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The Interchangeable Relationship between Exchange Rate, Money Supply and Inflation rate in Iraq for the period of (2003-2023)

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Article Info		Abstract:
Received	November, 2023	This study investigates the interplay among Iraq's money supply, inflation rates, and exchange rates over a two-decade span from (2003 to 2023). Annual data for the specified period were gathered for the money supply, exchange rates, and inflation rates. Employing the Autoregressive Distributed Lag (ARDL) approach in E-Views 12, a comprehensive Multiple Regression Analysis was conducted. Based on the results of the analysis, it appears that there is a one-way causal relationship between the money supply and inflation, as well as between the exchange rate and inflation. Moreover, the money supply and the exchange rate have an impact on increasing inflation rate. Additionally, the inflation rate and the exchange rate have an impact on increasing money supply. The robustness of the models is confirmed through an array of statistical analyses, including descriptive statistics, unit root tests, co-integration analysis, and diagnostic checks. The outcomes of this research provide valuable insights for decision-makers, facilitating a comprehensive understanding of Iraq's economic dynamics. Furthermore, these findings contribute to the development of well-informed strategies for future economic initiatives.
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Introduction:

The interdependence among exchange rates, money supply, and inflation rates is a crucial aspect within the economy of any nation, with particular relevance to Iraq, given the country's susceptibility to a range of economic and political variables. It can be asserted that grasping this relationship aids in foreseeing economic shifts and adopting effective economic strategies to guarantee both economic and societal stability. Moreover, Iraq encountered notable economic and political hurdles, encompassing a period of low oil prices and internal conflicts. These difficulties yielded economic repercussions on both the inflation rate and money supply, accompanied by fluctuations in the exchange rate.

The exchange rate plays a pivotal role in comprehending the relationship between inflation rates and money supply in Iraq. Variations in the exchange rate can have a substantial impact on import costs, potentially resulting in price increases. This can lead to an increase in the inflation rate if not controlled effectively. Money supply is an additional element that influences the inflation rate. An increase in the money supply without a commensurate rise in production can result in an inflation rate increase. Judicious management of the money supply is essential to

maintain price stability. Comprehending this correlation within the specific timeframe in Iraq is crucial to secure both economic and social stability. Gaining insight into this relationship can play a role in steering forthcoming economic policies and bolstering the stability of the Iraqi economy.

Research Problem:

The main research issue relates around understanding and examining the interconnected of the exchange rate, money supply, and inflation rate in Iraq. Additionally, it involves evaluating how alterations in the exchange rate and the amount of money in circulation influence the inflation rate within the Iraqi economy. This represents as the central focus of the research.

Research Importance:

The research's importance is underscored by:

- 1: The significant value of understanding how a variable like exchange rates, money supply inflation rates effective each other's within the Iraqi economy.
- 2: Its contribution to the formulation of monetary policies aimed at preserving price stability and promoting economic growth.

Research objective:

The research has the following objectives:

- 1: To gain insight into and evaluate the no interchangeable relationship between the exchange rate, money supply, and inflation rate in Iraq over the period spanning from 2003 to 2023.
- 2: To identify and scrutinize the consequences of fluctuations in the exchange rate and alterations in money supply on inflation rates throughout this time frame.
- 3: To investigate into the interplay among these variables and their correlations with inflation rates, offering a comprehensive evaluation of this interrelationship.

Research Hypothesis:

The research hypothesis is founded on the assumption that a reciprocal relationship exists between the exchange rate, money supply, and inflation rate in Iraq during the specified period. This hypothesis suggests that variations in the exchange rate and alterations in the money supply will have a tangible influence on the inflation rate in Iraq.

H0: There is no interchangeable relationship between Exchange Rate, Money Supply and Inflation rate.

H1: There is an interchangeable relationship between Exchange Rate, Money Supply and Inflation rate.

