# THE ECONOMIC RELATIONSHIP BETWEEN EXCHANGE RATE AND MONEY SUPPLY AND THEIR IMPACT ON AGRICULTURAL PRODUCTS IN IRAQ

**R. T. Al-Wasity**
**Assist. Prof.**
**Dept. Agric. Economics,**
**Coll. of Agric. Engin. Sci. University of Baghdad**
**raja.t@coagri.uobaghdad.edu.iq**

**Hala A. Al-Attabi**
**Researcher**
**Dept. of Plant Protection**
**Ministry of Agriculture**
**halaghaniss@gmail.com**

## ABSTRACT

**This research aimed to measure and analyze the impact of exchange rate shocks on some variables of the Iraqi economy during (1990-2022), because of the different effects of these shocks on the macroeconomic variables represented in money supply and agricultural output. Exchange rates are related to the policy chosen by the Central Bank of Iraq in managing the foreign exchange market and in the rentier nature of the Iraqi economy. The research uses a quantitative method in estimating the levels of the impact of exchange rate shocks on some economic variables. Several methods are conducted to achieve the goals, including the VAR model, variance decomposition and Impulse Response Functions. The results showed that exchange rate variance reached 100% in the same variable in the first year and decrease to 97% at the end of the period, and the same in the impulse response. It was an internal reaction that predicts what can be called the self-wave of an exchange rate rise, while both the variation and the response to the money supply shock in Iraq were dependent on the policy of the Central Bank and compatible with what was happening in the exchange rate, as the analysis of variance in the first year reached 38.98% for the same variable and 61% of it is due to the exchange rate. The results also showed that agricultural output was weakly affected by the exchange rate shock and money supply.**

**Keywords: Vector-Autoregression, impulse response function, variance decomposition.**



# تحليل اقتصادي للعلاقة بين سعر الصرف وعرض النقود وأثرهما في الناتج الزراعي في العراق

**رجاء طعمة الواسطي**
**أستاذ مساعد**
**قسم الاقتصاد الزراعى – كلية علوم الهندسة الزراعية– جامعة بغداد**

**هالة عبد الغني العتابي**
**باحثة**
**وزارة الزراعة**

## المستخلص

**هدف البحث الى قياس وتحليل أثر صدمات سعر الصرف على بعض متغيرات الاقتصاد العراقي خلال الفترة (1990–2022)، لما لاختلاف اثار هذه الصدمات في متغيرات الاقتصاد الكلي المتمثلة في عرض النقود والناتج الزراعي. ترتبط أسعار الصرف بالسياسة التي يختارها البنك المركزي العراقي في إدارة سوق الصرف الأجنبي، وبالطبيعة الريعية للاقتصاد العراقي. استخدم البحث المنهج الكمي في تقدير مستويات تأثير صدمات سعر الصرف في بعض المتغيرات الاقتصادية. تم إجراء عدة طرق لتحقيق الأهداف، بما في ذلك نموذج VAR وتحلل التباين وتحليل استجابة النبضة. أظهرت النتائج أن تباين سعر الصرف بلغ 100% في نفس المتغير في السنة الأولى وانخفض إلى 97% في نهاية المدة، ونفس الاستجابة بالنسبة للصدمة. ويمكن ارجاع ذلك الى رد فعل داخلي يمكن تسميته بالموجة الذاتية لارتفاع سعر الصرف، في حين أن كلا من التباين والاستجابة لصدمة عرض النقود في العراق كانا خاضعين لسياسة البنك المركزي ومتوافقة مع ما كان يحدث في سعر الصرف، حيث بلغ تحليل التباين في السنة الأولى 38.98% لنفس المتغير و61% منه يعود إلى سعر الصرف، كما أظهرت النتائج ضعف تأثر الناتج الزراعي بصدمة سعر الصرف وعرض النقود.**

**كلمات مفتاحية: متجه الانحدار الذاتي، تحليل استجابة النبضة، تحليل تجزئة التباين.**

**Received:13/5/2023, Accepted:9/8/2023**

## INTRODUCTION

The exchange rate has an essential role in daily economic life. Through it, the exchange process takes place between the country concerned with the outside world. Thus, it became a tool for linking the economies of the countries of the world (20), the price expresses the quality of economic performance. The exchange rate is very sensitive to the internal and external influences that occur to the country, and thus its exchange rate is subject to decline according to the degree of its vulnerability to these conditions in which the country is experiencing. Since the operations carried out by the country from as import and export with the outside world, which is restricted under the trade balance and that the value of the currency of this country affects the volume of exchange operations, this means that the change in the exchange rate of currency has an impact on the position of the balance of traders, as well as its impact on imported inflation (6). A balance of payments surplus in an open economy result in the accumulation of exchange reserves, which in turn affects money supply. On the other hand, economic theory explains the relationship between the money supply and the exchange rate through the purchasing power parity theory, which stipulates that an increase in the money supply leads to a rise in the general level of prices, and thus a decrease in the exchange rate of this country's currency (21). The study aims to identify historical fluctuations of the exchange rate in Iraq and its long-term impact on some variables and study whether be influenced by both the presentation of money and Agricultural products changes in the exchange rate of the Iraqi dinar and what is the nature of this influence and is it positive or negative? And the time dimension of this shock on the variables in Iraq.

## MATERIALS AND METHODS

The foreign exchange rate is the rate at which a currency is exchanged for another (23), and it plays a prominent role in the competitiveness of the economy and thus in the balance of payments, inflation and real growth. According to the purchasing power parity theory, the real exchange rate is defined by the following relationship (11):

$$\boldsymbol{R_E = E(P^*/P)}$$

Referring $R_E$ to the real exchange rate, $E$ nominal exchange rate, $P^*$ the general level of prices in foreign countries and $P$ the general level of prices in the domestic economy. The real exchange rate reflects the competitiveness of the economy, as it measures the prices of foreign goods compared to the local, and the rise in the real exchange rate means a decrease in the value of the local currency compared to the foreign currency and vice versa (16). The change in real exchange rates is due to one of the changes in the elements of the above equation, it may be due to the change in the nominal exchange rate $E$ or the change in the ratio $P^*/P$, or both. Changes in the money mass can affect both interest rates and the general level of prices, and thus the nominal and real exchange rate, as the interest parity condition between them is as follows (1):

