ESTIMATION OF THE IMPACT OF SOME VARIABLES OF AGRICULTURAL ECONOMIC POLICY ON THE IRAQI DOMESTIC AGRICULTURAL PRODUCT FOR THE PERIOD 1994-2015 USING THE METHOD OF COINTEGRATION AND THE ARDL MODEL

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ABSTRACT

The calculations of gross domestic product (GDP) show the contribution of each sector, whether Service fully or productively, to the formation of the national income.The agricultural sector is an important sector, although it did not take the lead in the composition of GDP because of the large contribution of the oil sector, especially in recent years, which witnessed the return of Iraq to the international oil market. The research aimed to measure the impact of some economic variables in agricultural GDP and analyze the role that these variables can play on the growth of this output, which can promote growth in the Iraqi agricultural sector. The research was based on the quantitative method to arrive at its results by following one of the modern methods to study the causal relationship, the method of multivariate cointegration, the ARDL model and the test of the causal relationship to determine the direction of the relationship between the economic variables studied, based on the assumptions of the economic theory. The study found that there is a long-term effect between the agricultural GDP index and the other economic variables under study and that there is a causal relationship between the long term and the short term.

Keyword: Agricultural net value added. CUSUM, Accumulation of fixed agricultural capital

***Part of Ph.D. dissertation of the first author**

مجلة العلوم الزراعية العراقية -2018: 49(6):1073-1082 محمد والحيالي

تقدير اثر بعض متغيرات السياسة الاقتصادية الزراعية على الناتج المحلي الزراعي العراقي للمدة 1994-2015 باستخدام اسلوب التكامل المشترك متعدد المتغيرات ونموذج ARDL

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المستخلص

ان حسابات الناتج المحلي الاجمالي توضح مدى اسهام كل قطاع سواء كان خدميا ام انتاجيا في تكوين الاقتصاد الوطني، والقطاع الزراعي من القطاعات المهمة رغم انه لم يتبوأ مقام الصدارة في تكوين الناتج المحلي الاجمالي بسبب ضخامة مساهمة القطاع النفطي لا سيما في السنوات الاخيرة التي شهدت عودة العراق الى السوق النفطية الدولية. استهدف البحث قياس اثر بعض المتغيرات الاقتصادية الزراعية في اجمالي الناتج المحلي الزراعي وتحليل الدور الذي يمكن ان تلعبه هذه المتغيرات على نمو هذا الناتج والتي يمكن من خلاله تعزيز النمو في القطاع الزراعي العراقي .اعتمد البحث على الأسلوب الكمي في الوصول الى نتائجه عن طريق اتباع احد الأساليب الحديثة لدراسة العلاقة السببية وهو أسلوب التكامل المشترك متعدد المتغيرات ونموذج ARDL واختبار العلاقة السببية لتحديد اتجاه العلاقة بين المتغيرات الاقتصادية محل الدراسة معتمدا على افتراضات النظرية الاقتصادية وعلى بيانات البنك الدولي والجهاز المركزي للإحصاء، الحسابات القومية ومنظمة الأغذية والزراعة الدولية (الكتب السنوية الإحصائية) وبعض البحوث والاطاريح الجامعية والشبكة الدولية (الانترنت) لبيانات سنوية للفترة 1994-2015 وقد تم تحديد بعض المتغيرات المؤثرة في اجمالي الناتج الزراعي بالاستناد الى الادبيات الاقتصادية التي تناولت هذا الموضوع وقد توصل البحث الى ان هناك اثرا طويل الاجل بين كل من مؤشر الناتج المحلي الزراعي وباقي المتغيرات الاقتصادية قيد الدراسة وان هناك علاقة سببية طويلة الاجل وقصيرة الاجل بينهما .