Theoretical Framework:

The primary objective of presenting the theoretical framework is to comprehend the various dimensions of the research variables and how they interact with each other. Therefore, within this research, some key concepts related to the research topic are briefly outlined.

1: Concept and Definition of the exchange rate:

When we make purchases or invest in a foreign country, we need to acquire that country's currency for the transaction. The same requirement applies when foreigners invest in our local economy or purchase our products; they need to obtain our local currency. A key distinction between international and domestic trade is the absence of a common international currency unit, unlike domestic trade, which operates under a unified national currency within a single monetary system. In this context, the exchange rate represents the value of one currency in terms of another, with one currency acting as a commodity and the other as the medium used to assess that commodity. There are two perspectives on treating these currencies as commodities: the direct method, where the commodity is the foreign currency, and the indirect method, where the commodity is our local currency, and its value is measured in terms of foreign currency (Alshukri, Ali, 2022: 503).

The exchange rate can be described as the quantity of one currency required to acquire a unit of another currency, or conversely, it represents the amount of foreign currency needed to obtain one unit of the local currency within a country (Kadhim, Dhhan, 2020: 2). There are alternative definitions of the exchange rate, such as viewing it as the comparative value of the local currency in relation to foreign currency units. This value is determined similarly to other relative prices, influenced by the interplay of supply and demand forces between the two specific currencies (Abdullah, Taha, 2023: 69). It can be said that the exchange rate serves as the pricing mechanism that defines the

worth of a nation's currency concerning another currency. It holds a pivotal role in international trade and the realm of global finance. The exchange rate influences the pricing of commodities and services in cross-border transactions and additionally exerts its influence on the investment decisions made by both individuals and businesses in international markets.

2: Concept and Dimensions of the money supply

Economists have differing interpretations when it comes to defining the money supply, with the variations centering on the elements that make up the money supply. Consequently, various definitions of the money supply have arisen. It encompasses the physical cash held by individuals, as well as the reserves kept in the central bank. This definition also represents the total available and circulating mediums of exchange within a country within a specified time period (Resen, 2022: 457). It signifies the complete stock of money in the economy during a specific timeframe, typically falling within one fiscal year (Putri, Prasetyo, 2020: 369). The prevailing viewpoint aligns with traditional and Keynesian economic theories, emphasizing the role of money as a medium of exchange. According to this perspective, the money supply is constituted by the currency held by the public and the demand deposits with commercial banks (Sengupta, 2016: 1). Based on the definitions provided earlier, we can assert that the money supply, frequently called the money stock, represents the overall amount of money within an economy at a given moment. This holds a pivotal role as an economic gauge, impacting elements such as inflation, interest rates, and the general stability of the economy. In this specific context, a differentiation is made among the following components:

First: The monetary base (M0):

This represents a gauge of the quantity of coins (both coins and paper) in circulation within the economy, including the reserves held by commercial banks at the central bank. It's the most readily accessible form of money. In simpler terms, the monetary base is the total of the currency in circulation along with the bank deposits maintained at the central bank. These deposits are essentially the cash reserves held by banks at the central bank and can be expressed using the following equation (Al-Khaikani, Naima, 2020: 2):

$$MB=C+R$$

Second: The narrow concept of money supply (M1):

It represents the complete sum of funds working as a medium of exchange and issued by financial institutions authorized to generate legal currency. The central bank manages the issuance of legal currency, while commercial banks are responsible for generating deposits. In other words, M1 encompasses the current deposits of private individuals and the net amount of currency in circulation for trade. The equation for M1 can be expressed as follows (Al-Khaikani, Naima, 2020: 2):

$$M1 = DD + CR$$

Third: The Broad Money Supply (MS2)