$$\boldsymbol{E_t = \frac{1 + i_t^*}{1 + i_t} E_{t+1}^e}$$

According to above equation, a higher local interest rate $i$ compared to the foreign interest rate $i^*$ leads to capital inflows (assuming free movement of capital) which leads to an improvement in the value of the local currency, and vice versa. In the sense that there is a direct relationship between the amount of money and the nominal and real exchange rate according to the condition of interest rate parity assuming the stability of relative prices, increasing the amount of money leads to raising the nominal and real exchange rate and thus a decrease in the external value of the local currency. On the other hand, one of the hypotheses of the quantity theory of money is that prices move in an equal proportion to the relative growth of the amount of money circulating in the economy. This means that when the amount of money increases by 10% in an economy, the general level of prices increases in the same proportion, assuming that the economy is functioning effectively and that there is a balance between supply and demand, according to the following relationship (13): $M = KYP$, where M is the amount of money, $K$ is the ratio of cash balance to income (reciprocal of money turnover), $Y$ is the real product. The last equation can be written as follows: assuming that both $Y$ and $K$ are constant, the increase in $P = \frac{M}{K*Y}$ money leads

to an increase in the general level of prices (with the stability of other factors). Inflation also increases the money supply through the expansion of credit, the easing of lending conditions and the stability of the general level of prices. On the other hand, changes in the exchange rate can be accompanied by changes in the money supply according to the objectives of the Central Bank and according to the rule (John Taylor) to balance the potential output, that the real appreciation in the value of the currency must be followed by an expansionary monetary policy, i.e., an increase in the money supply to cancel the deflationary effect on the local economy (26). The rule is to determine the interest rate based on the difference between the target inflation rate and the actual inflation rate, while at the same time taking into account the difference in the actual growth rate of the potential output (18).

**Variance Decomposition Analysis**

It is an analysis that measures the relative importance of the variable in explaining the variance of the prediction errors of the variables in the model under study, in other words, the components of the analysis of the fractionation of variance and the analysis of the impulse response functions can be obtained by the following model (7):

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

Since *Mi*: represents the matrix of the model coefficients *(n×n), V:* represents the structural shock vector or random error limit vector (*n×1*). The analysis of the components of variance reflects the importance of the random variable in the model, as the test shows the effect of the independent variables on the dependent variable and the size of the change in the variable in the period (*t*) as a result of shock in the variable itself or shock in other variables, and it is one of the methods in describing the dynamic behavior of the model, in which the impact of shocks on the model variables is measured over time by dividing the error variance of each variable into several parts, each part belongs to a variable of the model variables, in other words, variance of error term for a variable attributable to unpredicted shock for each of the model variables (15).

**Impulse response function – IRF**

The impulse response function is useful in studying the interaction between variables in an autoregressive model, these functions represent the reaction of variables to shocks to which the system is exposed. In modern economics, the impulse response function describes the economy's reaction over time to external shocks, and is modelled in the context of Vector autoregressive models – VAR (10). The VAR methodology has introduced a powerful analytical tool, the impulse response function - IRF to track the responses of system variables to system shock impulses. Sims in 2002 have developed many applications around this tool. However, it was not long before it was discovered that VAR shock orthogonality is a required procedure for the shocks followed by the IRF to be unrelated (25). He has examined the three-dimensional indication of VAR as a method of abbreviated shock orthogonality called Cholesky Decomposition or Wald Causality (22). The impact of shock in a random variable (*Y*) and for a certain period of time (*S*) can be predicted by the following equation (14):

$$\boldsymbol{A_S = \frac{\partial Y_{t+1}}{\partial V}}$$

Where: $A_S$: matrix represents the model's response to a shock of one standard deviation in the duration *t* in each of the model variables, $Y_{t+1}$: the number of economic variables, *V*: random error.

**VAR Model**

To estimate the shocks affecting the exchange rate and the rest of the economic indicators, it is necessary to estimate the VAR model first, and among the important variables in this field are variables (exchange rate *EX*, money supply *M1* and agricultural products *AP*) and the model was estimated in the logarithmic formula to eliminate the standard error, to become the VAR model as follows:

$$lEX_t = a_1 + \sum_{k=1}^{m} \beta_{11} lEX_{t-k} + \sum_{k=1}^{m} \beta_{12}\, lM1_{t-k} + \sum_{k=1}^{m} \beta_{13}\, lAP_{t-k} + \varepsilon_{t1} = lM1_t = a_2 + \sum_{k=1}^{m} \beta_{21} lEX_{t-k} + \sum_{k=1}^{m} \beta_{22}\, lM1_{t-k} + \sum_{k=1}^{m} \beta_{23}\, lAP_{t-k} + \varepsilon_{t2}$$

$$lAP_t = a_3 + \sum_{k=1}^{m} \beta_{31} lEX_{t-k} + \sum_{k=1}^{m} \beta_{32}\, lM1_{t-k} + \sum_{k=1}^{m} \beta_{33}\, lAP_{t-k} + \varepsilon_{t3}$$

Whereas: *AP:* agricultural output, *EX:* exchange rate, money supply *M1*, *ε:* random error and m: optimal slowdown period.

**1-Exchange rate in Iraq**

The escalating price trends during the economic sanctions phase on Iraq produced serious repercussions on the purchasing power of the national currency, and the imbalance between the forces entrusted with supply and demand for the national currency and the foreign currency led to instability in the exchange rate of the Iraqi dinar against the US dollar, and there was a significant and serious deterioration of this price in the parallel market, and the consumer price index recorded high levels, This indicates that the economy is exposed to the most dangerous type of inflation, which is hyper-inflation (5), to show the disparity between the official exchange rate and the unofficial exchange rate, and exceptional foreign trade with specific countries showed the emergence of a third exchange rate in addition to the official and parallel rate. The Iraqi market is suffering from severe dumping in agricultural products (4), beside currency witnessed serious vibrations in its real value and a sharp deterioration in its exchange rates against other currencies, due to the deterioration of economic conditions, the accompanying pessimistic expectations that prompted individuals to keep the dollar, whether in daily transactions or in the treasury value. Which increased the demand for the dollar and then its price rose at very high rates, as it rose from 4 dinars to the dollar in 1990 to 1674 dinars in 1995 as shown in Figure 1. The lifting of the partial ban on oil exports in 1996 caused a wave of optimistic price expectations that reflected positively on the exchange rate, but the exchange rate quickly deteriorated again from 1997 until the end of 2000 due to the absence of liquidation of the increases in the money supply originally caused by the expansionary policy agreement, while it witnessed a relative improvement in 2002 after the significant improvement in the balance of payments as a result of the increase in the value of exports. Worked the monetary policy represented by the Central Bank after 2003 and through the mechanism of daily auctions for the sale and purchase of foreign currency (the US dollar) to unify the exchange rates of the Iraqi dinar, by meeting the market's need for foreign currency and the needs of the private sector to finance all its imports within balanced exchange rates. The exchange rate of the Iraqi dinar has witnessed a significant improvement towards the US dollar during the period 2004-2014, and the issuance of the Central Bank of Iraq Law No. 56 of 2004 granted the Central Bank of Iraq (the monetary authority) full independence with its endeavors to achieve its goals in the new stage, which was to confront inflation, control cash liquidity levels, maintain the stability of the exchange rate and contribute to achieving high rates of economic growth, to return in 2021 to 1472 dinars.

