EFFECT OF SHOCKS OF AGRICULTURAL TERMS OF TRADE (TOT) ON SOME AGRICULTURAL INDICATORS IN IRAQ FOR THE PERIOD (1990 - 2019)

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ABSTRACT

This study aimed to investigate the impact of agricultural TOT shocks and the strength of their effects on some indicators of the agricultural sector. The research uses VAR, Variance decomposition and IRF approaches. The research is due to the almost monolithic exports and the multiplicity of imports, and the results of the agricultural product response to the shock of the agricultural gross terms of trade (GBTT) indicated that it had a negative impact, due to the shocks that the last variable was subjected to, which was reflected on an agricultural product, but they are not permanent as they returned to the normal situation within the sixth year. The research recommended adopting the TOT criterion as one of the criteria for drawing agricultural development plans in Iraq and one of its basic indicators to link the import capacity with the export capacity, as well as the need to pay attention to reviving agricultural exports to Iraq to stimulate agricultural terms of trade and then agricultural investment.

Keywords: Variance decomposition, VAR, impulse response function, stationary.
***Part of Ph.D. dissertation of the 1st author.**

أثر صدمات معدلات التبادل التجاري الزراعي على بعض المؤشرات الزراعية في العراق للمدة (1990 – 2019)

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المستخلص

يهدف البحث دراسة أثر صدمة معدلات التبادل التجاري الزراعي وقوة آثارها على بعض مؤشرات القطاع الزراعي، ولقد استخدم البحث أسلوب متجه الانحدار الذاتي وتحليل تجزئة التباين وكذلك دالة استجابة النبضة في هذا المجال، ولقد توصل الباحثان أن معدل التبادل التجاري الزراعي لم يكن في صالح البلد في اغلب سني الدراسة بسبب شبه أحادية الصادرات وتعدد الاستيرادات، ولقد اشارت نتائج استجابة الناتج الزراعي لصدمة معدل التبادل التجاري الزراعي الاجمالي بانها ذات تأثير سلبي، بسبب الصدمات التي تعرض لها المتغير الأخير مما انعكس بالنتيجة على الناتج الزراعي الا انها ليست دائمية إذ عادت الى الوضع الطبيعي عند السنة السادسة، وأوصى البحث باعتماد معيار معدل التبادل التجاري الزراعي كأحد معايير رسم خطط التنمية الاقتصادية الزراعية في العراق وأحد مؤشراتها الأساسية لربطه القدرة الاستيرادية بالقدرة التصديرية، فضلاً عن ضرورة الاهتمام بإنعاش الصادرات الزراعية للعراق لتحفيز معدلات التبادل التجاري الزراعي ومن ثم الاستثمار الزراعي.

الكلمات المفتاحية: تجزئة التباين، متجه الانحدار الذاتي، دالة استجابة النبضة، الاستقرارية.
***جزء من أطروحة الدكتوراه للباحث الأول.**

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INTRODUCTION

The issue of foreign trade as an engine for growth and development has an important place in the economic thought related to the economic development of developing countries, including Iraq, especially in light of the practical reality of widening the gap separating the developed countries from the developing countries after the weak results for some policies that were followed in some developing countries, especially the import substitution policy and the foreign borrowing policy, have led to an exacerbation of the deficit in the trade balance, an increase in the volume of external indebtedness and the faltering of development efforts. This is reflected in the prices, which affect the foreign trade sector in general and agricultural exports in particular, especially when it has become clear that the growth and increase of external demand for the country's export products lead to stimulating and directing investment in it to adopt better methods of producing and marketing its products, and these results cause an increase in income and consequently an increase in savings and investment. The Iraqi economy is open to the global economy and linked to it at the regional and international levels through the external macroeconomic variables characterised by foreign trade, remittances, employment and foreign investments. With the growing phenomenon of the liberalization of foreign trade and free transfer of capital and technology between countries. This research tries to discover the sensitivity of the Iraqi agricultural sector and the extent that which it is directly and indirectly affected by positive and negative shocks that occur in the agricultural TOT, and their reflection on the agricultural product, agricultural terms of trade, agricultural investment and the rest of the indicators. Accordingly, and due to the conditions that the Iraqi economy has gone through, such as wars and economic sanctions, have resulted in internal and external shocks that have an important role in shaping the features of the country's economic system, which is a natural reflection of the political differences and radical changes that Iraq has experienced throughout three decades. The research attempts to emphasise the most important aspects of these crises and their positive or negative results and consequences, the time dimension affected by them, and studying their impact on the consequences of the conditions and variables mentioned above to achieve the research objectives, which is: studying the impact of local and external economic shocks that occur in agricultural TOT and the strength of their effects on the agricultural sector indicators. Among the most important variables in which shocks may occur are food prices and oil prices. Iraqi economy, including the agricultural economy, is a small economy open to the global economy (sometimes to the point of dumping), as it will be more affected by economic shocks. In this field, (11) studied terms of trade shocks and economic recovery, which dealt with the factors that contribute to a rapid recovery of growth after the continuation of negative shocks to the rate of trade, using a sample of 159 countries for the period 1970-2006. The researchers used the percentage change in the annual terms of trade as an indicator of the existence of a shock in it, and the results indicated the importance of the policies followed because the rapid recovery processes are to some extent closely related to the depreciation of the real exchange rate and improvements in the stability of the government and the institutional environment, as well as the increases in support on time may help in the recovery process. Meanwhile, (8) studied "Dynamic Effects of Terms of Trade Shocks: The Impact on Debt and Growth", the researchers quantify borrowing costs to increase with the debt-to-equity ratio, by generating procyclical debt flows in response to the term of trade shocks, consistent with empirical evidence, since capital flows synchronized with the economic cycle attract unsustainably large capital flows during favourable shocks and force countries to over-adapt to adverse shocks, the research finds non-linear adjustments, involving a potential overshoot of the level of long-term debt.