It's commonly referred to as local or domestic liquidity and is typically denoted as (M2) in statistical data. M2 includes not just the narrow money supply (M1) but also incorporates time deposits and savings deposits held by commercial banks. This concept finds its roots in the ideas of Milton Friedman and Anna Schwartz, who believed that the narrow concept of money supply alone doesn't accurately represent the available monetary resources within the economy. They argued that the broader concept provides a more suitable framework for understanding the overall money supply, emphasizing that advanced industrial economies offer various assets that can be readily and swiftly converted into means of payment. This notion can be illustrated by the following equation (Al-Araji, Salih, 2023: 374):

$$MS2 = MS1 + SD + STD$$

Fourth: broadest Money Supply (MS3):

This concept involves a more comprehensive interpretation of the money supply, taking into account domestic liquidity (MS2), as well as deposits held in entities beyond commercial banks, such as savings institutions, credit unions, savings and loan associations, and savings deposits. In simpler terms, the money supply encompasses both physical currency and non-cash obligations within financial intermediaries, including the central bank and commercial banks, as well as non-cash obligations within other financial intermediaries and savings institutions. This concept can be clarified through the use of the following equation (Al-Araji, Salih, 2023: 374-375):

$$MS3 = MS2 + LTD$$

3: The Concept and Definition of inflation:

Inflation is a widely recognized economic term, yet there exists a disparity of opinion among economists regarding its precise definition. Economic literature lacks a universally encompassing concept of inflation. The evolution of inflation theories, influenced by the progression of economic thought, has led to diverse interpretations. Essentially, inflation can be understood as a sustained upward movement of prices driven by high demand and limited supply. It represents a continual and widespread increase in overall price levels, with the proviso that price increases should persist in an upward and ongoing manner, excluding one-time spikes (Al-Jubouri, Abu Shtewi, 2022: 191).

As per Milton Friedman, he famously asserted that inflation "is invariably a monetary phenomenon in all circumstances." Subsequently, economists began to characterize inflation as a phenomenon linked to price escalation stemming from monetary expansion but acknowledged its potential other triggers. In economics, inflation signifies collective growth in the supply of money, money incomes, or prices. Typically, inflation is conceptualized as an excessive surge in the overall price levels (Shkliarevsky, 2023: 3). Inflation is described as the upsurge in the overall price level, linked to the expansion of the money supply and the devaluation of the currency (Mohamed, Abtan, 2022: 538). It can be said that it is a general and sustained increase in the price levels of goods and services in the economy over a specific period of time. Inflation results in a reduction in the currency's buying power and a gradual escalation in the cost of living. Various factors, including heightened demand for goods and services, shortages in supply, and mounting production expenses, can give rise to inflation.

4: The Interchangeable Relationship between Exchange Rate, Money Supply and Inflation rate:

Dornbusch was the first to articulate the connection between exchange rates and inflation. He introduced an econometric model to assess the impact of exchange rates on price levels. Dornbusch's pioneering research laid the foundation for subsequent studies in this area. When exploring the link between exchange rates and domestic prices, Dornbusch delved into factors such as market density, import volumes, import substitution, and domestic production channels.

Agenor and Montiel also identified four primary mechanisms through which exchange rate fluctuations influence inflation (Monfared, Akin, 2017: 330):

1. An open economy can directly influence the prices of imported substitute and traded goods.
2. Indirectly, it can raise the prices of final products by affecting imported input costs.
3. Exchange rate fluctuations can introduce uncertainty into foreign currency prices, influencing domestic price setters and resulting in higher domestic prices.
4. Lastly, exchange rate variations can impact wages, which in turn affect prices.

The classical theory suggests a direct connection between the money supply, acting as an independent variable, and the overall price level, which functions as a dependent variable. This implies that alterations in the money supply have consequences on the general price level and, subsequently, on inflation. Hence, governmental monetary authorities play a role in managing the money supply with the intention of regulating acceptable inflation levels, while assuming a consistent level of production and money circulation. Monetarists, led by Friedman, assert that an increase in the money supply is the primary factor responsible for elevating the overall price level and, by extension, causing inflation. During periods of economic recession, these monetary authorities might resort to expanding the money supply, resulting in an increase in the general price level and the emergence of inflation. Conversely, these authorities may be compelled to implement a deflationary policy to combat inflation by reducing the money supply (Najmaddin, Hamid, Ahmed, 2011: 14).