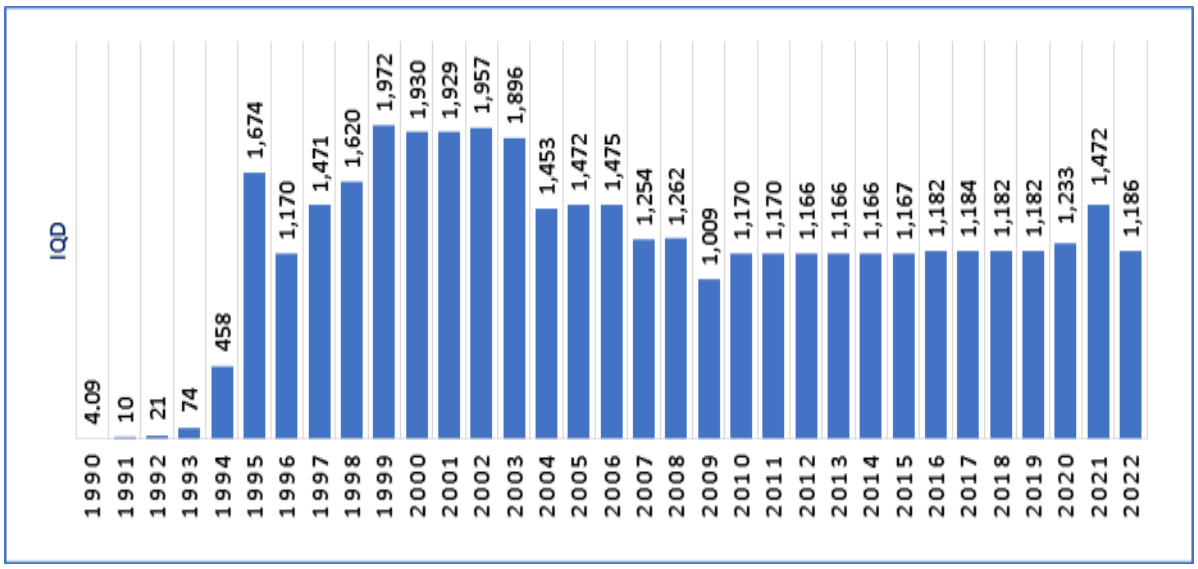


**Figure 1. Exchange rate in Iraq from 1990 to 2022**

**Resource: Prepared by Authors based on data from the Central Bank of Iraq.**

The depth of the impact of the Iraqi fiscal policy on macroeconomic variables, and its ability to move these variables in the desired direction in the light of continuous procedures for fiscal policy, but the expansionary trend taken by this policy during the study period has left several negative effects that weighed on the national economy.

**2-Money supply in Iraq**

The rentier specificity of the Iraqi economy made the money supply, which is part of the monetary policy, become one of the variables of the fiscal policy due to the dependence of public spending on oil revenues and a large percentage exceeding 95%, as oil revenues (in dollars) are converted into local currency through the exchange rate of the dinar determined by the Central Bank, and during the period 1990-2003 the rates of increase in the money supply doubled significantly, due to the continuous expansion of the practice of (Cheap Money policy). by linking the expansion of the supply of money on the one hand and the expansion of public spending on the other (8). The annual growth rate of the money supply during the period of approximately 4.8% was used in this aspect of the money supply in its narrow sense "Narrow Money Supply" and this volume of money is called cash of current operations "Transaction Money" and is called in the economy money supply *M1*. It is the sum of the currency held by the public and deposits of transactions in depository institutions and includes financial institutions whose funds are obtained mainly through deposits from the public, such as commercial banks, loans, savings banks and credit unions (12). Hence the money supply equation M1 is (24):

$$\boldsymbol{M1 = CR + DD + OD}$$

Where: *CR*: Current in Circulation: among the public or individuals outside banks, consisting of cash in circulation, cash reserves held in banks and trading notes. *DD*: Demand Deposits: Individuals' financial deposits within commercial bank accounts.

*OD*: Other Deposits: Financial deposits held as reserves in banks The money supply increased in 2004 as a result of trade openness, increased oil exports, as well as the restoration of confidence in the Iraqi dinar as a result of the replacement of the old currency with the new internationally defined dinar, the increase in the salaries of employees, social protection networks and loans provided by banks such as housing loans and loans for the unemployed. The issuance of the Central Bank of Iraq Law No. 56 of 2004 granted the Central Bank of Iraq (Monetary Authority) full independence in its endeavors to achieve its objectives in the new phase. In the years 2010-2014, which preceded the oil price crisis, government spending was increasing annually because of the rise in oil revenues. The money supply increased by 50% in 2021 compared to 2013 because of the increase in the process of restricting oil revenues conducted by the Ministry of Finance, and the money supply reached its maximum in 2022 and amounted to $109 billion, as shown in Figure 2.

