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The Impact of Corruption on Agriculture Sector in Iraq: Econometrics Approach

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Abstract

The agricultural sector is an important economic activity in most Arab countries, including Iraq, in terms of its capacity to a large proportion of the total manpower. This makes it a major source of sustenance for a large proportion of the total population. Its contribution to the gross domestic product (GDP) has decreased in the past two decades because of many reasons including irrigation water shortage and the decrease in the total cultivated areas.....etc. However, the impact of corruption, which is one of the economic phenomena that have repercussions on both developed and developing countries, especially countries that are going through difficult circumstances, including Iraq, which leads the most corrupt countries, has been neglected. Therefore, investigating the reasons for the low growth of the agricultural sector is the big goal for decision-makers. This study aims to demonstrate an equilibrium relationship between corruption and the growth of the agricultural sector in Iraq for the period (2004Q2 - 2019Q4) in both short and long runs. To achieve this objective, Johansen and Juselius, and VECM model were used. The study concluded that there is a co-integration between the growth of the agricultural sector and corruption and the existence of a long-run equilibrium relationship between them in the long run. Also, the results found that corruption contributed 29% to the explanation of the changes in the agricultural sector's contribution to the GDP. This indicates the importance of this study and the neglect of previous studies on the impact of corruption on the growth of the agriculture al sector. Therefore, appropriate measures must be taken to develop economic policies to combat corruption for the advancement of the agricultural sector.

Keywords: Agriculture sector; Corruption; Co-integration; VECM.

1. Introduction

The agricultural sector is one of the most important economic sectors that contribute to economic development, especially in developing countries. This is through providing job opportunities and achieving food self-sufficiency, in addition to stimulating agriculture-related industries. The agricultural sector has several characteristics that make it a link under a series of sectors of the national economy. Despite the importance of the agricultural sector in the Iraqi national economy, its contribution to the GDP is not commensurate with its importance at a time when the demand for agricultural products, especially food, is increasing.

The changes in GDP present the course of the economic development process. Thus, obtaining prior information about the development endeavours, which contain plans and programs aimed at developing the national economy in all its sectors, including the agricultural sector, which witnessed various developments. In 1953, the agriculture sector contribution to the GDP was 22% that was decreased to 13% in 2001. After that, its contribution increased to 37.2% during the nineties of the past century because of the decline in oil revenues and the adoption of the policy of price control (prices are given in advance) for the main agricultural products. Its contribution decreased to 8.4% in 2003, and this decrease continued to reach 4.56% in 2011 and 2% in 2018, as shown in Figure 1.



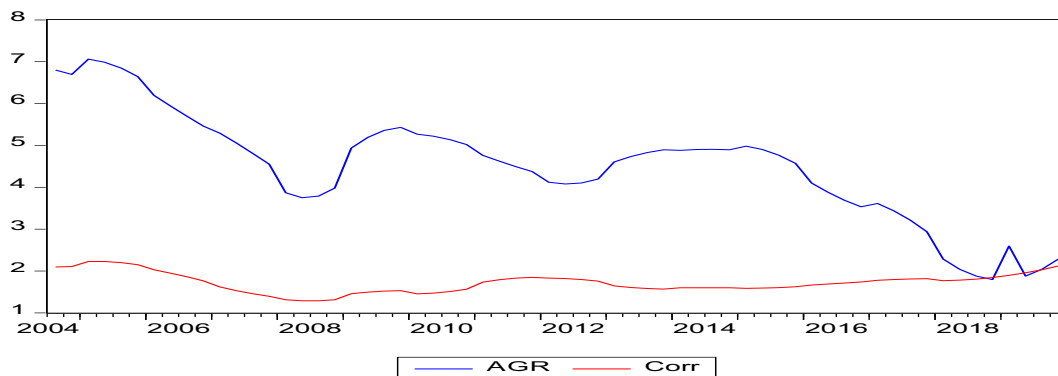


Figure 1. Contribution of the agricultural sector to GDP and corruption in Iraq for the period (2004Q2 -2019Q4)

Since the 1980s and 1990s, Iraq has gone through very difficult circumstances, especially after the American invasion to Iraq in 2003. Iraq underwent a period of turbulent transitions at the political and economic levels, and during that period deteriorating security and lack of rule of law and order created a fertile environment for the spread of the phenomenon of corruption.