Both the money supply and the exchange rate contribute to worsening inflation within the framework of the Iraqi economy, marked by the stagnation and dysfunction of its production infrastructure. This infrastructure struggles to match successive growth in public expenditures, causing aggregate demand to surpass aggregate supply and consequently giving rise to inflationary trends (Mnahi, 2020: 26).

From above discussion, We can say that when the money supply increases in Iraq, there is typically an impact on the depreciation of the local currency's exchange rate compared to other currencies. Exchange rate fluctuations can directly impact the money supply by altering import costs, potentially contributing to an increase in inflation if the exchange rate falls or a decrease in inflation if it rises. If inflation rates increase in Iraq, the money supply can potentially rise due to increased spending and borrowing. As for the exchange rate, when inflation rates go up, it can

lead to a depreciation of the local currency and a decrease in the exchange rate. However, if measures are taken to curb inflation, it can contribute to improving the value of the local currency and an increase in the exchange rate.

Literature Review:

The interchangeable relation between exchange rate, money supply and inflation has received significant concern in economic literature at both the global and international levels, which has reached contradictory results in this area. Below are a number of studies covered this regard:

In Ghana Chibber and Shafik (1990) study the linkage between inflation, exchange rate and money supply; spanning the years 1965 to 1988. According to their findings, one key component that helps to explain the Ghanaian inflationary process is growth in the money supply. Real salaries and the official exchange rate, for example, could only have a small impact on inflation. However, there was a strong positive correlation between the general price level and the parallel market exchange rate. This might all be directly translated to mean that recent price swings in Ghana have little to do with the government's recently established exchange rate strategy. In Addition, Mahamadu and Philip (2003) present similar results have similar result for the case of Ghana when they utilize an error-correcting mechanism, to investigate the connection between inflation, exchange rates, and monetary growth. The finding supports the presence of a stable equilibrium relationship over the long term between inflation, money supply, exchange rate, and real income. In accordance with the theory, the results show that inflation in Ghana over the long run is positively correlated with the money supply and the exchange rate, whereas it is inversely correlated with real income.

According to another study is conducted by (Sean et al., 2019) investigate the relationship among money supply, inflation and exchange rate in Cambodia through using Bayesian Vector Autoregressive (B-VAR) approach, with the monthly data in the period of October-2009 and April-2018. The statistical findings show that Cambodia's money supply positively relies on the prior period, which suggests that it has been rising firmly for a while. Inflation upswings as a result of a rise in the money supply, showing an increase in the overall cost of goods. The exchange rate also shows a positive link with inflation at the same period. This statistically significant positive link shows that growing inflation in Cambodia is a direct outcome of the Khmer Riel's depreciation against the US Dollar. Based on variance decomposition, the money supply causes an 8% shock to the exchange rate and a 0.13% shock to inflation, whereas the exchange rate in Cambodia can generate an inflation of 0.024%. These statistical findings lead to the conclusion that a rise in money supply in Cambodia results in a decline in the Riel's value versus the US Dollar and, as a result, a rise in inflation.

A study by (Mahmood Ali et al., 2015) looks into how Pakistan's exchange rate volatility is affected by inflation, interest rates, and money supply. By using the Johansen Cointegration (trace test & eigenvalue) Tests, the Vector Error Correction Model (VECM), the Granger Causality Test, and the Impulse Response Function (IRF), monthly data for the time span of July 2000 to June 2009 have been studied to estimate. The findings show that inflation and exchange rate volatility have both short- and long-term correlations. Increased interest rates and a high money supply raise inflation, which causes an increase in exchange rate instability.

(Emmanuel, 2010) analyzes the impact of exchange rates and the money supply on inflation in Nigeria during a 28-year period from 1982 to 2009.