MATERIALS AND METHODS

Terms of Trade – TOT

They are criteria used to assess the extent to which a country's foreign trade impact has evolved in one of its economic sectors, and its impact on its national economy. These foreign trade indicators reflect the structural features

of the national economy, the extent to which that economy has developed, the policies followed in various economic sectors, as well as the country's position in the global trade system (1). It gives a level of export earnings or import expenditures. Gains in terms of trade indicate a relative increase in real income (because the same volume of exports enables Increasing the volume of imports), and losses in the terms of trade indicate a relative decrease in real income (because the same volume of exports enables the purchase of imports that are smaller than it) (24). There are many types of TOT indicators, one and most important of them is Gross Barter Terms of Trade – GBTT. In its calculation, the index numbers of the quantity of exports and the quantity of imports of the concerned country are used, as it is calculated by dividing the index of the quantity of agricultural exports of the country by the index of the quantity of its agricultural imports according to the following formula (12), (13):

$$GBTT = Q_x/Q_m * 100$$

Where:

Q_x is the index of the quantity of agricultural exports.

Qm is the index of the quantity of agricultural imports.

when the result is greater than 100, it is in the interest of the country, and this relationship represents the number of imported units that the country obtains for each unit it exports, whether the value of exports is smaller, greater or equal to the value of imports, and it links between the exported quantities and the imported quantities, it is a measure of the relationship between the quantities of imported products and the quantities of exported products (19). The terms of trade shocks affect economic performance significantly. The experiences of some countries have proven this. Also, (18) found that one of the most important effects on the Australian economy in the past decade is the thriving in terms of trade, and it was found that rises in terms of trade led to reducing domestic inflation in the short term. Meanwhile, (6) considered the terms of trade shocks as one of the most important crises that may affect any country, as it was found that a negative change in the terms of trade is the costliest and most important type of shock in reducing income growth. The shocks of the terms of trade lead to a decrease in the relative price of exportable goods to imported goods and then influence spending and influence on the movement of resources. In small economies where the price of tradable goods is assumed to be fixed in the world market and the short-run supply of non-tradable goods is inelastic, the price of tradable goods will fall relative to non-traded goods, and then the real exchange rate will fall (11), which it has a prominent role in the competitiveness of the economy and thus in the balance of payments (22), inflation, and real growth according to the Purchasing Power Parity theory (3).

While the tradable and non-tradable goods models provide insights into what can happen to economic growth, the reality is often more complex, and once a new equilibrium is reached after the terms of trade shock, neoclassical models anticipate a return to growth. to its trajectory is long-term, but the experiences show that negative trade shocks can harm long-term growth, and the terms of trade shock may leave a permanent effect on the economy by undermining the so-called Learning-By-Doing Process (20). However, negative terms of trade shocks can help improve income growth in the medium term if they help the economy weed out inefficient firms (7). TOT has also been considered by some as a major driver of fluctuations in real income and current account in developing countries, the deterioration of which leads to lower national savings and increased dependence on foreign partners, which in turn may disrupt growth and lead to significant economic instability (17).

Some economic indicators of Iraq

First: Agricultural terms of trade

Countries are often exposed to shocks in their terms of trade, these shocks are among the shocks affecting the agricultural sector and agricultural foreign trade, as these rates are not affected by internal conditions only, but are also affected by external circumstances, and this effect increases if the country is exposed to it leads to cases of dumping in many agricultural products and commodities, so it imports and exports many goods and services so that make it affected by any movement that

the world is exposed to. Figure 1 shows that the agricultural terms of trade were affected in one way or another by the interactions that occurred at the global level of prices and quantities during the research period. It reached 185.4 in 2003, and a minimum amount was 11.5% and an annual growth rate of 3%, and it is obvious that most of the studied years were not in the advantage of Iraq, as we see that the value of the indicator is less than 100 in most years. The decrease in the agricultural export quantities index, which was reflected in the value of the indicator, means that fewer quantities of agricultural imports are obtained in return for more quantities of agricultural exports.

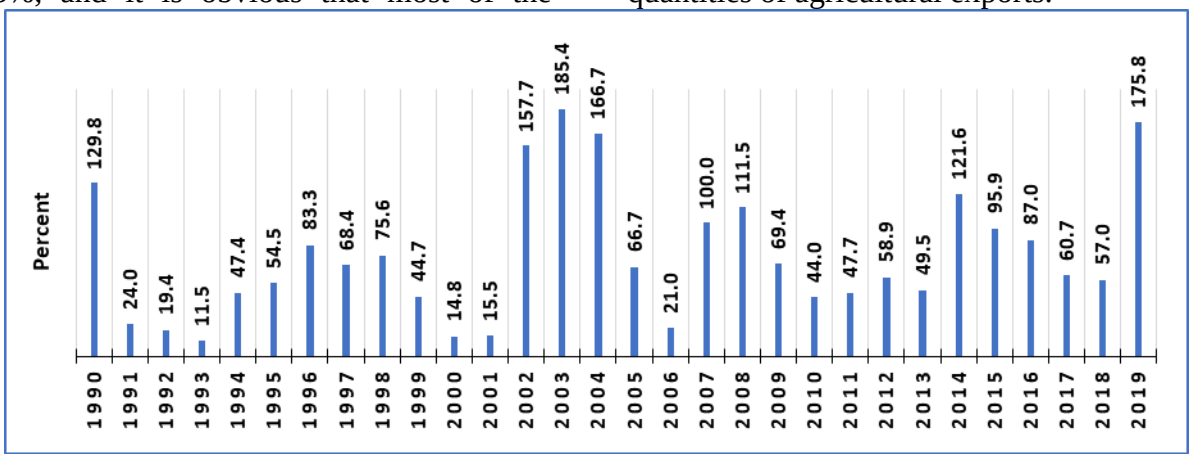

Figure 1. Agricultural GBTT in Iraq for the period 1990 - 2019.

