SQ stability test (structural stability test)

Figure (1) Cusum



Source: Eviews10 statistical program outputs.

Figure (2) Cusum SQ test



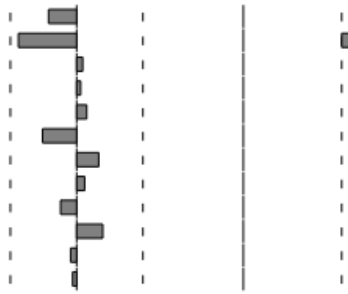
Source: Eviews10 statistical program outputs.

Figures (1) and (2) show the structural stability test, with the graph falling within the critical limits at (5%) significance level, indicating structural stability for the model variables and consistency in the short and long terms.

D. The Partial Correlation and Autocorrelation Functions:

Figure 3: Autocorrelation Function

Date: 04/11/25 Time: 23:21
Sample: 2000 2023
Included observations: 23
Q-statistic probabilities adjusted for 1 dynamic regressor



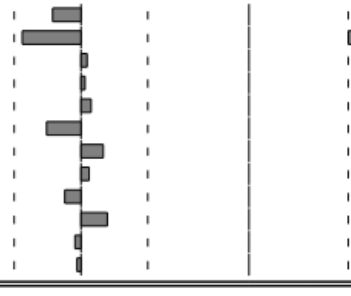
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.175	-0.175	0.7980	0.372
		2	-0.367	-0.410	4.4922	0.106
		3	0.037	-0.155	4.5320	0.209
		4	0.020	-0.203	4.5446	0.337
		5	0.058	-0.041	4.6521	0.460
		6	-0.216	-0.349	6.2306	0.398
		7	0.135	-0.009	6.8861	0.441
		8	0.048	-0.203	6.9757	0.539
		9	-0.101	-0.129	7.3942	0.596
		10	0.161	0.030	8.5390	0.576
		11	-0.033	-0.018	8.5915	0.660
		12	-0.017	0.032	8.6058	0.736

*Probabilities may not be valid for this equation specification.
Source: Eviews10 statistical program outputs.

We note from figure (3) that the variables fall within the limits, so there is no autocorrelation.

Table (4) Partial Correlation Function

Date: 04/11/25 Time: 23:21
Sample: 2000 2023
Included observations: 23
Q-statistic probabilities adjusted for 1 dynamic regressor



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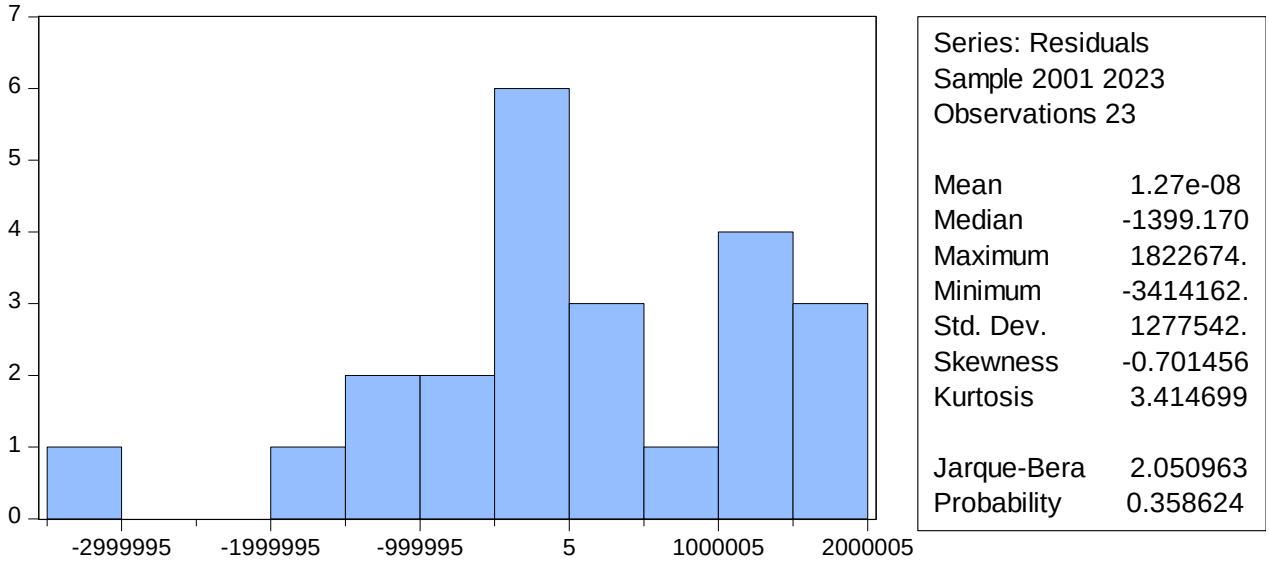
*Probabilities may not be valid for this equation specification.

Source: Eviews10 statistical program outputs.

Figure (4) illustrates the partial correlation function, showing that the variables fall within the bounds, meaning there is no partial correlation.

E. Model validity test:

Figure (5) Normal distribution of residuals



Source: Eviews10 statistical program outputs.

Figure (5) shows the Jarque-Bera test value, indicating that the null hypothesis accepted because the probability is greater than (5%).

Conclusions and Recommendations

Conclusions:

1- We note from the results that the time series stabilized after taking its first difference using the augmented Dickey-Fuller (ADF) test. This led to conducting other tests, such as the bounds test and standard diagnostic tests. The results showed that the F value calculated at significance levels of (1%, 2.5%, 5%, and 10%) confirmed the existence of a long-term equilibrium relationship between the dependent variable and the independent variables, as its value was greater than the critical value for the upper and

lower limits in the bounds test. The results of the remaining tests also showed that the model is free of the problem of heteroscedasticity and there is no autocorrelation or partial correlation.

2- The research results demonstrated that agricultural labor productivity is affected by a number of economic factors, and that this effect is either negative or positive, thus confirming the research hypothesis.

3- The results demonstrated that the independent variables affecting agricultural labor productivity were agricultural subsidy amounts and cultivated land, which had a positive impact. The independent variables not affecting agricultural productivity were agricultural loans and the number of agricultural labor, which had a negative impact.

Recommendations:

1- Emphasize the agricultural lending policy and implement agricultural banking recommendations that provide financial support to farmers, given their broad positive impact on developing the agricultural sector in the country.

2- Develop policies and strategic plans to address the number of labor forces in proportion to the cultivated areas.

3- Emphasize the education and training of agricultural workers, as they are an important component of agricultural production and contribute directly to the productivity of agricultural labor**.**

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