كلمات مفتاحية: صافي القيمة المضافة الزراعية، المجموع التراكمي للبواقي المتابعة CUSUM، تراكم راس المال الثابت الزراعي

***البحث مستل من اطروحة الدكتوراه للباحث الاول**

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INTRODUCTION

Agricultural production faces a high degree of risk as it requires a relatively long period of time from the use of inputs, and the intervention of many factors beyond the control of the agricultural product in determining the final output in quantity and quality and because of this nature of agricultural production, the fluctuations in the volume of production is one of the main features In general, and in Iraq in particular, the facts indicate that Iraq was influenced by the political, economic and legislative variables witnessed by the length of the study period and the effect was therefore reflected on the effectiveness of its contribution to GDP. The economic literature is rich in applied studies that support the positive impact of some of these variables on the growth of agricultural production. In 2016, was an econometrical study of the effect of government subsidies on the growth of agricultural production in Algeria was carried out using the self-regression model of lag times using annual data for the period (1970-2011)(14), saying that there is a negative impact to support agricultural inputs on agricultural output in the long run. Also was studied the impact of CAP subsidies on total agricultural productivity (TFP) in the EU (EU)(24), the benefits have a negative impact on the productivity of the farm and after the separation of these subsidies has become a positive impact on productivity in many countries of the Union. In addition to the above, the subject of price policy and its partial and total effects has been studied by (1,2,3,5,6,8,11,15,16,19,20,26,27). The problem of the research is that the agricultural policy of the state affects the growth of agricultural GDP by controlling a range of agricultural economic variables such as: (amounts of subsidies to the agricultural sector, agricultural loans, and quantities received from strategic crops such as wheat, rice, barley, this effect is transferred to the agricultural market either directly through short-term impact or indirectly through the long-term impact. In light of this relationship, which can arise between these variables and the total agricultural output, the question arises about the nature of the relationship between short and long term. The research assumes that there is a causal relationship between some agricultural economic variables and the agricultural local product and the impact of this relationship in the short and long term. The aim of the research is to determine the impact of some variables of agricultural economic policy on the agricultural GDP.

MATERIALS AND METHODS

The research was based on the quantitative method of reaching its results by following one of the modern methods to study the causal relationship, the method of multivariate joint integration, the ARDL model and the test of the causal relationship to determine the direction of the relationship between the economic variables studied, based on the assumptions of economic theory. In addition, the research data were based on the World Bank, the Central Bureau of Statistics, the National Accounts, the Food and Agriculture Organization of the United Nations (Statistical Yearbooks), some research papers, university papers and the Internet was also relied on. The model was generally formulated as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 + ... + b_6X_6 + U_{ti} ....(1)$$

Where:

Y: Agricultural Gross Domestic Product in million Iraqi dinars

X_1: Amounts of subsidies provided to the agricultural sector (in million Iraqi Dinars)

X_2: Agricultural loans (in million Iraqi dinars)

X_3: Amounts received from wheat crop (tones)

X_4: Amounts received from rice crop (tons)

X_5: Net Nominal Protection coefficient for Wheat Crop

X_6: Net Nominal Protection coefficient for Rice Crop ==U_{ti} : Random error term. $b's$: Model parameters.

The general formula of the ARDL model based on the UECM model and the BOND test proposed by (almusabah)[1] is composed of a

[1] Almusabbah.E.A. Unive. Of Alkassem. Coll. of Administration and Economic, KSA.

dependent variable and K of the independent variables is(12):

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i\, \Delta Y_{t-i} + \sum_{i=0}^{q} \emptyset_i\, \Delta X1_{t-i} + \sum_{i=0}^{m} \vartheta_i\, \Delta X2_{t-i} + \sum_{i=0}^{n} \partial_i\, \Delta X3_{t-i} + \sum_{i=0}^{s} \sigma_i\, \Delta X4_{t-i} + \sum_{i=0}^{r} \delta_i\, \Delta X5_{t-i} + \sum_{i=0}^{k} \gamma_i\, \Delta X6_{t-i} + \lambda_1 Y_{t-1} + \lambda_2 X1_{t-1} + \lambda_3 X2_{t-1} + \lambda_4 X3_{t-1} + \lambda_5 X4_{t-1} + \lambda_6 X5_{t-1} + \lambda_7 X6_{t-1} + \varepsilon_t ----$$

In order to test the existence of cointegration between the variables in the model, the hypotheses are formulated as follows:

Null hypothesis: There is no cointegration

$$H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = 0$$

Alternative hypothesis: existence of cointegration

$$H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7 \neq 0$$

STATISTICAL RESULTS

The first step is to examine the time series stability grades. This was done by the software developed by the (almusabah) and with ADF and PP, it is important to note that testing the stability of variables is not a necessary condition to start the application of the ARDL model, but the model does not work accurately if there are some variables stable in the case of the second difference, which has been confirmed by the fact that the variables are stable first order and shown in Table 1.