Source: calculated by researchers according to indices on FAO website: www.fao.org.faostat, years of study.

Second: Agricultural product in Iraq

Agricultural product varied clearly during the studied period, and the first and lowest decline was in 1991 as a result of the beginning of the imposition of economic it was reached 2877 million dinars in 1991 after it was 3447 million dinars in 1990, with a negative annual change rate 16.5%. After that, the agricultural product gradually began to improve due to the state's tendency at the time to support the agricultural sector to provide food needs, due to the scarcity of food imports as a result of economic sanctions, but in an unstable manner until the severe shock accompanying the events of 2003, as agricultural product fell from 5432 million dinars in 2002 to 3850 million dinars in 2003, after which the situation took a gradual recovery until 2006 as a result of trade openness and the demand for importing production requirements such as machinery, equipment, improved seeds and others. The sharp decline in the water levels of the Tigris and Euphrates rivers in 2008 negatively affected agricultural production, as the amount entering the Euphrates River on the Syrian border, was estimated at approximately 14.7 billion cubic meters, while the average for the years (2006, 2007 and 2009) amounted to 20 billion cubic meters. The Tigris River witnessed a decrease of more than 50% in the rate of water inflow from 43 billion cubic meters on average in the same years to 20.03 billion cubic meters in 2008 (21). Thus, we find that the value of agricultural product fell sharply in that year. After that, agricultural product recovered from 2010 to reach its peak in 2014 with a value of 6 billion dinars of agricultural product and a compound growth rate of 54% over 2010, to solve the new crisis that agricultural production experienced as a result of the difficult security conditions, which Iraq been through in 2014, as a result of which the agricultural product decreased to 3787 million dinars in 2015 and 3171 million dinars in 2017, as shown in Figure 2.

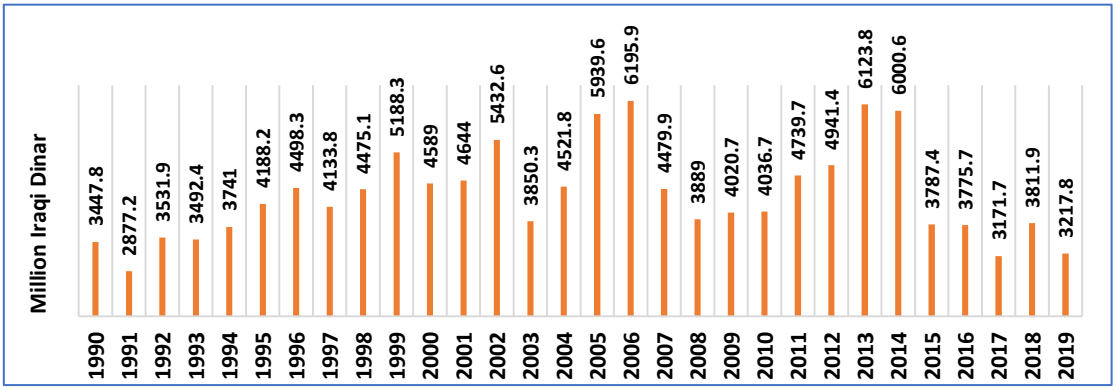

Figure 2. Value of agricultural product at constant prices in Iraq for the period 1990 - 2019.

Source: Ministry of planning/ CSO, dep. of national accountants, studied years - Baghdad. www.cosit.gov.iq

Third: Food price index

Food Price Index (FPI) is a measure of the monthly change in the international prices of a basket of food commodities, and it consists of an average of five price indices for a group of commodities weighted by the average export shares of each group during the period 2014-2016 as a basis. The index, according to the FAO, includes (meat price index, dairy products price index, grain price index, oil price index and sugar price index). The economic developments and prospects report issued by the World Bank found that households in the Middle East and North Africa region are highly vulnerable to global food prices, as well as to many shortcomings in local markets, and the shocks caused by high global food prices have been transmitted to varying degrees in domestic food commodity prices, in most countries of the Middle East and North Africa (16). It is clear from Figure 3 that food prices were characterized by fluctuation and rises in trend, with an annual growth rate of 2.3% calculated from the equation ($y = 5E - 19e0.0232^{x}$), and also witnessed sharp fluctuations during the period from 2007 to 2015 as a reflection of the global food crisis. since the end of 2007, it reaches its highest level in 2011 with a value of 131,9. The crisis affected various countries and inflicted the most severe damage, according to FAO reports, on poor countries (10).

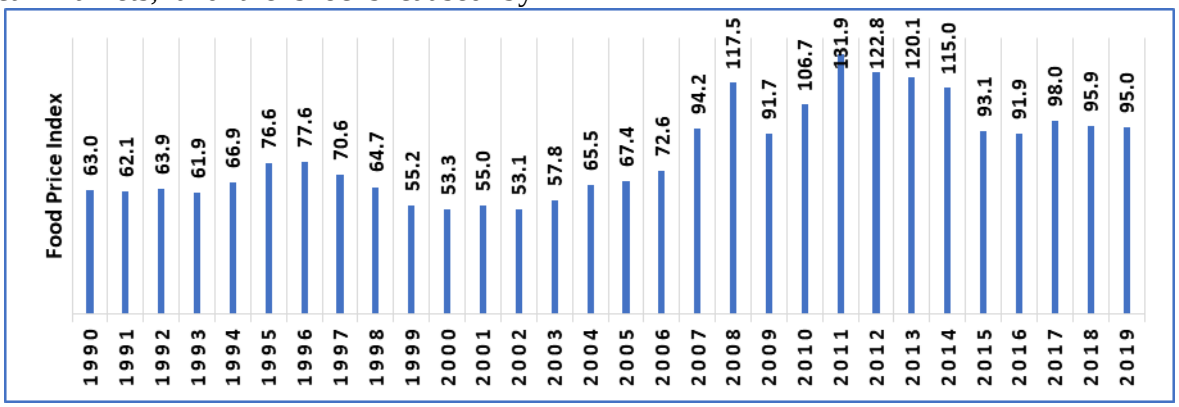

Figure 3. World Food Price Index for the period 1990-2019.