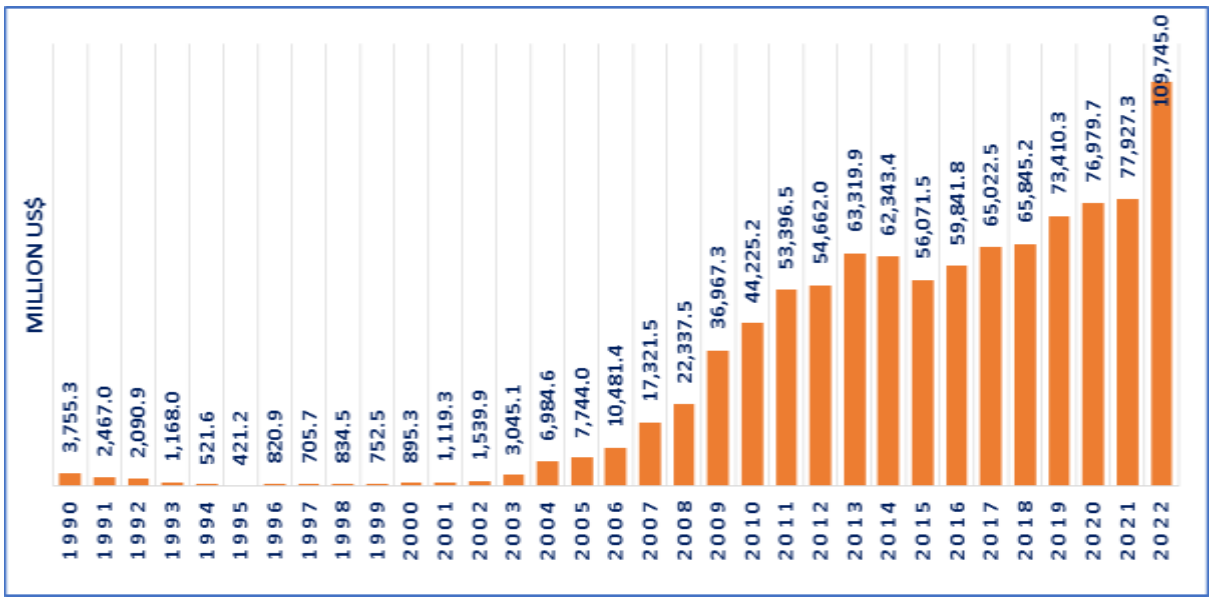


**Figure 2. The evolution of the money supply M1 in Iraq**

**Resource: By authors using Central Bank's data**

## 3. Agricultural product

The agricultural sector is one of the pioneering sectors for economic development, so it requires the necessity of advancing agricultural development through achieving maximum efficiency for the use of available agricultural resources (9). It can be one of the sources of diversification of national income, but the decline and weakness of production capacities has affected the growth rate of most crops and animal products, which is an obstacle to this (2). However, agricultural product varied clearly during the period studied, and the first and lowest decline was in 1991 as a result of the beginning of the imposition of economic sanctions, as it reached $ 3598 million in 1991 after it was $ 4849.1 million in 1990 and a negative annual change rate of 25.8%, after which Agricultural products gradually improved due to the state's orientation at the time towards supporting the agricultural sector to provide food needs, due to the scarcity in food imports as a result of economic sanctions, but not stable until the acute shock associated with the events of 2003, as Agricultural products fell from $ 5968.7 in 2002 to $ 4743.1 million in 2003, and 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 years 2006, 2007 and 2009 amounted to 20 billion cubic meters, as for the Tigris River, it witnessed a decrease of more than 50% in the rate of water import flow from 43 billion $m^3$ in the average of the same years to 20.03 billion $m^3$ in 2008 (19), in addition of the fluctuation of rains, and the various environmental, political and demographic changes (3). Thus, the value of Agricultural products fell sharply in that year. After that, agricultural production recovered from 2010 to reach its peak in 2014 with an agricultural product of $ 6 billion to solve the new crisis experienced by agricultural production. As a result of the difficult security conditions that the country went through in 2014, as a result of which the Agricultural products decreased to $3074 million in 2015 and $3156.4 million in 2017. Then the gradual improvement returned to reach about $ 6505.6 million in 2022.

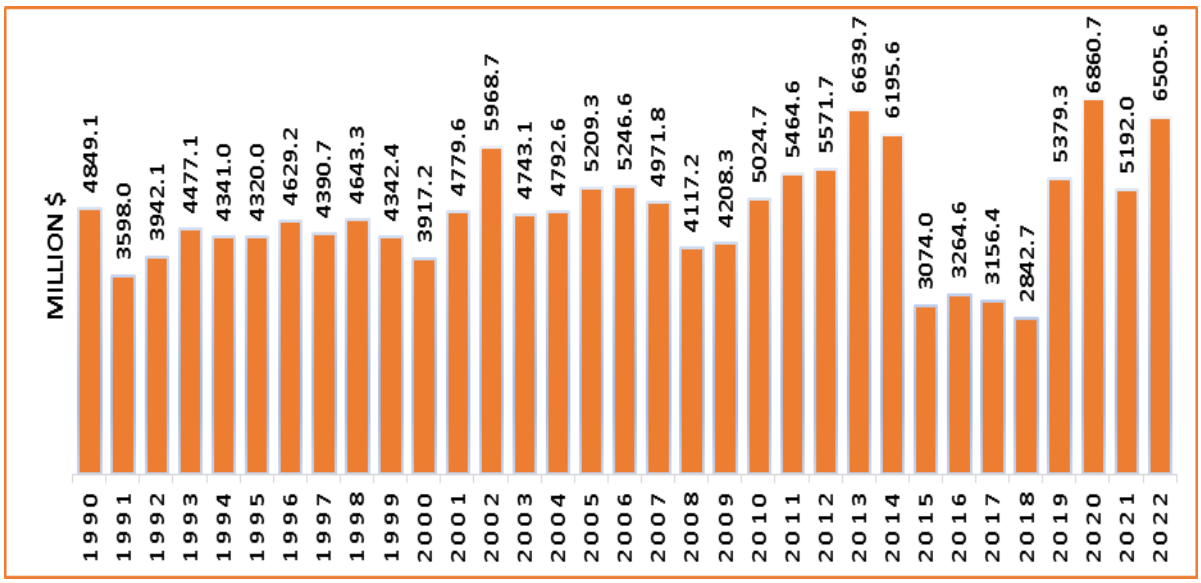


**Figure 3. Agricultural products in Iraq.**

**Resource: Researcher preparation in light of FAO online data**

## RESULTS AND DISCUSSION

**Unit root tests:** To investigate the stationary of the study variables, the Phelps-Peron (PP) stationary test was used as an indicator. The results in Table 1 specify that the time series of all studied variables were not stationary in their levels *I(0)*, as the Phillips-Perron test (PP) test indicated that the test values calculated for each variable in absolute value are less than the tabular values in their absolute value, at the level of statistical significance 5% or 10%, and therefore the null hypothesis is accepted, which states that the variables are not stationary at the level, but when applying the first difference of these variables, all variables became stationary, as the values of (PP) calculated in absolute value for all variables is greater than the tabular values at the level of significance 5% or 10%, i.e. they are integrated from the grade *I(1)*.

**Table 1. Unit root test (pp)**

| | | At Level | | |
|---|---|---|---|---|
| | | LEX | LM1_$ | LAP |
| With Constant | t-Statistic | -12.1007 | -0.2598 | -3.1140 |
| | Prob. | 0.0000 | 0.9203 | 0.0355 |
| | | | No | ** |
| With Constant & Trend | t-Statistic | -13.0538 | -2.6774 | -3.1728 |
| | Prob. | 0.0000 | 0.2518 | 0.1078 |
| | | | No | No |
| Without Constant & Trend | t-Statistic | 0.3759 | 1.0658 | 0.1985 |
| | Prob. | 0.7869 | 0.9215 | 0.7374 |
| | | No | No | No |
| | | At First Difference | | |
| | | Dr. LEX | D($LM1_) | d(LAP) |
| With Constant | t-Statistic | -8.3958 | -3.2463 | -5.7644 |
| | Prob. | 0.0000 | 0.0266 | 0.0000 |
| | | | ** | |
| With Constant & Trend | t-Statistic | -6.1588 | -3.2762 | -5.6655 |
| | Prob. | 0.0001 | 0.0890 | 0.0003 |
| | | | * | |
| Without Constant & Trend | t-Statistic | -9.7490 | -3.0612 | -5.8350 |
| | Prob. | 0.0000 | 0.0034 | 0.0000 |

**Notes: (*); Significant at 10%; (**) Significant at 5%; (***) Significant at 1%. and (no) Not Significant**

**Resource: By authors using Eviews 12.**

### Estimation of the VAR model

Before the VAR model estimation process, it is required to conduct the selection of the optimal deceleration period for the model variables, according to the known criteria (AIC, SC and HQ), and based on this origin, the optimal lag period of the model was extracted by one period according to all criteria, as shown in Table 2.