Table 1. Check the stability of time series

UNIT ROOT TEST RESULTS TABLE (ADF)								
Null Hypothesis: the variable has a unit root								
At Level								
		Y	X1	X2	X3	X4	X5	X6
With Constant	t-Statistic	-1.9575	-1.6395	-1.5408	-1.9321	-2.3908	-1.4917	-1.0843
	Prob.	0.3015 n0	0.4458 n0	0.4940 n0	0.3122 n0	0.1565 n0	0.5180 n0	0.7020 n0
With Constant & Trend	t-Statistic	-3.2408	-3.0835	-3.2567	-3.6628	-2.4510	-3.6062	-2.3765
	Prob.	0.1049 n0	0.1408 n0	0.1021 n0	0.0543 *	0.3455 n0	0.0537 *	0.3796 n0
Without Constant & Trend	t-Statistic	-1.4315	-1.0660	-0.9460	-0.3718	-1.8324	0.6401	0.3851
	Prob.	0.1376 n0	0.2493 n0	0.2957 n0	0.5382 n0	0.0647 *	0.8461 n0	0.7861 n0
	At First Difference							
		d(Y)	d(X1)	d(X2)	d(X3)	d(X4)	d(X5)	d(X6)
With Constant	t-Statistic	-2.6101	-3.1784	-4.5585	-4.6002	-2.8005	-6.8952	-5.8678
	Prob.	0.1083 n0	0.0407 **	0.0022 ***	0.0020 ***	0.0779 *	0.0000 ***	0.0001 ***
With Constant & Trend	t-Statistic	-2.3979	-5.1925	-4.4909	-4.2681	-3.1523	-6.7020	-5.6940
	Prob.	0.3672 n0	0.0025 ***	0.0108 **	0.0166 **	0.1265 n0	0.0001 ***	0.0009 ***
Without Constant & Trend	t-Statistic	-2.2150	-5.3997	-4.6093	-4.3969	-1.6597	-6.6245	-5.4734
	Prob.	0.0292 **	0.0000 ***	0.0001 ***	0.0002 ***	0.0906 *	0.0000 ***	0.0000 ***
Notes:								
b: Lag Length based on SIC								
c: Probability based on MacKinnon (1996) one-sided p-values.								
This Result is The Out-Put of Program Has Developed By:								
Dr. Imadeddin AlMosabbeh								
College of Business and Economics								
Qassim University-KSA								

Source: From the researcher by using Eviews program

Model (1) was estimated by the OLS method and the results shown in table (2).

Table 2. Results of the estimation of model (1) by using OLS method

Dependent Variable: Y
Method: Least Squares
Date: 03/24/18 Time: 18:34
Sample: 1994 2015
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	0.342294	0.762401	0.448968	0.6599
X2	7.850690	2.621600	2.994618	0.0091
X3	2.936416	0.304641	9.638927	0.0000
X4	0.071422	0.038686	1.846195	0.0847
X5	3456111.	732688.9	4.717024	0.0003
X6	-2664985.	1063773.	-2.505219	0.0243
C	-2088049.	561834.1	-3.716486	0.0021

R-squared	0.978553	Mean dependent var	6778908.
Adjusted R-squared	0.969974	S.D. dependent var	5226435.
S.E. of regression	905642.4	Akaike info criterion	30.52405
Sum squared resid	1.23E+13	Schwarz criterion	30.87120
Log likelihood	-328.7645	Hannan-Quinn criter.	30.60583
F-statistic	114.0643	Durbin-Watson stat	1.835791
Prob(F-statistic)	0.000000		