Source: FAO website: www.fao.faostata.org.

Fourth: Crude oil prices

In Iraq, the events of the nineties of the twentieth century, represented by the Second Gulf War, caused the cessation of oil revenues as a result of the complete cessation of oil production, and exports were restricted after the war by imposing economic sanctions from the United Nations, so oil production remained close to the level of domestic consumption until 1996, and in this year Iraq agreed to the oil-for-food program, and it was allowed to export by $2 billion worth of oil every six months, and we note the drop in oil prices during this period from 22.26 dollars in 1990 to 18.62 dollars in 1991, then rise again in 1996 to 20.26 dollars. The developments in the nineties of the twentieth century in the oil market, and the instability of its prices ended with an oil price shock in 1998, which led to the decline in crude oil prices to their lowest

level, amounting to 12.28 dollars per barrel, and this shock has several reasons. The most important of them is the growing problem of collecting data and statistics related to the forces of supply and demand and the ratios of oil stocks with the beginning of the concept of globalization in 1990, and this led to weak estimates of demand and supply, and that optimistic expectations about the increase in demand growth rates encouraged the producing countries to increase production, especially the OPEC countries in the first months of 1998, in addition to that climatic factors were also present as one of the reasons affecting the decline in the demand of the (OESD) countries due to the mild winter in that period (9). Figure 4 shows the fluctuation of oil prices after the 1998 crisis, starting with a gradual improvement from 2001 to its highest level in 2008, reaching 94.45 dollars per barrel, with an annual change rate of 36.73% from 2007. The year 2008 witnessed the entry of the financial crisis that began in 2007 is the stage of crisis, and these events were not isolated from the oil market and the forces affecting it because of the strong relationship between the global economy and the oil market and its effects on prices.

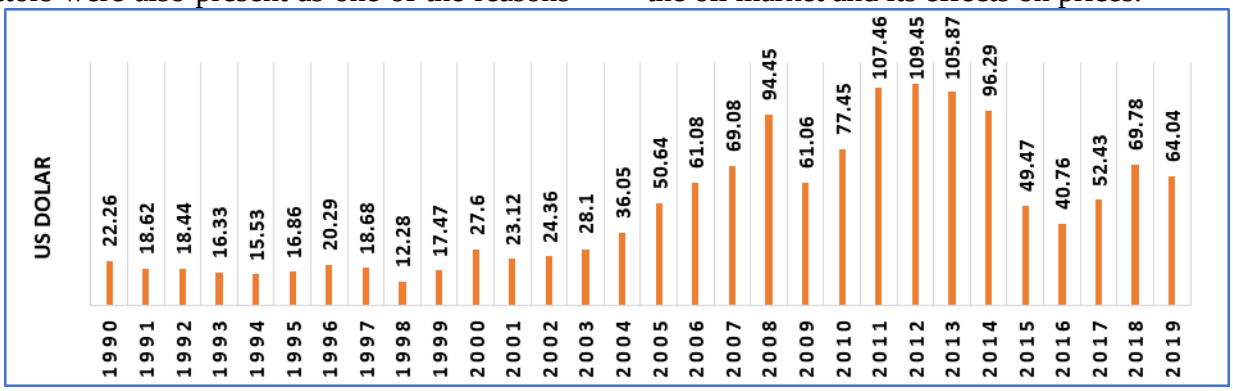

Figure 4. OPEC basket crude oil prices for the period 1990 - 2019.

Source: OPEC website, Annual Statistical Bulletin - Studied years

Variance decomposition analysis – VDA

It is an analysis that measures the relative importance of the variable in explaining the variance of prediction errors for the variables in the model under study, in other words, it reflects the relative contribution of the change in a variable to the interpretation of the change in other variables separately. We can obtain it from the following model (2):

$$Y_t = \mu + \sum_{i=0}^{\infty} M_i V_{t-1}$$

Where: *Mi* is the coefficients matrix of the model (n×n).

V the structural shock vector or the random error vector (n×1).

Variance decomposition analysis reflects the importance of the random variable in the model, as the test shows the impact of the independent variables on the dependent variable and the size of the change in the variable in the time (*t*) as a result of the shock in the same variable or the shock in other variables, and it is one of the ways to describe the dynamic behaviour of the model, which it measures the impact of shocks on the model variables is over time by dividing the error variance for each variable into several parts, each part belonging to a variable of the model (15).

Impulse response function – IRF

Impulse Response Function is useful in studying the interaction between variables in the VAR model. It describes the economy's response over time to external shocks and is modelled in the context of VAR models. The impulse response functions measure the impact of the shock on an endogenous variable within a vector autoregressive model (VAR) on present and future values for the other variables of this model, by testing the response of the dependent variable in the VAR model to shocks at the error term (5). The response functions show the effect of an only and sudden drop of a variable on itself and the rest of the system variables at all times, assuming that there is no correlation between error terms, and the impact of the shock in the random variable on Y_t for a certain time (s) can be predicted by the following equation (14):

$$A_s = \frac{\partial y_t + 1}{\partial V}$$

where: A_s the matrix represents the model's response to a shock of one standard deviation in time *t* in each of the model variables. The VAR model characterises the dynamic relationships between a set of variables chosen to describe a special economic phenomenon, and the analysis of shocks and response functions allows for studying the impact of a specific shock on system variables (23). It follows the time path of the various sudden shocks to which the different variables included in the model are exposed and reflects how each of these variables responds to any sudden shock in any variable in the model over time, and the impact of the shock in the random variable can be predicted on the variable for a certain time (14).