The findings indicate that, despite their correlation, money supply and exchange rate each have a different impact on inflation. In contrast to the exchange rate, the money supply has a positive impact. Additionally, it is evident that the effect of the exchange rate is greater than that of the money supply. Akinbobola (2012) examined Nigeria's money supply, exchange rate, and inflation dynamics by applying quarterly data from 1986:01 to 2008:04. The findings support the hypothesis that long-term inflationary pressure is inversely influenced by money supply and exchange rates significantly. His argument for the negative link is that inflation may not be caused by aggregate demand but rather by problems with the local and global supply chains for goods. Changes in international prices and real output have a direct impact on inflationary pressure. In other words, a greater supply of goods and services will ease pressure on prices. This implies that actual output growth can be used to reduce excessive inflationary pressure as well.

Applying the ARDL model, (Jawo et al., 2023) evaluate whether the real effective exchange rate, economic growth, and money supply contribute to inflation in the Gambia from 1985 to 2021. The results show that, with the exception

of real effective exchange rates and money supply, which are significant at 5% level in the long run, all variables impact inflation positively in the long run and negatively in the short run at a significant level of 1%. The recursive cumulative sum demonstrates that the relationship was stable while the square recursive cumulative sum reveals instability in the relationship between the dependent and independent variables, which could be caused by an exogenous change to output and an increase in the quantity of government debt, particularly external debt.

In the USA, (Crowder1998) studied the long-term relationship between inflation and the money supply. The findings indicate that this relationship is statistically significant as well as economically. The key finding is that the trend component of monetary base growth, or the growth component, accounts for all of the CPI inflation's trend or growth component. Even many academics think that the 1979–1982 Federal Reserve policy experiment and advancements in the financial sector of the economy have contributed to the weaker relationship between money growth and inflation in the United States over the past two decades. Moreover, (Bozkurt, 2014) evaluates the relation between money, inflation, and growth in Turkey. For the duration of 1999:2–2012, quarterly statistics on the money supply, GDP, money velocity, and deflator are utilized. The findings of this research indicate that the primary long-term drivers of inflation in Turkey are the money supply and velocity of money. On the other hand, a 1% drop in income causes a 1% drop in inflation.

In examining the link between the money supply and inflation in Nigeria, (Daniel Ikezam, 2018) used the components of the narrow and broad money supply as independent variables. The results showed that while Net Foreign Assets and Savings Deposit have a positive influence on inflation, Currency in Circulation, Demand Deposits, and Savings Deposit had a negative link with inflation rate. The study concludes that money and the rate of inflation in Nigeria are significantly related.

(Batarseh, 2021) studies the connection between inflation and the money supply in the Jordanian economy from 1980 to 2019. The findings of the study show that there is no consistent association across time between the factors. The short-term relationship between the consumer price index (CPI) and the money supply is not causal. There is a short-term unidirectional causal relationship between the money supply and the CPI, which indicates that Jordan's money supply drives inflation, not the other way around, and that the money supply can account for changes in the CPI in the country's economy. (Sultana et al., 2019) used monthly data from May 2010 to December 2017 along with the Co-Integration and Vector Error Correction Techniques to examine the connection between Bangladesh's money supply and inflation. They showed that, in the short run, neither the money supply nor inflation were affected. Meanwhile, they discovered a long-term causal link between the money supply and inflation, indicating that the money supply has a considerable impact on inflation in the long run.

On the contrary, (Diermeier & Goecke, 2016) used Granger Causality and Correlation in VAR Approach to examine the relationship between money supply and inflation in different nations of the Euro Zone, regardless of the variance in time lag. They discovered a "disconnection" between inflation and the expansion of aggregates of money. This could be as a result of the European Central Bank's (ECB) monetary policy being in crisis mode ever since the start of the European financial and economic crisis in 2008.