**Table 2. Optimum lag period**

| Endogenous variables: LEX LM1 LAP<br>Exogenous variables: C<br>Sample: 1990 2022<br>Included observations: 31 | | | | | |
|---|---|---|---|---|---|
| **Lag** | **LogL** | **LR** | **FPE** | **SC** | **HQ** |
| **0** | **-13.61151** | **ME** | **0.000586** | **1.210483** | **1.116947** |
| **1** | **76.55898** | **157.0712*** | **3.13E-06*** | **-3.610004*** | **-3.984149*** |
| **2** | **83.87452** | **11.32730** | **3.56E-06** | **-3.085010** | **-3.739765** |

**Resource: By authors using Eviews 12.**

Based on the results obtained from the unit root tests and the selection of the optimal lag period, it is possible to estimate the VAR model, and Table 3 shows the analysis results of the estimated model.

**Table 3. Estimated VAR Model**

| Sample (adjusted): 1991 2022<br>Included observations: 32 after adjustments<br>Standard errors in ( ) & t-statistics in [ ] | | | |
|---|---|---|---|
| | **LEX** | **LM1_$** | **LAP** |
| **LEX (-1)** | **0.689273**<br>**(0.02330)**<br>**[ 29.5838]** | **0.542735**<br>**(0.14046)**<br>**[ 3.86395]** | **0.013314**<br>**(0.01147)**<br>**[ 1.16051]** |
| **LM1_$(-1)** | **-0.009648**<br>**(0.00461)**<br>**[-2.09154]** | **0.987980**<br>**(0.02781)**<br>**[ 35.5251]** | **0.000423**<br>**(0.00227)**<br>**[ 0.18620]** |
| **LAP (-1)** | **0.081799**<br>**(0.34272)**<br>**[ 0.23867]** | **0.590739**<br>**(2.06616)**<br>**[ 0.28591]** | **0.477375**<br>**(0.16876)**<br>**[ 2.82870]** |
| **C** | **0.535603**<br>**(0.72475)**<br>**[ 0.73902]** | **-2.045391**<br>**(4.36925)**<br>**[-0.46813]** | **1.086826**<br>**(0.35688)**<br>**[ 3.04539]** |
| **R-squared** | **0.969979** | **0.980207** | **0.277871** |
| **Adj R-squared** | **0.966763** | **0.978086** | **0.200500** |
| **Sum sq. resids** | **0.064287** | **2.336490** | **0.015588** |
| **S.E. equation** | **0.047916** | **0.288870** | **0.023595** |
| **F-statistic** | **301.5614** | **462.2108** | **3.591419** |
| **Log likelihood** | **53.95611** | **-3.532657** | **76.62604** |
| **Akaike AIC** | **-3.122257** | **0.470791** | **-4.539128** |
| **Schwarz SC** | **-2.939040** | **0.654008** | **-4.355911** |
| **Mean dependent** | **1.892908** | **9.124881** | **2.132817** |
| **S.D. dependent** | **0.262826** | **1.951389** | **0.026388** |

**Resource: By authors using Eviews 12**

**First: Testing the validity of the VAR model**

Before starting IRF or Variance Decomposition Analysis, the subject requires a set of tests to ensure the integrity of the estimated model, so that we can be reliable in this field and consider it applicable, especially if we know that these models provide a coherent and reliable approach to data description, forecasting, structural reasoning and policy analysis (21). Therefore, there was a need to conduct this set of tests, which are as follows:

**1-Roots of Characteristic Polynomial Test**

In this test, it is assumed that the roots of the characteristic polynomial of the matrix of the set of functions estimated in the VAR model are less than one, provided that this situation is within the difference level, so the model is considered not passing the stability property if we make sure that it has a root greater than one, but if the model (i.e. it has roots of a distinct polynomial less than one) when taking the difference, then it is called an integrated of degree d or *I(d)*, *d* here is the number of differences applied (17). Returning to the test result, Table 4 shows that the model does not include roots up to the one and that all the roots are located in the unity circle, and thus the model met and passed the stability requirement.

**Table 4. Roots of Characteristic Polynomial**

| Endogenous variables: LEX LM1_$ LAP<br>Exogenous variables: C<br>Lag specification: 1 1 |
|---|
| **Root** |
| **0.969219** |
| **0.713763** |
| **0.471645** |
| **No root lies outside the unit circle.** |
| **VAR satisfies the stability condition.** |

**Resource: Eviews 1 Software Output**

**2-Autocorrelation LM Test**

The test results show that there is no sequential correlation problem for slowing levels up to 1, as the significant statistic shows that the model does not have the problem, as it reached 0.433 for the first slowdowns, and this means accepting the null hypothesis "There is no serial correlation for the rank of lag *h*", which is here one rank as in Table 5.

**Table 5. Serial correlation (LM) tests**

**Sample: 1990 2022**
**Included observations: 32**
**Null hypothesis: No serial correlation at lag h**

| lag | lre*statat | push | prob. | Rao f-stat | push | prob. |
|---|---|---|---|---|---|---|
| 1 | 17.36821 | 9 | 0.433 | 2.108758 | (9, 56.1) | 0.433 |

**Resource: Eviews 12 output.**

**3-Heteroscedasticity Tests**

The results of the test as in Table 6 showed that the probability of the problem of instability of the homogeneity of variance according to the White test was 0.10, which is of course not significant, and therefore we accept the null hypothesis based on the absence of the problem.