RESULTS AND DISCUSSION

Unit root test results

In order to investigate the stationary of the variables, the Phillips-Peron unit root test (PP) was conducted to, as the results shows in Table 1, and they represent the variables (agricultural product AP, agricultural GBTT, food price FP and oil price OILP), and the results indicate that the time series for all study variables were not stationary in the levels *I(0)*, as the Phillips-Perron (PP) test indicated that the test values calculated for each variable in absolute value are less than the *t* table values in their absolute value, at a statistical significance level of 5% or 10%, and therefore the null hypothesis is accepted, which states that the variables are not stationary at the level *I(0)*, but when the first difference of these variables is taken, all the variables have become stationary, as the (PP) values calculated in the absolute value of all the variables were greater than the *t* table values at the level of significance 5% or 10%, i.e. it is an integral of degree *I(1)*.

Table 1. PP unit root test for the variables

		At Level I(0)				At first difference I(1)			
		AP	GBTT	FP	OILP	d(AP)	d(GBTT)	d(FP)	d(OILP)
With Constant	t-Statistic	-2.5040	-2.9249	-1.3859	-1.3891	-6.0780	-5.6288	-4.9592	-4.6412
	Prob.	0.1249	0.0547	0.5752	0.5737	0.0000	0.0001	0.0004	0.0010
		No	No	No	No	***	***	***	***
With Constant & Trend	t-Statistic	-2.2485	-3.1208	-1.9300	-1.8530	-12.8988	-5.4093	-4.8678	-4.5499
	Prob.	0.4469	0.1204	0.6133	0.6525	0.0000	0.0008	0.0028	0.0059
		No	No	No	No	***	***	***	***
Without Constant & Trend	t-Statistic	-0.3654	-1.4273	0.1568	-0.3320	-6.2441	-5.1666	-5.0037	-4.6864
	Prob.	0.5441	0.1400	0.7242	0.5569	0.0000	0.0000	0.0000	0.0000
		No	No	No	No	***	***	***	***

Notes: (***) Significant at the 1%. and (No) Not Significant

Source: Eviews 12 program output.

VAR model

To achieve the objectives of the research and to form an overall scene of the type of shocks that the agricultural economy has been exposed to in Iraq, in addition to their sources and importance, the model will be as follows:

$$GBTT_t = a_1 + \sum_{k=1}^{m} \beta_{11} GBTT_{t-k} + \sum_{k=1}^{m} \beta_{12} AP_{t-k} + \sum_{k=1}^{m} \beta_{13} FP_{t-k} + \sum_{k=1}^{m} \beta_{14} OILP_{t-k} + \varepsilon_{t1}$$

$$AP_t = a_2 + \sum_{k=1}^{m} \beta_{21} GBTT_{t-k} + \sum_{k=1}^{m} \beta_{22} AP_{t-k} + \sum_{k=1}^{m} \beta_{23} FP_{t-k} + \sum_{k=1}^{m} \beta_{24} OILP_{t-k} + \varepsilon_{t2}$$

$$FP_t = a_3 + \sum_{k=1}^{m} \beta_{31} GBTT_{t-k} + \sum_{k=1}^{m} \beta_{32} AP_{t-k} + \sum_{k=1}^{m} \beta_{33} FP_{t-k} + \sum_{k=1}^{m} \beta_{34} OILP_{t-k} + \varepsilon_{t3}$$

$$OILP_t = a_4 + \sum_{k=1}^{m} \beta_{41} GBTT_{t-k} + \sum_{k=1}^{m} \beta_{42} AP_{t-k} + \sum_{k=1}^{m} \beta_{43} FP_{t-k} + \sum_{k=1}^{m} \beta_{44} OILP_{t-k} + \varepsilon_{t4}$$

Estimation of VAR model

Before estimating the model, a test was conducted to determine the optimal lagged period according to the criteria (AIC, SC and HQ), and the result was that the lowest value of the SC criterion at one lagged period, while the lowest result of each of the criteria AIC and HQ at four slowing periods, as in Table 2. The researchers took the SC criteria because it is suitable for small samples and the estimated VAR model results shown in Table 3.

Table 2. VAR Lag Order Selection Criteria

Endogenous variables: GBTT AP FP OILP
Exogenous variables: C
Sample: 1990 2019
Included observations: 26

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-564.5635	NA	1.16e+14	43.73565	43.92920	43.79139
1	-526.3914	61.66263*	2.15e+13	42.03010	42.99787*	42.30879
2	-513.3725	17.02460	2.99e+13	42.25943	44.00141	42.76105
3	-492.3379	21.03464	2.67e+13*	41.87215*	44.38834	42.59672*

Source: Eviews 12 program output.

Table 3. The estimated VAR model

Vector Autoregression Estimates
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	AP	EX	INV	GBTT
AP(-1)	0.432368	0.002515	61.09404	0.005529
	(0.19780)	(0.08428)	(107.496)	(0.01201)
	[2.18587]	[0.02984]	[0.56834]	[0.46030]
EX(-1)	0.359649	0.772454	-37.78762	0.019226
	(0.29146)	(0.12418)	(158.395)	(0.01770)
	[1.23395]	[6.22032]	[-0.23857]	[1.08632]
INV(-1)	0.000112	-5.05E-05	0.873952	-4.04E-07
	(0.00017)	(7.3E-05)	(0.09279)	(1.0E-05)
	[0.65403]	[-0.69445]	[9.41865]	[-0.03894]
GBTT(-1)	-2.307435	-0.718394	417.7211	0.376692
	(3.13293)	(1.33484)	(1702.60)	(0.19024)
	[-0.73651]	[-0.53819]	[0.24534]	[1.98011]
C	2147.816	387.6189	-155419.7	-0.386147
	(765.582)	(326.191)	(416058.)	(46.4877)
	[2.80547]	[1.18832]	[-0.37355]	[-0.00831]
R-squared	0.382880	0.700309	0.801011	0.236073
Adj. R-squared	0.280026	0.650360	0.767847	0.108752
Sum sq. resids	13981737	2538178.	4.13E+12	51552.89
S.E. equation	763.2643	325.2037	414798.2	46.34692
F-statistic	3.722578	14.02061	24.15248	1.854158
Log likelihood	-230.8957	-206.1543	-413.5361	-149.6537
Akaike AIC	16.26867	14.56237	28.86456	10.66577
Schwarz SC	16.50441	14.79811	29.10030	10.90151
Mean dependent	4389.507	1229.557	717000.6	73.64098
S.D. dependent	899.5320	549.9777	860893.4	49.09324
Determinant resid covariance (dof adj.)		1.98E+25		
Determinant resid covariance		9.27E+24		
Log likelihood		-998.1846		
Akaike information criterion		70.21963		
Schwarz criterion		71.16259		
Number of coefficients		20		