Iraq takes place in tops of the global corruption list. According to the international index of the most corrupt countries: Iraq, Venezuela, North Korea, Libya, Sudan, Yemen, Afghanistan, and Syria. This affected the agricultural sector as well. The low contribution of the agricultural sector to the GDP and the deviation of standards and indicators for agricultural production from its global counterpart not only in Iraq but also in most developing countries, which spurred many studies to explain the reasons for this low contribution. For example, a study by Ahmed El-Rasoul examined the relationship between growth in the Egyptian agricultural sector and government spending in this sector. A study [1] examined the effect of corruption in fertilizers on the agricultural sector in Bangladesh. [2] study found that competition reduces corruption. [3] study on the impact of corruption on farmers' efficiency in rice production in Bangladesh. Other studies have investigated the relationship between corruption and economic growth [4-9].

Previous studies neglected the impact of corruption on the growth of the agricultural sector. This is what distinguishes this study from previous studies, and it deals with the impact of corruption on the agricultural sector and its contribution to the gross domestic product in Iraq for the period from mid-2004 to the end of 2019.

This study derives its importance from the importance of the agricultural sector, as a proxy of the contribution of this sector to the gross domestic production and its impact on the corruption that has raged in Iraq for the period (2004Q2 - 2019Q4). Investigating the reasons for its low contribution has become very important and an important requirement for achieving economic development, which raises questions about the serious, will on the part of decision-makers in tackling this problem. Therefore, the study aims to study the impact of corruption on the agricultural sector in Iraq in the short and long run. The rest of this study includes four parts, the second section deals with the presentation of the standard model and the data and statistical methods used, and in the third part it is concerned with the presentation and analysis of the results, and finally, the fourth part provides a summary of the results and recommendations reached by the study.

2. Econometric Model and Data

The Econometrics model used to test corruption on the Agriculture, forestry, and fishing, value added (% of GDP) as a proxy of growth of the agricultural sector. Farming in this case includes hunting, fishing, as well as crops and livestock production. The added value is the net sector output, after collecting all the outputs and subtracting the intermediate inputs, which can be represented by the following formulas:

$$\text{AGR} = f(\text{CORR})$$

Where: CORR, the annual corruption rate, while AGR is the growth of the Iraqi agricultural sector. Taking into account the limitations of the objective scale of corruption (such as the number of individuals convicted of corruption), a CPI was used that ranged from 0 (very corrupt) to 10 (very clean), which was used in many studies as a study of [10-12]. These data were obtained from the transparency international, while the contribution of the agricultural sector to GDP from the second quarter of 2004 to the end of 2019 was obtained from the international financial statistics (online) issued by the International Monetary Fund [13].

Examining the effect of corruption on the long and short term growth of the agricultural sector in Iraq, VECM was used to test this effect according to the following stages: testing the stationary of time series subject to study, common integration test for study variables using Johansen and Joselius method, and the use of VECM after selecting the appropriate lag length..