In addition, a study performed by Clemens and Alex (2002) who experimentally estimate and analyze the relationship between exchange rate accommodation and the level of inflation persistence for 10 European nations during the years 1974–1998. In the study a non-linear autoregressive inflation equation is used. They account for the possibility of an undetermined number of adjustments in the inflation mean during the estimating process. For most of the smaller and more dependent exchange rate mechanism (ERM) countries, their findings offer corroborating evidence of a positive relationship between exchange rate accommodation and inflation persistence, even when mean level variations in inflation are properly considered. They rarely find any evidence of this favorable correlation between the larger nations and those that remained outside the ERM for the majority of the period. Overall, their findings offer only weak evidence that the theoretically expected positive relationship between exchange rate accommodation and inflation persistence exists.

In Pakistan, the simultaneous setting of the general price level and exchange rate is studied by (Ahmad & Ali, 1999). According to the study, price levels and exchange rates adjust slowly and gradually to internal and external pressures. Therefore, anti-inflationary measures like monetary contraction are likely to manifest themselves gradually. Furthermore, it is impossible to postpone indefinitely the inevitable neutralizing impact of inflation on the

real exchange rate following a devaluation. They further explained that anti-inflationary and exchange rate policies cannot be set independently in the long run; instead, attention should be paid to those that are effectively under the control of monetary authorities, such as money supply policies.

Furthermore, in a variation of the Dornbusch model with variable output, (Levin, 1997) examined the impact of money supply growth on the exchange rate and other variables. The most important discovery is that an increase in the money supply results in an overshoot or undershoot of the exchange rate. Additionally, in contrast to the real interest differential model, the real exchange rate depends inversely on the real interest rate throughout a portion of the adjustment process. Overshooting may be necessary to counteract expected depreciation because of the influence of money supply expansion on anticipated long-run inflation, even though it has no immediate impact on the nominal interest rate. Therefore, undershooting might be required to maintain the predicted exchange rate movement. As a result of the nominal exchange rate's initial depreciation, the real exchange rate of the home country's currency also falls and initially exceeds the level of long-run equilibrium.

Iraq's share of interest concerning this subject is also covered in a number of articles. For instance, (KIRACI et al., 2019) conduct the same model and examine the relationship between the inflation rate, the foreign exchange rates of the main currencies used in the northern region of Iraq (NRI), the money supply, and the gross domestic product (GDP) for the years 2008–2016. The results show that there is a long-run relationship between all the variables. The US dollar and inflation in the area have a positive and statistically significant relationship. The Euro and inflation have a negative relationship that is statistically significant. Turkey is a major source of imports for NRI, but an unexpected finding is that the Turkish Lira variable is not highly significant. This might be because payments for imports are made in dollars rather than Turkish liras. In addition, the variables GDP and money supply also have a negative long-run relationship, however it is not statistically significant. The total amount of money supply supplied by the Iraqi Central Bank was included in the research as the money supply variable, however as there is no sophisticated banking system in the area, the quantity of money supply in NRIs is not proportionate to the amount offered by the Central Bank. The amount of dinar entering the area is made up of the dinars that are supplied as payments to the market after being converted from the proceeds of oil exports. As a result, oil income and the value of the dollar will determine the NRI money supply, making the money supply variable statistically unimportant.

(Mhamad & Tursoy, 2021) use the ARDL bounds test approach to investigate the long- and short-term relationships between the exchange rate, interest rate, money supply, and GDP to analyze the factors affecting the exchange rate in Iraq for the years 1990 to 2020. The findings demonstrate a substantial and short-run link between the exchange rate, interest rate, money supply, and GDP. Consequently, a combination of monetary and fiscal policies is required for exchange rate management. The research offers some fresh perspectives for decision-makers on how to handle the Iraqi currency.

Methodology and Data Collection

To demonstrate the Interchangeable Relationship between Exchange Rate, Money Supply and Inflation rate in Iraq, we applied the (ARDL) model, measuring and analyzing the subject using annual data for the period of (2003 -2023) related to Exchange Rate, Money Supply and Inflation rate.