**Table 6. Heteroskedasticity tests**

**Sample: 1990 2022**
**Included observations: 32**
**Joint test:**

| Chi-sq | Push | Prob. |
|---|---|---|
| 46.69112 | 36 | 0.1093 |

**Resource: Eviews 12 software output**

**Second: Variance Decomposition Analysis**

The variables will be presented separately to clarify the role and importance of each of them, and according to the logic of the economic theory, which are variables (exchange rate *EX*, money supply *M1* and Agricultural products *AP*) as follows:

**1-Variance decomposition analysis of EX**

Table 7. shows the percentages of variance of the variable *EX*, and the role of other variables in this variance when a shock occurs by one standard deviation, and from it we see in the first year that 100% of the variance of the *EX* variable is due to the variable itself, and it began to decrease in the second period (second year) to reach 99%, and so on to reach 97% after 10 years, while the variable *M1* has no role in this variance in the first year, rising to approximately 0.2% in the third year it gradually reaches 2.7% in the tenth year, while the *AP* variable has a weak role in explaining the variance of the *EX* variable, reaching 0.1% in the third year and stabilizing around 0.2% until the tenth year.

**Table 7. Variance Decomposition of LEX**

| Period | S.E. | LM1_$ | LAP | LEX |
|---|---|---|---|---|
| 1 | 0.288870 | 0.000000 | 0.000000 | 100.0000 |
| 2 | 0.393742 | 0.058088 | 0.102575 | 99.83934 |
| 3 | 0.467048 | 0.205257 | 0.188843 | 99.60590 |
| 4 | 0.524213 | 0.439482 | 0.232615 | 99.32790 |
| 5 | 0.571270 | 0.746243 | 0.246481 | 99.00728 |
| 6 | 0.611291 | 1.105879 | 0.245996 | 98.64813 |
| 7 | 0.646071 | 1.498789 | 0.241388 | 98.25982 |
| 8 | 0.676760 | 1.908193 | 0.237761 | 97.85405 |
| 9 | 0.704140 | 2.321067 | 0.236973 | 97.44196 |
| 10 | 0.728772 | 2.728022 | 0.239220 | 97.03276 |

**Resource: Eviews12 Software Output**

**2-Variance decomposition of M1**

Table 8. shows the variation in the money supply *M1* and the relative importance of explaining the other variables of fluctuations in it when it was exposed to a shock by one standard deviation, and it is clear that 38% of them were explained by the fluctuations of the same variable in the first year, and gradually increased to reach 53% in the tenth year, and the most important variable that had a role in explaining the variance is *EX* variable, as it reached 61% in the first year, and decreased to less than that in the second year, to reach approximately 45% in the tenth year, For the *AP* variable, its relative importance is very low.

**Table 8. Variance Decomposition of LM1**

| Period | S.E. | LM1_$ | LAP | LEX |
|---|---|---|---|---|
| 1 | 0.023595 | 38.98773 | 0.000000 | 61.01227 |
| 2 | 0.026153 | 41.98074 | 0.122133 | 57.89713 |
| 3 | 0.026716 | 44.45501 | 0.292798 | 55.25219 |
| 4 | 0.026851 | 46.50740 | 0.464094 | 53.02850 |
| 5 | 0.026886 | 48.21677 | 0.620225 | 51.16300 |
| 6 | 0.026896 | 49.64708 | 0.757394 | 49.59552 |
| 7 | 0.026899 | 50.85002 | 0.876148 | 48.27383 |
| 8 | 0.026901 | 51.86720 | 0.978444 | 47.15436 |
| 9 | 0.026901 | 52.73210 | 1.066525 | 46.20137 |
| 10 | 0.026902 | 53.47166 | 1.142513 | 45.38583 |

**Resource: Eviews 12 software output.**

**3- Variance decomposition of AP**

Analysis of the variance segmentation of the *AP* variable shows that 97% of the variance is caused by the same variable in the first year, as in Table 9 and the rest is due to the *M1* variable and this percentage continued in the same variable to the tenth year to reach 97.2%, while the relative importance of fluctuations in the *AP* variable and due to the variable *M1* stabilized slightly to reach 2.5% at the tenth year, as for the role of the *EX* variable, it had no role in this variation, as in the form of 4.

**Table 9. Variance Decomposition of LAP**

| Period | S.E. | LM1_$ | LAP | LEX |
|---|---|---|---|---|
| 1 | 0.047916 | 2.521410 | 97.46252 | 0.016075 |
| 2 | 0.059492 | 2.560618 | 97.40294 | 0.036443 |
| 3 | 0.065083 | 2.579692 | 97.33892 | 0.081384 |
| 4 | 0.068131 | 2.587599 | 97.28998 | 0.122420 |
| 5 | 0.069933 | 2.590512 | 97.25830 | 0.151186 |
| 6 | 0.071083 | 2.591469 | 97.23956 | 0.168967 |
| 7 | 0.071873 | 2.591733 | 97.22902 | 0.179247 |
| 8 | 0.072457 | 2.591772 | 97.22325 | 0.184979 |
| 9 | 0.072915 | 2.591751 | 97.22013 | 0.188116 |
| 10 | 0.073294 | 2.591723 | 97.21846 | 0.189821 |

**Resource: Eviews 12 software output**

**Third: Impulse Response Function Analysis**

The impulse (or shock) will be analyzed in the model variables, which are (exchange rate *EX*, money supply *M1*, and Agricultural products *AP*), using the Cholesky system, where the colored lines indicate a confidence limit of 95%, and the black line indicates the impulse response function, and is interpreted as a shock (called Impulse or innovation as well) by one standard deviation in one variable, leading to an increase (or decrease) in the other variable, and the result of the analysis is as follows:

**1. Impulse response of exchange rate**

Table 10 and Figure 5 represent the response of the *EX* to a shock of one standard deviation in the same variable and the other variables over ten years, and it is found that there was a significant positive effect of the shock in the same variable in the first year and that the impact of this shock remained positive throughout the subsequent ten years, but it began to gradually decline starting from the second year and reached low values at the end of the period. As for the shock by one standard deviation in the money supply variable *M1*, it did not have an effect in the first year on the *EX* variable, but its negative impact began in the second year and the third year and continued to decline negatively until the end of the period, and this means that the increase in the money mass has a permanent negative impact on the exchange rate, which led to a devaluation of the local currency against the US dollar due to the decline in real prices because production did not keep pace with the increase in the money mass. As well as for the *AP* variant, as the shock in it did not affect the *EX* in the first year, and started from the second year, then it began to gradually decrease in the long term, which is a very weak effect in any case, as in Figure 4.