2.1 Stationary Test

The stationary of the time series is a prerequisite for the study and analysis of time-economic chains [12]. The obtained regression is spurious regression if those chains are un-stationary. The time series is stationary if:

$$\begin{aligned} cov(y_t, y_{t+k}) &= E(y_t - \mu)(y_{t+k} - \mu) \\ E(Y_t) &= \mu \\ var(y_t) &= E(Y_t - \mu)^2 = \sigma^2 \end{aligned} \quad [14]$$

There are several ways to test the stationary of the time series, the most important of which is the unit root test (URT), which can be conducted in several ways. The first is called the Augmented Dickey-Fuller (ADF) test and the second is called the Phillips Perron (PP). The ADF test is one of the most important tests used to test the stationary of time series and determine the degree of integration. The ADF test is based on the following formula:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^p \alpha_i \Delta y_{t-i} + \varepsilon_t$$

Where:

Δ = The first difference for the time series ; Y_t = A variable whose time series stationary is tested ; δ =Parameter of a slowdown variable

$$\Delta Y_t = (Y_{t-1} - Y_{t-2}), \quad \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3}), \text{ etc.}$$

t = Chronological trend

ε_t = Random error limit

The estimated formula for the above equation depends on the optimum slowdown period P (it is the time that guarantees no self-correlation between the residues) and that is obtained by applying the test that gives the lowest values for the Akai (AIC) standard, which is calculated as follows:

$$AIC = n \log \left(\frac{SSR}{n} \right) + 2k$$

Where:

n= number of observations in the sample; SSR= sum of squares of error limits; K= number of coefficients in the equation.

The hypotheses in the ADF test are as follows:

$$H_0 = \delta = 0 \quad Vs. \quad H_1 = \delta < 1$$

The second test is the Phillips- Perron Test (PP), which depends on the same equations used in the ADF test, but it does not use the time differences used in the ADF test. The following formula is used to estimate the PP test:

$$\Delta Y_t = \alpha_1 + \alpha_2 Y_{t-1} + \alpha_3 t + \varepsilon_t$$

ε_t represents the stationary condition.

The preference of the PP test over the ADF test is due to its consideration of the possibility of errors resulting from the stationary of the discrepancy in the estimate used and then correcting the standard errors of the estimated parameters. The null hypothesis is rejected if the calculated absolute value of the t-statistic is greater than the absolute value of the tabular t-statistic. The time series y_t is free of the root of the unit, then this chain is integral of degree zero, that is, I (0). If the absolute value of the t-statistic calculated for δ less than the absolute value of the corresponding tabular t statistic calculated in [15] at a significant level, do not reject the null hypothesis.

2.2 Co-integration

Conducting a Co-integration test requires that all the time series are all integrated from the same rank, since the unit root test confirmed that all variables of the model are integrated from the first rank, therefore the second step is to test the existence of a co-integration among those variables or not, In other words, testing a long-run relationship among those variables. To achieve this objective, the Johansen and Juselius test have used [16], which is considered one of the most important tests of the co-integration in the case of more than two variables, which treats all variables of the model as internal variables, and the following equation illustrates this test:

$$\Delta Y_t = \beta_1 + \beta_2 t + \sum_{i=1}^{p-1} \delta_i \Delta Y_{t-i} + \Pi Y_{t-p} + \varepsilon_t, \quad i = 1, 2, \dots, p-1$$

The effects of long-run model variables are referred to in the equation above with the symbol Π , while the rank of the matrix is indicated by the symbol r, which specifies the number of co-integration vectors of the model. To test the existence of a co-integration among variables of a model or not, and also to finding the number of vectors of co-integration, [16] and [17] will be used, where these methods propose two tests: the first is the Trace test

(λ_{trace}) and the statistics are calculated as follows:

$$\lambda_{trace} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i), \quad r = 0, 1, 2, \dots, n-2, n-1$$

The null hypothesis will be tested in this test $H_0 : r \leq n$ vs. $H_1 : r > n$.

A second test is the Maximum Eigenvalue Test (λ_{\max}), and the statistics are calculated as follows:

$$\lambda_{\max} = -T \ln(1 - \hat{\lambda}_{r+1}), \quad r = 0, 1, 2, \dots, n-2, n-1$$

The null hypothesis that is tested is: $H_0 : r \leq r_0$ Vs. $H_1 : r > r_0 + 1$

The null hypothesis will be rejected if the calculated values of the tests are greater than the corresponding value [16]. Thus, there is a long-run equilibrium relationship between the variables. In other words, there is a Co-integration among these variables.