Source: From the researcher by using Eviews program

Then, the number of lag period was determined for the variables of the first difference for each variable of the model according to the Akaike (AIC) standard. The ARDL model is very sensitive to the slow times. It is worth mentioning that we use EVEWS 9.5 with the latest version and table (3) shows the lag periods which were 1,1,0,0,1,1,1

Table 3. Periods of lag period for the variables of the first difference for each variable of the model according to the Akaike (AIC)

Dependent Variable: Y
Method: ARDL
Date: 03/24/18 Time: 18:35
Sample (adjusted): 1995 2015
Included observations: 21 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): X1 X2 X3 X4 X5 X6
Fixed regressors:
Number of models evalulated: 64
Selected Model: ARDL(1, 1, 0, 0, 1, 1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y(-1)	0.101026	0.114683	0.880908	0.3990
X1	0.640024	0.523742	1.222020	0.2497
X1(-1)	-1.019202	0.770638	-1.322544	0.2154
X2	8.622667	2.676880	3.221163	0.0092
X3	2.033758	0.333099	6.105564	0.0001
X4	0.071478	0.039713	1.799853	0.1021
X4(-1)	0.133299	0.050751	2.626559	0.0253
X5	3220410.	685640.5	4.696937	0.0008
X5(-1)	1549696.	561597.0	2.759445	0.0201
X6	-3844378.	834776.8	-4.605276	0.0010
X6(-1)	-3721860.	1136270.	-3.275506	0.0084

R-squared	0.994500	Mean dependent var	7087237.
Adjusted R-squared	0.989000	S.D. dependent var	5146393.
S.E. of regression	539765.1	Akaike info criterion	29.54134
Sum squared resid	2.91E+12	Schwarz criterion	30.08847
Log likelihood	-299.1840	Hannan-Quinn criter.	29.66008
Durbin-Watson stat	2.304280		

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

Source: From the researcher by using Eviews program

The model was estimated using the ARDL method and the conitegration and long run form (CALRF), one lag time for the dependent variable and one lag time for the independent variables with no constant and direction to obtain the results shown in table (4), what is important in this estimate is that the CALRF, which is exactly like Johansson's fault-correction model, is different from the value of the coint Eq (-1), which is 0.90, with very high significance, where λ1 check the two conditions necessary in that it is negative and sufficient in its significance and explains that 90% of the short-term errors can be corrected by the unity of time, which is a year in order to return to a long-term equilibrium.

Table 4. ARDL model estimation results and CALRF criteria

ARDL Cointegrating And Long Run Form
Original dep. variable: Y
Selected Model: ARDL(1, 1, 0, 0, 1, 1, 1)
Date: 03/24/18 Time: 18:36
Sample: 1994 2015
Included observations: 21

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1)	0.657747	0.348395	1.887937	0.0884
D(X2)	8.456398	1.694139	4.991562	0.0005
D(X3)	2.014852	0.243905	8.260807	0.0000
D(X4)	0.073118	0.023544	3.105528	0.0111
D(X5)	3200205.785	422974.49972	7.565954	0.0000
D(X6)	-3847315.76	540888.28799	-7.112958	0.0000
CointEq(-1)	-0.901505	0.116536	-7.735854	0.0000

Cointeq = Y - (-0.4218*X1 + 9.5917*X2 + 2.2623*X3 + 0.2278*X4 + 5306164.2409*X5 -8416520.7298*X6)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	-0.421790	1.026132	-0.411049	0.6897
X2	9.591670	2.732134	3.510688	0.0056
X3	2.262309	0.199946	11.314574	0.0000
X4	0.227790	0.028706	7.935176	0.0000
X5	5306164.249	1214717.1892	4.368230	0.0014
X6	-8416520.72	1276888.9016	-6.591428	0.0001

Source: From the researcher by using Eviews program

In order to verify the existence of a cointegration of the variables in the model, and by using the BONDS TEST methodology, whose results are presented in table 5. This is the most important table. It shows that the calculated f value of 3.78 is greater than the highest tabular value at significance level 2.5% was 3.59, this means that the null hypothesis that there is no cointegration and acknowledgment of a cointegration between the variables of the model is rejected. The results of this table indicate that the regression model estimates reflects a high level of estimation quality as indicated by the coefficient of determination which equal 90%.