**Table 10. Response of LEX**

| Period | LEX | LM1_$ | LAP |
|---|---|---|---|
| 1 | 0.047916 | 0.000000 | 0.000000 |
| 2 | 0.035180 | -0.001434 | 0.001905 |
| 3 | 0.026183 | -0.002577 | 0.002090 |
| 4 | 0.019787 | -0.003421 | 0.001673 |
| 5 | 0.015215 | -0.004012 | 0.001121 |
| 6 | 0.011931 | -0.004402 | 0.000612 |
| 7 | 0.009560 | -0.004642 | 0.000200 |
| 8 | 0.007839 | -0.004770 | -0.000113 |
| 9 | 0.006581 | -0.004819 | -0.000341 |
| 10 | 0.005653 | -0.004811 | -0.000502 |

**Resource: Eviews 12 software output**

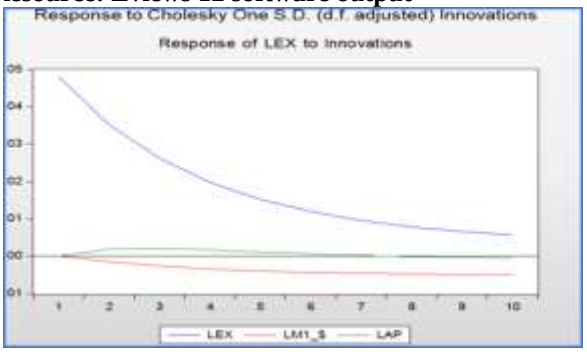


**Figure 4. Response of the lEX to shocks**

**Resource: Eviews 12 output**

**2-Impulse response of money supply**

It is noted that there is a positive response to the money supply to the shock and by one standard deviation in itself, we see that it is positive and similar over time, it began in the first year and took a gradual decline to the end of the period semi-linearly and it is symmetric and has a permanent effect and this is logical and consistent with economic logic, as shown in Table 11.

**Table 11. Response of LM1**

| Period | LEX | LM1_$ | LAP |
|---|---|---|---|
| 1 | -0.225638 | 0.180371 | 0.000000 |
| 2 | -0.197096 | 0.180416 | 0.013760 |
| 3 | -0.175398 | 0.178571 | 0.021198 |
| 4 | -0.158739 | 0.175586 | 0.025232 |
| 5 | -0.145768 | 0.171910 | 0.027364 |
| 6 | -0.135487 | 0.167822 | 0.028392 |
| 7 | -0.127170 | 0.163502 | 0.028756 |
| 8 | -0.120291 | 0.159066 | 0.028709 |
| 9 | -0.114470 | 0.154592 | 0.028402 |
| 10 | -0.109434 | 0.150134 | 0.027929 |

**Resource: Eviews 12 software output**

while the response of the money supply to a shock by one standard deviation in the exchange rate *EX* was negative and low until the end of the period and is permanent symmetric, which means that an increase in the exchange rate may be accompanied by a large money supply in reaction to an exchange rate shock. For money supply response to the shock in the *AP* variant, we see that it began in

the second year, as it did not have a response in the first year, and the result is logical because it is assumed that the improvement in *M1* stimulates agricultural production, and it is symmetrical and of relatively lower value than the *M1* response to its self-shock, but it is permanent and also symmetric as shown in Figure 5.

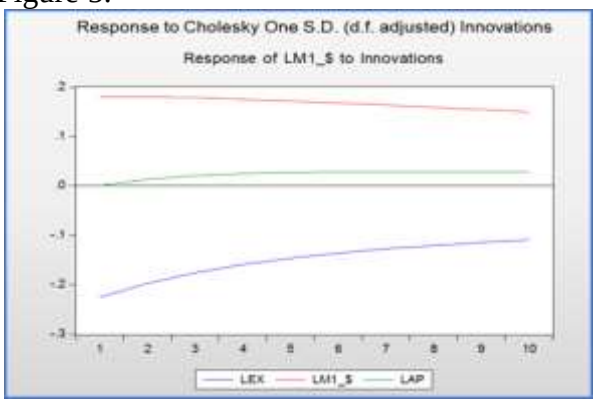


**Figure 5. Response of the LM1_$ to shocks**

**Resource: Eviews 12 output**

**1. Impulse response of agricultural output**

The results of the impulse response analysis in the *AP* variable show a shock of one standard deviation in the same variable that came positive in the first year and then decreased in the second and third years down to the end of the long-term of the predicted period, as shown in Table 12 and Figure 6. While we see that the exchange rate shock had a weak impact on agricultural output, the dependence on the agricultural sector for food provision in the nineties of the last century absorbed the impact of sudden exchange rate appreciation. reaching the *M1* money supply shock, the results show that the impact of the shock was weak and positive in the first year, decreased in the second year and almost disappeared in the fourth year until the end of the period, meaning that the increase in money supply did not benefit Agricultural products in any way.

**Table 12. Response of LAP**

| Period | LEX | LM1_$ | LAP |
|---|---|---|---|
| 1 | -0.000299 | 0.003747 | 0.023293 |
| 2 | 0.000400 | 0.001865 | 0.011120 |
| 3 | 0.000576 | 0.000947 | 0.005339 |
| 4 | 0.000549 | 0.000494 | 0.002586 |
| 5 | 0.000459 | 0.000264 | 0.001267 |
| 6 | 0.000360 | 0.000145 | 0.000631 |
| 7 | 0.000273 | 8.18E-05 | 0.000322 |
| 8 | 0.000204 | 4.64E-05 | 0.000168 |
| 9 | 0.000151 | 2.59E-05 | 9.10E-05 |
| 10 | 0.000111 | 1.36E-05 | 5.09E-05 |

**Resource: Eviews 12 software output**

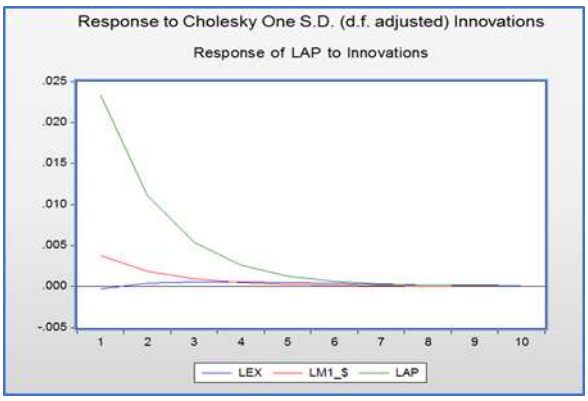


**Figure 6. Response of the LAP to shocks**

**Resource: Eviews 12 output**

## CONCLUSIONS

**1.** The stability of the data was not achieved as in most of the total data that contain a time trend, and the variables became stationary after first difference.

**2**. We note through the analysis of the variance decomposition and impulse response analysis the strength of the impact of exchange rate variable itself, that is, the variance and the impulse that they got in it was an internal reaction that predicts what may called the self-wave, and this is consistent with the reality that happened in Iraq, as despite the rise in the money supply, but the exchange rates were under the tutelage of the policies of the Central Bank followed during the period of rise, and the increase in the money supply did not affect the nominal and real exchange rates.