Source: Eviews 12 program output.

Test of Validity of VAR model

Roots of characteristic polynomial test

Table 3 shows that the model does not include roots with a value of one and that all roots are located in the *unit* circle as in Figure 5.

Table 3. Roots of characteristic polynomial test

Roots of Characteristic Polynomial
Endogenous variables: GBTT AP FP OILP
Exogenous variables: C
Lag specification: 1 1

Root	Modulus
0.856857	0.856857
0.789738	0.789738
0.441418 - 0.103674i	0.453429
0.441418 + 0.103674i	0.453429

No root lies outside the unit circle.
VAR satisfies the stability condition.

Source: Eviews 12 program output.

Thus, the model fulfilled the condition of stability, and the test of the normal distribution proved that the parameter of Jarque-Bera was not significant and reached 0.72, accordingly, we accept the null hypothesis which states that the residuals are distributed normally.

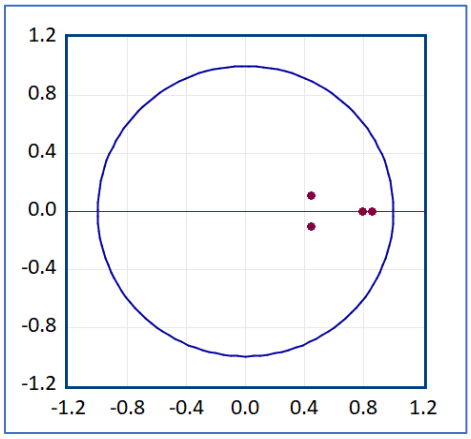

Figure 5. Roots of characteristic polynomial.

Source: Eviews 12 program output.

Autocorrelation LM Test

The test results show that there is no serial correlation problem for three levels of lags, as the significance statistic shows that the model does not contain the problem and it reached (0.48, 0.20 and 0.28) for the first, second and third lags respectively, and this means accepting the null hypothesis that states "There is no serial correlation", as shown in Table 4.

Table 4. Autocorrelation test

VAR Residual Serial Correlation LM Tests
Sample: 1990 2019
Included observations: 29
Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	15.59967	16	0.4812	0.983582	(16, 52.6)	0.4874
2	39.33257	32	0.1745	1.299469	(32, 49.5)	0.2001
3	56.21117	48	0.1944	1.195806	(48, 36.7)	0.2888

*Edgeworth expansion corrected likelihood ratio statistic.

Source: Eviews 12 program output.

VAR Residual Heteroskedasticity Test

The results of the test showed that the probability of the existence of the problem of Heteroskedasticity according to White's test (Levels and Squares) was 0.68, as in Table 5, which is not significant, therefore we accept the null hypothesis based on the absence of the problem.

Table 5. Heteroskedasticity Tests

Sample: 1990 2019
Included observations: 29
Joint test:

Chi-sq	df	Prob.
73.54842	80	0.6813

Source: Eviews 12 program output.

After we ensure that the VAR model was free of second-degree problems, as well as that the model fulfilled the condition of stability by testing the roots, it became possible to perform the analyses of Variance Decomposition and Impulse Response Function - IRF.

Variance Decomposition

In this context, the researchers analyse the variance decomposition of the variables that can be analysed, which is, that the economic theory allows their analysis. The researchers believe that it is unrealistic from the perspective of economic theory; (as external variables), to analyse global food prices (FP) and study the impact of local variables on it, given that Iraq is a price-taker country and not a price maker. The same thing of the oil prices. However, it is important to study the effect of these external variables on the internal variables represented by GBTT and INV, as follows:

Variance decomposition of GBTT

For this model, it appears that the variance in the variable depends entirely on its own in the first year, as in Table 6, which means a hundred percent of forecasting error variance in GBTT is explained by the variable itself. In the second year, it decreases to 96% to show the AP variable at a rate of 2.6%. It stabilizes at the level of 88% starting from the seventh year until the end of the long term (10 years), then the percentage of the AP variable becomes approximately 8% and the OILP variable at 4% approximately. The FP variable had little effect in explaining the variance of the GBTT variable. The standard error - S.E. column is the forecast standard error of the variable for each forecast horizon which was 47.13 in the first year and raised to 53.3 in the tenth year for the estimated model.

Table 6. Variance decomposition of GBTT

Period	S.E.	GBTT	AP	FP	OILP
1	47.131	100.00	0.000	0.000	0.000
2	50.723	96.723	2.664	0.004	0.607
3	51.859	93.339	5.145	0.011	1.503
4	52.488	91.133	6.556	0.018	2.291
5	52.859	89.863	7.246	0.023	2.866
6	53.075	89.144	7.576	0.027	3.252
7	53.201	88.729	7.738	0.029	3.502
8	53.275	88.485	7.823	0.031	3.660
9	53.320	88.338	7.869	0.032	3.760
10	53.347	88.248	7.896	0.033	3.823

Source: Eviews 12 program output

Variance decomposition of AP

The variance decomposition analysis of the AP variable shows that a percentage of 97% of the variance was caused by the same variable in the first year, as in Table 7, and the rest belongs to the GBTT variable, and this percentage began to decrease in the same variable in the second year to reach 93.7%, but at the end of the period, the variance in AP variable that belongs to the same variable gradually decreased to 90.6% in the tenth year, while the relative importance of fluctuations in AP variable due to the GBTT variable increased slightly to reach 7.8% at the tenth year. And the relative importance of it, dependent on the GBTT variable, stabilized at 7% from the third year to the tenth year. While the role of the food price FP and the prices of oil did not have an important role worth to mention it in this analysis. The S.E. was high in all forecasted years.