Table 5. BONDS TEST

ARDL Bounds Test
Date: 03/24/18 Time: 18:38
Sample: 1995 2015
Included observations: 21
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	3.785260	6

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	1.75	2.87
5%	2.04	3.24
2.5%	2.32	3.59
1%	2.66	4.05

Test Equation:
Dependent Variable: D(Y)
Method: Least Squares
Date: 03/24/18 Time: 18:38
Sample: 1995 2015
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1)	1.562986	0.927634	1.684918	0.1229
D(X4)	0.204851	0.046190	4.434963	0.0013
D(X5)	1767409.	1038874.	1.701274	0.1197
D(X6)	-2235846.	1957666.	-1.142098	0.2800
X1(-1)	-0.857135	1.225137	-0.699624	0.5001
X2(-1)	8.344486	3.984011	2.094494	0.0627
X3(-1)	0.801588	0.806043	0.994474	0.3434
X4(-1)	0.110322	0.087287	1.263899	0.2349
X5(-1)	5111291.	1553097.	3.291031	0.0081
X6(-1)	-5310606.	2622866.	-2.024734	0.0704
Y(-1)	-0.632524	0.287636	-2.199041	0.0525

R-squared	0.903815	Mean dependent var	419093.6
Adjusted R-squared	0.807631	S.D. dependent var	2226193.
S.E. of regression	976406.8	Akaike info criterion	30.72683
Sum squared resid	9.53E+12	Schwarz criterion	31.27396
Log likelihood	-311.6317	Hannan-Quinn criter.	30.84557
Durbin-Watson stat	2.546206		

Source: From the researcher by using Eviews program

The results of table (6) show that the model does not suffer from the problem of autocorrelation series according to the LM test as its statistical value appeared at the level of 0.3538, which makes us accept the null hypothesis that there is no problem of serial autocorrelation. The model does not suffer from the problem of heteroskedasticity. It has a probability value of 0.2860 which is greater than 0.05, which makes us accept the null hypothesis that the random error limit varies in the estimated model. Since the value of Jarque-Bera is greater than 5% normal distibution assurance model

Table 6. LM test results and heteroskedasticity test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	**0.384281**	**Prob. F(1,9)**	**0.5507**
Obs*R-squared	**0.859939**	**Prob. Chi-Square(1)**	**0.3538**
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	**1.360358**	**Prob. F(11,9)**	**0.3273**
Obs*R-squared	**13.11315**	**Prob. Chi-Square(11)**	**0.2860**
Scaled explained SS	**2.196319**	**Prob. Chi-Square(11)**	**0.9977**