2.3 Vector Error Correction Model (VECM)

VECM is a special case of VAR for the first-time stationary time series that is employed to describe the dynamic exchange relationship between those series. It is used to check the shape of the short or long-run equilibrium relationship. It can be applied in the case of small samples, unlike other statistical methods. It separates the relationship in the long term from the short term. The parameter estimated according to this model is more consistent than other methods [17]. This model is not applied until after ensuring that there is a co-integration between the study variables.

3. Result and Discussion

ADF and PP tests were performed to test the stationary of time series, Johansen and Juselius and error correction model were also performed. The results of these tests are presented below:

3.1 Selection of Log Length

We use the lag order selection criteria to choose the appropriate lag length. The appropriate time log is chosen based on the SC standard, by estimating the unrestricted self-regression vector for each variable and one-time gap after another. Then choose the time gap at the lowest value for the SC standard. Table (1) presents the results of determining the time gap for the variables under study.

Table 1. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-77.32912	NA	0.055450	2.783478	2.855164	2.811338
1	89.68791	316.4533	0.000182	-2.936418	-2.721360	-2.852839
2	114.1857	44.69769	8.87e-05*	-3.655638*	-3.297208*	-3.516340*
3	115.8809	2.973994	9.63e-05	-3.574767	-3.072965	-3.379750
4	116.2579	0.634947	0.000110	-3.447644	-2.802470	-3.196908
5	124.2738	12.93804*	9.57e-05	-3.588555	-2.800009	-3.282099

Table 1. presents that the various criteria (FPE, AIC, SC, HQ and FPE) indicate that the optimum lag criterion is 2.

3.2 Unit root test

Extended Dicky Fuller ADF and PP tests were used to investigate whether the variables under study were stationary or not and also determined their degree of co-integration. Table (2) presents the results of the analysis of the ADF and PP test at the level and the first differences of variables with intercept, Trend and Intercept and None.

The results in Table (2) indicate that the calculated value of t for the time series levels in question is less than the critical values for the levels and all variables. This indicates the inability to reject the null hypothesis

($H_0: \delta = 0$) of the existence of the unit root (un-stationary) for these levels at the 1% level of significance, whether with a fixed limit only or with a fixed limit and a general trend for these variables.

The results also indicate the rejection of the null hypothesis that the time series in question is not free from the root of the unit at its first differences. It is stationary at the level of significance of 1%, whether it is a fixed limit or a fixed limit and a general trend. The calculated value of t for levels is greater than the critical values for the first differences and for all time series studied.

Therefore, corruption and the contribution of the agricultural sector to the Iraqi gross domestic product are integrated from the first degree, I (1).

Table 2. Results of the unit root test (ADF and PP Test).

	Augmented Dickey-Fuller (ADF) Test			Phillips-Perron (PP) Test										
	Level		1st difference	Level		1st difference								
	Intercept	Trend and Intercept	Intercept	Trend and intercept	Intercept	Trend and intercept								
Corruption	-2.099 (0.256)	-2.051 (0.562)	-0.109 (0.642)	-3.193*** (0.025)	-3.649*** (0.033)	-3.223*** (0.001)	-1.733 (0.410)	-1.453 (0.835)	-0.202 (0.609)	-3.2296** (0.023)	-3.619*** (0.036)	-3.257*** (0.001)	I(1)	Decision
AGRG	-0.307 (0.917)	-1.625 (0.771)	-1.657 (0.091)*	-4.226*** (0.001)	-4.226*** (0.007)	-3.858*** (0.000)	-0.453 (0.893)	-1.575 (0.791)	-1.944* (0.051)	-4.343*** (0.000)	-4.361*** (0.005)	-3.986*** (0.000)	I(1)	

Note: The figures in parenthesis are p-value, *, **, *** denote that the corresponding coefficient is significant at 10%, 5% and 1% level, respectively.