Table 7. Variance decomposition of AP

Period	S.E.	GBTT	AP	FP	OILP
1	787.056	3.014	96.985	0.000	0.000
2	917.322	5.918	93.729	0.004	0.348
3	957.145	7.237	92.015	0.009	0.738
4	969.857	7.691	91.257	0.013	1.037
5	974.195	7.815	90.930	0.016	1.238
6	975.876	7.840	90.777	0.018	1.364
7	976.642	7.840	90.697	0.019	1.442
8	977.042	7.837	90.652	0.021	1.490
9	977.273	7.834	90.624	0.021	1.520
10	977.412	7.832	90.607	0.022	1.539

Source: Eviews 12 program output.

Impulse Response Function Analyses

With the same previous principle, the impulse (or shock) will be analysed for the variables that are susceptible in the local economy, whether the source of the shock is internal or external, so the researchers analyse the impact of the shock on the variables of (GBTT) and agricultural product (AP) in Iraq.

Impulse response of GBTT

In this model, we noted it is reaching the maximum in the first year, but the situation has returned to its normal level since the fourth year through the absolute values of the response. As for the response of GBTT to a shock of one standard deviation in the AP variable, we see that it was zero in the first year and reached 8% in the second, as in Table 8, and gradually decreased to reach 1.7% in the eighth and 1 in the tenth, which is a weak response due to the nature of the relationship between the two variables, which is symmetric here. As for its response to the shock in the FP variable, it is almost non-existent with symmetry and positive values close to zero in all years, and the reason may be that Iraq is a small country in the field of agricultural foreign trade and food commodities, and thus it is a price taker, as for its response to the oil prices shock OILP is not better than the FP variable. The response is weak, reaching a maximum of 5% approximately in the third year, then gradually decreasing until reaches 1.3% in the tenth year, and the reason may be attributed to the same reason in the case of the FP variable. Figure 5 illustrates this.

Table 8. Impulse response of GBTT

Period	GBTT	AP	FP	OILP
1	47.13174	0.000000	0.000000	0.000000
2	16.34525	8.280508	0.347812	3.952703
3	4.659109	8.355250	0.448591	4.980111
4	0.688608	6.500281	0.438275	4.764372
5	-0.400750	4.674553	0.386226	4.117303
6	-0.535622	3.307553	0.324604	3.396219
7	-0.422389	2.368109	0.266644	2.738956
8	-0.288093	1.734408	0.216706	2.185272
9	-0.187584	1.300581	0.175348	1.735243
10	-0.122320	0.994467	0.141717	1.375468
Cholesky Ordering: GBTT AP FP OILP				

Source: Eviews 12 program output.

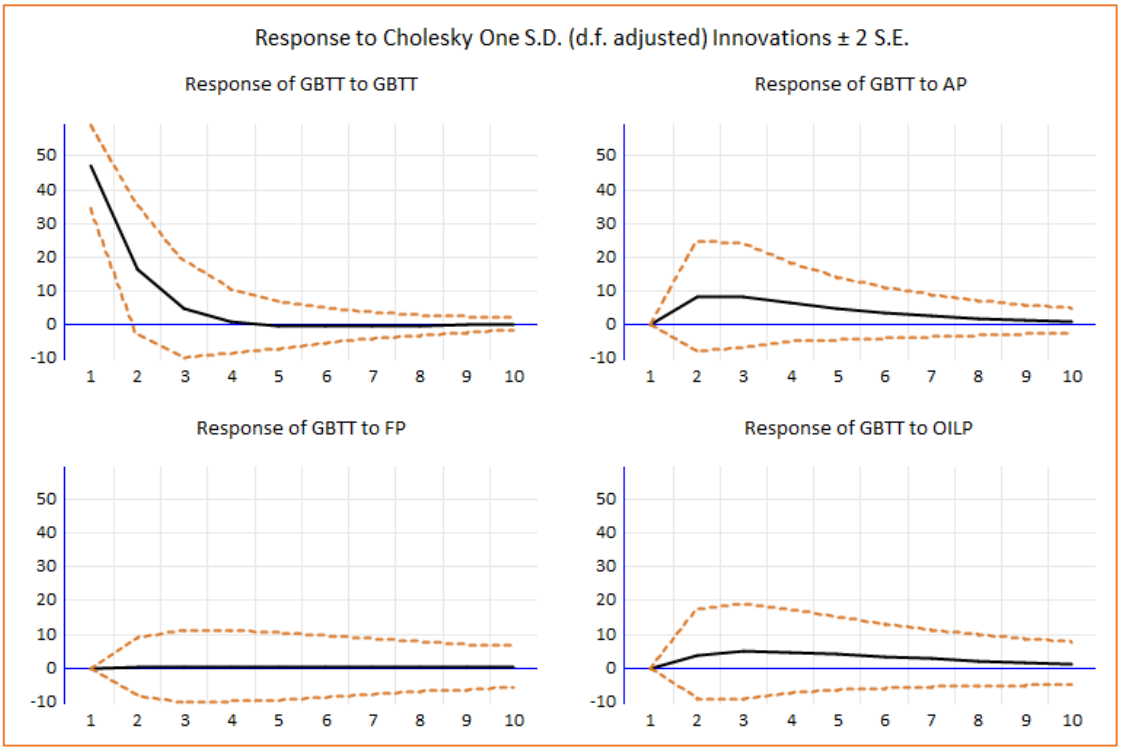

Figure 5. Impulse response analysis for 10-years of GBTT variable.