The ARDL approach is a dynamic econometric technique that incorporates a general function containing both the current and lagged values of the variables. Moreover, the ARDL approach has several advantages; especially it can also be based macro data. Particularly, Exchange Rate, Money Supply and Inflation rate will be estimated in current study. The ARDL approach can be applied regardless of whether the regressors are stationary of order zero or one [i.e., $I(0)$ and/or $I(1)$]. Additionally, the ARDL approach can simultaneously estimate the long-run and short-run dynamics. The ARDL approach is associated with the ECM and can be obtained by applying the error correction term estimated using the residual of the long-run regression. The ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information (Ahmed, 2014).

For achieving study objectives the current study formulated the equations as follows:

$$\ln MS_t = B_0 + B_1 \ln ER_t + B_2 \ln INF_t + U_t \dots (1)$$

$$\ln ER_t = B_0 + B_1 \ln MS_t + B_2 \ln INF_t + U_t \dots (2)$$

$$\ln INF_t = B_0 + B_1 \ln ER_t + B_2 \ln MS_t + U_t \dots (3)$$

An ARDL representation of Equation (1, 2, 3) is formulated as follows:

$$\Delta \ln MS_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta \ln MS_{t-i} - \sum_{i=1}^p \alpha_2 \Delta \ln ER_{t-i} - \sum_{i=1}^p \alpha_3 \Delta \ln INF_{t-i} + U_t \dots (1.1)$$

$$\Delta \ln ER_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta \ln ER_{t-i} - \sum_{i=1}^p \alpha_2 \Delta \ln MS_{t-i} - \sum_{i=1}^p \alpha_3 \Delta \ln INF_{t-i} + U_t \dots (2.2)$$

$$\Delta \ln INF_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta \ln INF_{t-i} - \sum_{i=1}^p \alpha_2 \Delta \ln ER_{t-i} - \sum_{i=1}^p \alpha_3 \Delta \ln MS_{t-i} + U_t \dots (3.3)$$

Where:

$\ln MS_t$ = natural logarithm of Money Supply in Iraq in year t;

$\ln ER_t$ = natural logarithm of Exchange Rate in Iraq in year t;

$\ln INF_t$ = natural logarithm of Inflation Rate in Iraq in year t;

t = time period from 2003 to 2023;

P = optimal lag length;

α_0 = the drift component;

α_1 - α_2 = Coefficients or Parameters/ long-run dynamics of the model;

U_t = White noise residuals/ Error term or Disturbance.

Empirical Results and Discussion:

This section is related to providing a concise overview of the research findings and discussing them statistically and economically.

Description of the study variables:

The following table shows the results of some descriptive statistic indicators of study variables:

Table (1): Results of testing some statistical indicators (Descriptive Statistics) for the data and variables included in the model

Statistic indicators	Money Supply	Exchange Rate	Inflation Rate
Mean	59279	1263	9.82
Median	64694	1184	4.58
Minimum	2243	1166	-0.2
Maximum	122601	1470	53.2
Std. Dev.	30081.7	122.9546	14.70621

Source:
Prepared by
researchers
based

on annual data for the period (2003-2023) using the program E-views 12.

The above results show that the money supply during the study period is between the lowest value (2243) and the highest value (122601), with a mean and median (59279 and 64694) respectively. Moreover, the Exchange Rate during the same period is between the lowest value (1166) and the highest value (1470), with a mean and median (1263 and 1184) respectively. Additionally, the Inflation Rate during the same period is between the lowest value (-0.2) and the highest value (53.2), with a mean and median (9.82 and 4.58) respectively.