Source: From the researcher by using Eviews program

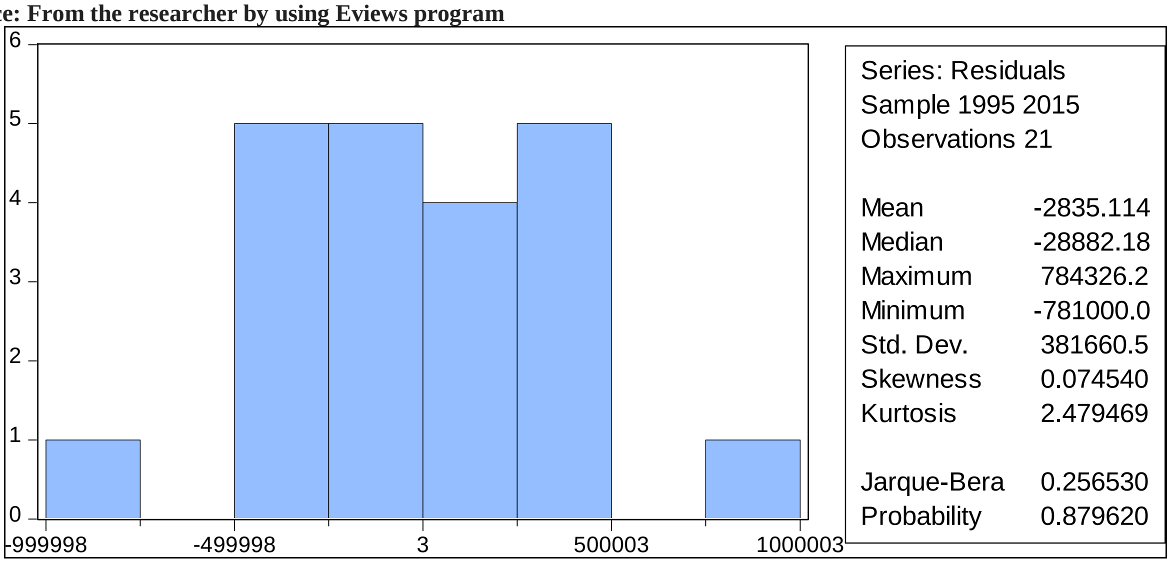

Figure 1. Test the normal distribution of residuals

Structural stability test results for the estimated ARDL model

The step after estimating the model formula is to test the structural stability of the short and long term coefficients, its mean, the data used in this research are free of structural changes over time, to achieve this, two tests are used: cumulative sum of recursive residua, (CUSUM) and cumulative sum of square recursive residual, (CUSUMS). The structural stability of the estimated coefficients of the UECM form of the ARDL model is achieved if the CUSUM and CUSUMSQ statistics are within the critical limits at a significant level of 5%. Hence, these coefficients are unstable if the diagram of the above two tests (6). Figure (2 and 3) shows that the estimated coefficients of the ARDL model are structurally stable over the period under study, confirming stability between the study variables and consistency in the model in the short and long run.

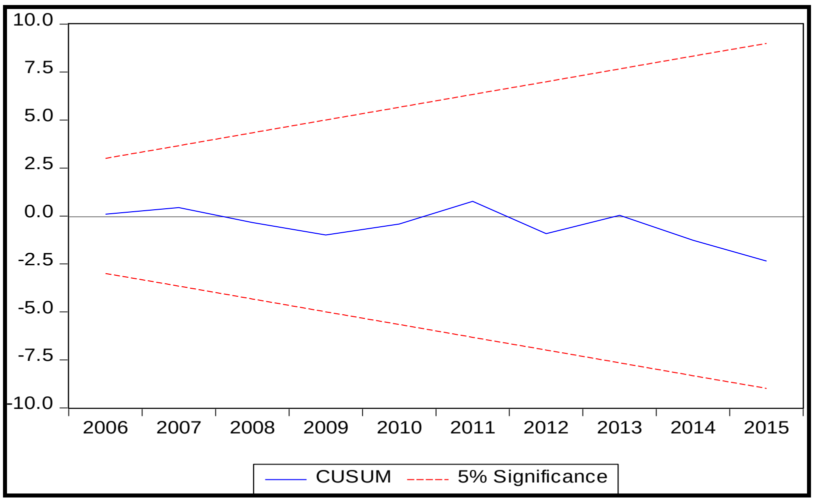

Figure 2. cumulative sum of recursive residua, (CUSUM)

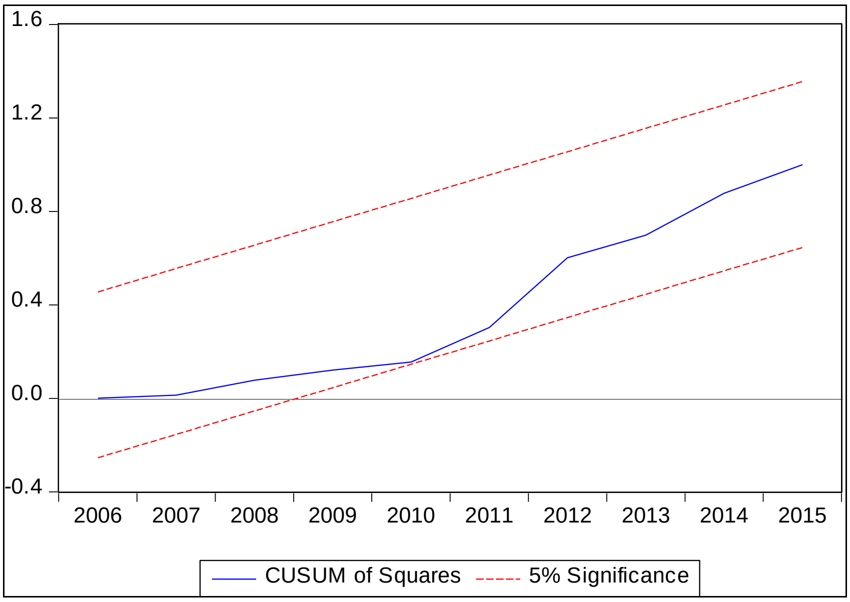

Figure 3. Cumulative sum of square recursive residual, (CUSUMS).