Source: Eviews 12 program output.

Impulse response of AP variable

The results of the analysis shown in Table 9 show the response of the AP variable to a shock of one standard deviation in the food price variable FP, in which it is found that the response was zero in the first year and started to rise in the second and third years then decline gradually in the fifth. In general, the response is very weak according to the nature of the relationship between the two variables compared to the response to the oil prices shock, as the latter came to zero in the first year and started strong and positive in the second year and rose in the third year at the maximum, then decline gradually, because Iraq depends on oil prices in directing the volume of investment spending for economic sectors, including the agricultural sector. Thus, it can contribute to an increase in agricultural output, yet it is a similar positive shock and a permanent response, as shown in Figure 6.

Table 9. impulse response of AP

Period	GBTT	AP	FP	OILP
1	-136.6533	775.1024	0.000000	0.000000
2	-176.4444	433.5072	5.848963	54.11265
3	-128.4496	232.9532	6.969304	61.90025
4	-77.74010	124.1438	6.430741	54.77031
5	-42.71473	67.74433	5.460381	44.58743
6	-22.11958	39.07827	4.498820	35.24611
7	-11.05958	24.37925	3.673406	27.64801
8	-5.466845	16.51347	2.998476	21.71146
9	-2.753173	11.97071	2.454460	17.11803
10	-1.467348	9.085034	2.016255	13.55503
Cholesky Ordering: GBTT AP FP OILP				

Source: Eviews 12 program output.

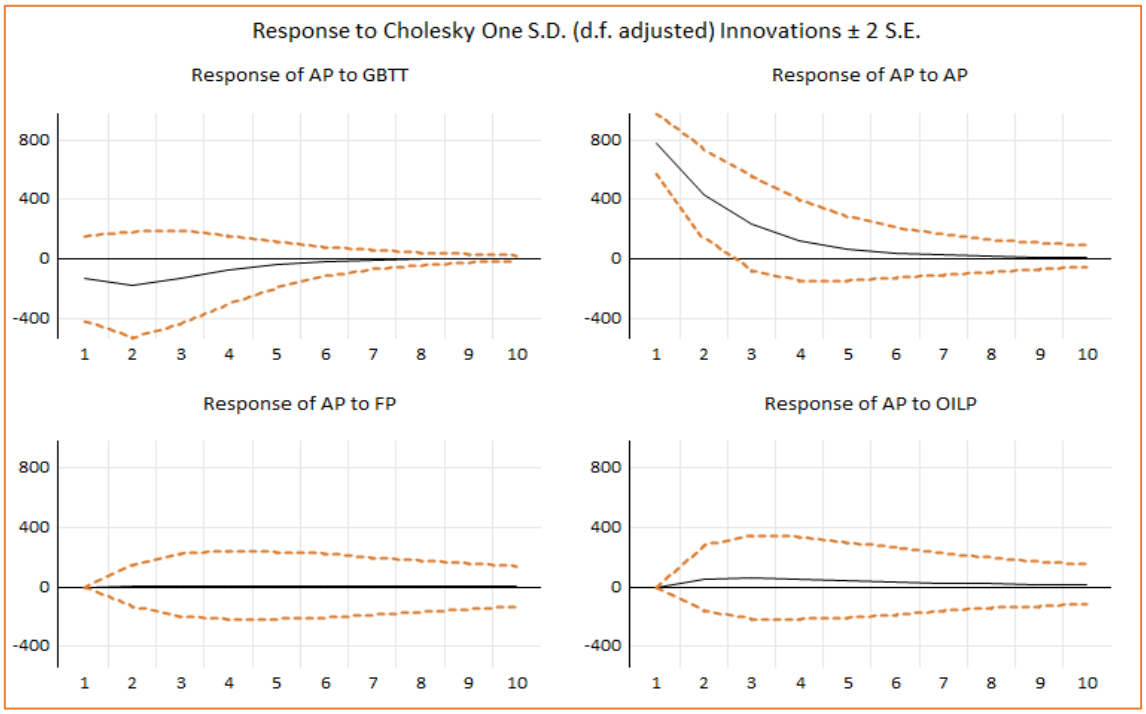

Figure 6. Impulse response analysis for 10-years of AP variable.

Source: Eviews 12 program output.

In light of data of the agricultural GBTT for Iraq, it is clear that it was in a state of deterioration from 1991 to 2001, then these rates improved for three consecutive years from 2002 until 2004, then return to the decline below the level of 100 in the remaining period except for some years. This is due to the semi-monogamy of exports, mainly dates, a few amounts of leathers and wools (4), and the multiplicity of imports of the rest of the agricultural, food, consumption and even investment commodities. The global food price variable also did not affect the overall agricultural TOT by analysing the variance decomposition, because the GBTT variable is calculated on the exported quantities of food and Iraq's agricultural exports depend on dates, leather and wool in quantities that are not primarily large, and thus it was not affected by food prices In addition, the index was not in the country's interest, in any case, for most of the study period, and the same applies to oil prices. As for the shock analysis of the GBTT variable, it was shown that the impact of the food price shock FP had almost no effect, and it is a result that is somewhat similar to the result of the analysis of the variance decomposition between the two variables. A positive shock in oil prices, has a positive impact on agricultural output, meaning employing this increase in the interest of the agricultural sector by increasing investment in productive projects, or it may be by increasing government spending by

increasing allocations to the agricultural sector. Therefore, the research recommends adopting the criterion of terms of trade as one of the criteria for drawing economic development plans in Iraq, and one of its main indicators to link the import capacity with the export capacity, and because ignoring this criterion is a clear deficiency in the plans for the development of the agricultural sector in Iraq.

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