3.3 Co-integration Test Results

The co-integration between the variables of the study (corruption and the growth of the Iraqi agricultural sector) was used using the method [16] because it is integrated from the first degree I (1). It is un-stationary in its levels and stationary in its first differences, which includes two tests: Trace Statistic (λ_{Trace}) and Max-Eigen Statistic (λ_{Max}). The SC standard was used to determine the appropriate lag length, as shown in Table (3), which also illustrates the trace statistic result and the choice of Max-Eigen Statistic.

Table (3) present that there is a co-integration between corruption and growth in the Iraqi agricultural sector according to the value of trace statistic and Max-Eigen Statistic between corruption. The rejection of the null hypothesis ($r = 0$) states that there is no co-integration at the 1% level of significance. This means that there is only one co-integration equation for corruption and the agricultural sector's contribution to the Iraqi gross domestic product. This means that there is a long-run equilibrium relationship between these variables, that is, they do not stay away from each other very much in the long run.

Table 3. Johansen and Juselius method results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.312081	22.88898	15.49471	0.0032
At most 1	0.013768	0.817983	3.841466	0.3658

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.312081	22.07099	14.26460	0.0024

At most 1	0.013768	0.817983	3.841466	0.3658
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

3.4. VECM Estimation

To detect a long-run equilibrium relationship between agricultural sector growth and corruption, these variables should be represented in the Error Correction Model (ECM) [18], which includes the ability to test and estimate the relationship in the short and long term between study variables. It is possible to avoid the standard problems caused by spurious regression after ensuring that the time series of the variables of the study model is un-stationary in the level and stationary in the first difference and that all the variables are jointly integrated.

In light of the results of the error correction model in Table (4), it is noticed that the significance of the error correction threshold at the 1% level of significance with the expected negative indication, this confirms that there is a long-term equilibrium relationship in the model. This means that corruption and the contribution of the agricultural sector to the gross domestic product are not far from each other in the long run so that they exhibit similar behaviour. The value of the error correction factor 0.032% indicates that corruption adjusts towards its equilibrium value in each period at a rate equivalent to 3.2% of the remaining imbalance in the longer term, where the equivalent of 3.2% of this deviation or imbalance in the period t is corrected.

It is clear from Table (4) that the value is (0.29) and this indicates that the currency auction explains 29% of the changes in the agricultural sector's contribution to the gross domestic product in Iraq during the study period. This indicates that corruption has a major impact on the growth of the agricultural sector in Iraq. 71% of unexplained factors are responsible for variables that are not included in the model and are represented by the random variable such as the lack of irrigation water and cultivated areas and loans granted to the agricultural sector and other factors that affect this sector.

Table 4. Results of Vector Error Correction Estimates.

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.032820	0.013870	-2.366257	0.0198
C(2)	0.505921	0.158500	3.191931	0.0019
C(3)	0.023121	0.158939	0.145470	0.8846
C(4)	-0.579530	0.762557	-0.759983	0.4490
C(5)	0.334119	0.768193	0.434942	0.6645
C(6)	-0.056051	0.031852	-1.759715	0.0813
C(7)	-0.010629	0.002283	-4.655981	0.0000
C(8)	-0.007782	0.026088	-0.298289	0.7661
C(9)	-0.000429	0.026160	-0.016399	0.9869
C(10)	0.512933	0.125512	4.086720	0.0001
C(11)	0.233525	0.126440	1.846926	0.0675
C(12)	-0.001255	0.005243	-0.239315	0.8113
Determinant residual covariance	5.66E-05			
Equation: $D(AGR) = C(1) * (AGR(-1) + 7.58886123539 * CORR(-1) - 17.3408123198) + C(2) * D(AGR(-1)) + C(3) * D(AGR(-2)) + C(4) * D(CORR(-1)) + C(5) * D(CORR(-2)) + C(6)$				

Table (4) present that the short-run parameters are not significant, which indicates that there is no short-run equilibrium relationship between corruption and the contribution of the agricultural sector to the gross domestic product in Iraq during the study period, and this is what the Wald Test indicated as in Table (5).