**3.** Both the variance and response to the money supply shock in Iraq were dependent on the policy of the Central Bank and compatible with what was happening in the exchange rate, as it is noted that the variation of the money supply has been interpreted by the same variable as well as the exchange rate and that the money mass was compatible with the Taylor rule to work at the level of potential output, as the Central Bank, if it wants to continue to reduce the inflationary impact of government expenditures, intervene daily in the exchange market to liquidating excess cash and controlling price deviations that lead to increasing inflationary expectations and generating persistent inflation.=

**4.** The lack of policies for the agricultural sector in Iraq for the elements of integration into the economic structure of Iraq, as we see that a large part of the variability of the variable stemmed from itself and a negligible part was from the money supply, but the price

of the row did not have an impact on the variation of agricultural output, as well as the case for the analysis of impulse of agricultural output, so it is necessary to create the appropriate environment and appropriate policies to advance the reality of the agricultural sector and direct an important part of the country's monetary wealth to it, such as investment in the structure Infrastructure and technology that are in his interest.

**REFERENCES**

1. Abdo, A. S. 2021. The relationship between money supply, exchange rate and economic growth in Egypt during the period (1989-2019). Alexandria University Journal for Administrative Sciences 58(3):123-163.

2. Ahmed, A. F. and A. M. Hmzah. 2017. Determinants of private agricultural investment in Iraq for the period (1990-2014). Iraqi Journal of Agricultural Sciences, 48(2):624-635. https://doi.org/10.36103/ijas.v48i2.430

3. Al-Attabi, H. A., B. H. Al-Badri, and S. A. Al-Badawi. 2020. An economic study of the relationship between agricultural imports and agricultural product in Iraq for the period 1991-2018 using Toda-Yamamoto causality. Iraqi Journal of Agricultural Sciences –51(3): 789-796. https://doi.org/10.36103/ijas.v51i3.1034

4. Al-Badri, B. H. and S. J. Mohammed. 2016. An economic analysis for pricing policy and policy of foreign trade of agricultural sector in Iraq during 2003-2013. The Iraqi Journal of Agricultural Sciences, 47(2): 563-572. https://doi.org/10.36103/ijas.v47i2.603

5. Al-Hayali, A. D. 2006. Measurement and analysis of some factors affecting inflation in Iraq during 1992-2002. Iraqi Journal of Agricultural Sciences, 37(4): 123-130.

6. Al-Issa, D. and B. H. Al-Badri. 2022. Economic analysis to estimate the imported inflation in the agricultural sector in Iraq for the period 1990-2019. Iraqi Journal of Agricultural Sciences, 53(5): 1241-1248. https://doi.org/10.36103/ijas.v53i5.1638

7. Al-Obaidi, E. S. 2016. Measuring and analyzing the impact of fiscal policy shocks on some macroeconomic variables in Iraq for the period 1990-2014. Ph.D. Dissertation. University of Baghdad/ College of Administration and Economics. pp: 118.

8. AL-Shabibi, M. S. 2011. Econometric Methods: Lectures and Applications. 1st Edi. Dar Al-Hamid. Algeria. pp:150.

9. Al-Sudani, A. H. and A. D. Al-Hiyali. 2021. An economic analysis of the effect of some economic variables on the structure of agricultural employment in Iraq for the period 1990-2017", Iraqi Journal of Agricultural Sciences, 52(3): 682–690. https://doi.org/10.36103/ijas.v52i3.1359

10. Al-Yousef, N. A. 2012. Econometrics. King Saud University, College of Administrative Sciences, Department of Economics. pp:190

11. Dornbusch, R.; Fischer, S. and Startz, R. 2011. Macroeconomics, 11th Edi. Mc-Graw-Hill Companies, New York. pp:293

12. Federal Reserve. 2015. "What Is the Money Supply? Is It Important?" https://www.federalreserve.gov/faqs/money_12845.htm. Accessed Jun. 12, 2023

13. Froyen, R. T. 2013. Macroeconomics: Theories and Policy, Pearson Education, London, pp:67

14. Greene, W. H. 2012. Econometric Analysis. Prentice Hall. New York, 7th edition. pp: 902

15. Hammoud, N. M. 2011. Using the co-integration methodology to show the impact of monetary and real variables on inflation. Anbar University Journal of Economic and Administrative Sciences, 4 (7):179-189

16. Jubair, B. N. and A. D. Al-Hayali. 2018. An economic study of the impact of foreign agricultural trade and some macroeconomic variables on the exchange rate in Iraq using the FMOLS model for the period (1990-2015). Iraqi Journal of Agricultural Sciences, 49(4): :142-110. https://doi.org/10.36103/ijas.v49i4.61.

17. Kunst, R. M. 2011. Vector autoregressions - Based on the book 'New Introduction to Multiple Time Series Analysis' by Helmut Lutkepohl. University of Vienna and Institute for Advanced Studies Vienna. Download https://homepage.univie.ac-.at/-robert.kunst/varpres2.pdf.

18. Mankiw, N. G. 2020. Principles of Macroeconomics. 5th Edi. Cengage learning. pp: 396

19. Ministry of Planning. 2010. Agricultural Statistical Atlas: Water, Dams and Reservoirs – Part V. Iraq–Baghdad. pp:5
20. Mohamed, S. J. and O. H. Salman. 2023. An economic analysis of the impact of the Iraqi dinar exchange rate on the imported quantities of rice during the period 1990 – 2020. Iraqi Journal of Agricultural Sciences, 54(2): 542–552. https://doi.org/10.36103/ijas.v54i2.1730
21. Nazzali, S. 2020. The relationship between the exchange rate and the money supply in the Algerian economy for the period 1990-2016. Journal of the Faculty of Politics and Economics, (5): 69-98.
22. Ronayne, D. 2011. Which Impulse Response Function? Department of Economics, University of Warwick. (971):1-47
23. Salim, Y. A. and A. F. Ahmed. 2019. Impact of monetary policy on the agricultural domestic product in Iraq for the period (1990-2014). Iraqi Journal of Agricultural Science, 50(2):557-566.
Doi: https://doi.org/10.36103/ijas.v2i50.656.
24. Salman, O. H. and S. J. Mohammed. 2020. Determinants of the Money Supply in Iraq for the Period 2003-2016 (Econometric Study). Journal of Administration and Economics/ Al-Mustansiriya University. No. (124):158-164
25. Sims, C. A. 2002. The role of models and probabilities in the monetary policy process. Brookings Papers on Economic Activity. (2):1-40.
26. Taylor, J. B. 2001. The Role of the Exchange Rate in Monetary-Policy Rules, American Economic Review, 91(2):263- 267.