RESULTS AND DISCUSSION

The results of table (4), show the long-term relationship between the total domestic agricultural production and the independent variables, showing that the change in all these independent variables has a significant effect on the agricultural GDP (variable dependent) except X1 (subsidies to the agricultural sector) among the explanatory variables, a combined integration with the agricultural GDP index is integrated in the sense that there is a long-term relationship between these explanatory and dependent variables (agricultural GDP) and that there is a causal relationship in the short and long term moving from the explanatory variables to the variable, that mean, the model is stable, which means that the probability of these variables being effective is high in the long term. As the results showed • There is a negative and insignificant effect on the variable of supporting the agricultural sector in the long term after it was positive and significant at 10% in the short term. This is in line with what is recommended by the IMF and the World Bank in their reform programs for developing countries. Services and prices of factors of production and the need to work in real prices, which must economically cover the cost of production and abandon the policy to support crop prices and remove subsidies on agricultural inputs such as chemical fertilizers, seeds and pesticides as they represent a heavy burden on agricultural gross domestic product. It is worth mentioning that the negative impact of long-term support to the agricultural sector is consistent with several studies such as (14) and (17), as it is theoretically explained that producers are working to reduce the use of inputs as a result of ensuring a share of the income coming from the subsidy. This negative impact may be mainly due to the low productivity of the factors of production in the long term because of support, and the product may change its behavior and starts in the search for investment in activities that are subsidized is considered relatively less productive. In addition, the results showed there is a positive and very significant effect of the coefficient of the variable agricultural loans as an increase of 1% in this coefficient will lead to an increase of agricultural GDP by 9.6%. This confirms the role and importance of agricultural loans in the long term to revitalize the Iraqi agricultural sector. If agricultural loans work if they are best exploited to increase the production of farmers in the various projects for which they borrowed these amounts, which will be reflected positively on the increase in agricultural GDP, and long-term results are consistent with what can be the use of the correct loans, That the use of loans in the short term was not effective, which confirms that the adoption of lending institutions to take decisive action to guide the use of loans in their real purposes, especially long-term loans. Also the results showed a positive and very significant effect of the quantities received from the wheat crop and the quantities received from the rice crop. A 1% increase in the X3 parameter will increase the agricultural output by 2.26% and the increase of 1% in the X4 parameter will increase the agricultural output by 0.23%. The positive impact of these two variables clearly indicates the success of the policy of the government and the right of its actions in motivating farmers towards the delivery of quantities produced to warehouses and silos of the government as well as increased awareness of the producers of the need to take these procedures, which will positively reflect the level of self-sufficiency of the main crops to acceptable degrees and encouraging , which has been observed in recent years as the low food gap for major crops, especially wheat, has been shown to be in favor of higher agricultural GDP. Finally, the results showed a positive and significant effect of the parameter of the variable coefficient of net nominal protection of the wheat crop. The negative and significance relation between the variable of the net nominal protection coefficient for the rice crop and the agricultural GDP is expected because this crop is controlled by factors other than supporting the producers of this crop. The study recommends reducing subsidies and leaving price incentives operating within the market mechanism, reflecting the ability of the market to encourage agricultural production and to intervene in the pricing of agricultural products in a relative manner. The rice crop is linked to the development of successful water resources policies and programs, given that this crop is governed by the water component, which is a temporal and geographical component. Therefore, the only way to know what might happen is to predict through mathematical equations and digital models that document past events according to various scenarios in order to develop appropriate water policies are integrated with price policies formulated by the government for this strategic crop

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