Table 5. Wald Test results.

Wald Test:			
System: %system			
Test Statistic	Value	df	Probabilit y
Chi-square	0.596667	2	0.7421
Null Hypothesis: C(4)=C(5)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(4)	-0.579530	0.762557	
C(5)	0.334119	0.768193	

3.5. Diagnostic Tests

The diagnostic tests indicate that the model has passed standard tests. Figure (2) reflects that the estimated model fulfils the stability condition. All of the coefficients are smaller than one and all the roots fall within one circle, which means that the model does not suffer from the problem of misstatement errors or inconsistency of discrepancy.

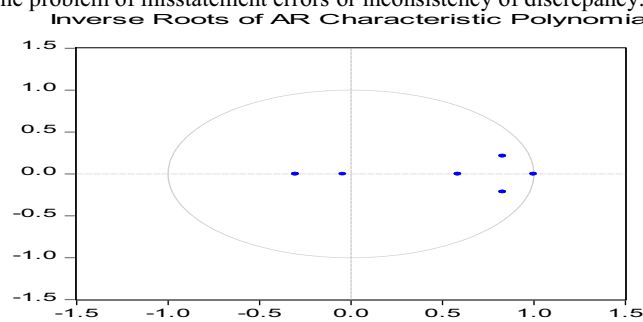


Figure 2. Inverse Roots AR characteristics Polynomial.

While Table (6) shows that the model is not serial-correlation between corruption and growth of agriculture sector in Iraq by using the LM test.

Table 6. serial correlation model results

Lags	LM-Stat	Prob
1	0.558188	0.9676
2	0.384826	0.9837

Probs from chi-square with 4 df.

The Breusch-Pagan-Godfrey test showed that there is no problem of Heteroskedasticity with a probability value of 0.959, as shown in Table 7.

Table 7. Results of VEC Residual Heteroskedasticity Tests.

Joint test:		
Chi-sq	df	Prob.
17.97568	30	0.9589

Individual components:

DependentR-squared F(10,48) Prob. Chi-sq(10) Prob.

res1*res1	0.158681	0.905324	0.5358	9.362153	0.4981
res2*res2	0.064936	0.333339	0.9676	3.831235	0.9546
res2*res1	0.168939	0.975752	0.4765	9.967424	0.4434

4. Conclusion

The study aimed to investigate the impact of corruption on Agriculture, value added (% of GDP) as a proxy of the growth of the agricultural sector in Iraq, expressing the contribution of this sector to the gross domestic product for the period (2004Q2-2019Q4). To achieve this objective, ADF and PP tests were used to test the stationarity of these variables and the VECM to test whether there is an equilibrium relationship between them in the short and long run. The presence of the unit root of the levels in the time series under study has been reached, that is, they are stationary in their levels, but stationary at their first differences at the 1% level of significance, I (1).

Using the Johansen and Juselius method, it was found that there is a co-integration between the growth in the agriculture and corruption in Iraq. Also, long-run equilibrium relationship has also been found between them by using VECM. That is, they change together in the long run.

The current values of the growth of the agricultural sector are affected by their previous value and the previous values of corruption, while there is no an equilibrium relationship between them in the short run.

The results also indicated the contribution of corruption by 29% in explaining the changes in the contribution of the Iraqi agricultural sector to the gross domestic product. This indicates the importance of this study and the neglect of previous studies on the impact of corruption on the agricultural sector. Therefore, decision-makers in Iraq must take the necessary measures to reduce corruption that will ultimately lead to increased agricultural production. It is not possible to achieve economic growth, reduce poverty, and enhance food security in most countries, especially developing countries, without improving the productive capacities inherent in the agricultural sector and increasing its contribution to general economic development.

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