Unit root stationarity test:

Stationarity is one of the important tests to reveal the stability of the data and variables in the model used, and there are many different tests that can be used to this purpose, but both (Dickey Fuller Augmented and Phillips Perron tests) are among the most used, the results of these two tests are shown as follows:

Table (2): Results of Unit Root Test

Variables	PP: Phillips-Perron	ADF: Augmented Dickey – Fuller
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	) First Difference(		)Level (		) First Difference(		)Level (	
	Intercept	Trend	Intercept	Trend	Intercept	Trend	Intercept	Trend
MS	-9.0627 (0.0000)	-8.3129 (0.0000)	-4.8048 (0.0012)	-7.1071 (0.0001)	-7.7832 (0.0000)	-7.3229 (0.0001)	-1.6416 (0.4431)	-6.1111 (0.0007)
ER	-3.3371 (0.0274)	-5.2604 (0.0025)	-1.5732 (0.4772)	-1.5100 (0.7913)	-3.4131 (0.0235)	-4.0002 (0.0287)	-1.5732 (0.4772)	-1.3829 (0.8342)
INF	-7.7005 (0.0000)	-8.1210 (0.0000)	-1.4812 (0.5198)	-0.9919 (0.9198)	-4.1400 (0.0079)	-2.9959 (0.1811)	-1.4545 (0.5327)	-2.6412 (0.2734)

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It is clear from Table (2) and through tests (Dickey Fuller Augmented and Phillips Perron tests) that all variables are significant in the first difference in (Trend / Intercept), that is, there is all variables are stationary.

Correlation Matrix “r”:

There are several ways to measure the relationships between economic variables, the simplest of which is the correlation matrix, and correlation can be defined as a measure of the degree of association of change in one variable with change in another variable or in a group of other variables. The main purposes of this test are two main points: The first point: to determine the direction of the relationship between the variables (negative sign -) means that there is an inverse relationship between the variables, while (positive sign +) means that there is a direct relationship between the variables. The second point: to determine the size of the relationship between the variables of the subject of study, and although there are different points of view on the interpretation of the correlation coefficient and the size of the relationship between the variables, but in general (if the result is close to the one, it indicates a strong relationship between the variables), otherwise (if the result is close to zero, it indicated the weak relationship between the variables, the size and direction of the study variables in Table No. (3):

Table (3): Results of Correlation Test

Variables	MS	ER	INF
MS	1		
ER	- 0.11	1	
INF	- 0.56	0.70	1

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

Table (3) shows a negative weak relationship between (Money Supply and Exchange Rate), but there is a good relationship between (Inflation Rate and Exchange Rate).

Co-integration Analysis:

Co-Integration is one of the important tests to show the level of integration between the variables, in order to allow an estimate of the model, it is necessary to have at least one Co-Integration between one of the independent variables and the dependent variable, and there are many different test that can be used to indicate the level of co-integration between the variables, but the (Johansen test Test) of the common tests, table (4) shows the results of this test.

Table (4): Results of Co-integration Analysis

Variables	Maximum Eigenvalue statistic	Critical Value (0.05)	Prob.	Trace statistic	Critical Value (0.05)	Prob.
MS	63.2227	21.1316	0.0000	95.6172	29.7970	0.0000
ER	22.0392	14.2646	0.0024	32.3945	15.4947	0.0001
INF	10.3553	3.84146	0.0013	10.3553	3.84146	0.0013

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It is clear from the (Johansen Test) shown in Table (4) that all the variables have a co-integration relationship at the significant level (5%), and these results support the procedure for estimating the econometrics model correctly for all variables.

Granger Causality Test:

The concept of causality focuses on the existence of a causal relationship between the variables of the study, although there are some economic reservations about this test, but it is considered one of the important tests to determine the direction of variables (dependent or independent variable), there are many tests to determine the direction and the causal relationship between variables (one direction or two direction), but the (Granger Causality) test is one of the main and most used tests in the field of economic analysis. The results of this test are presented in Table (5).

Table (5): Results of Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
ER does not Granger Cause MS	17	1.97531	0.1914
MS does not Granger Cause ER		2.78761	0.1014
INF does not Granger Cause MS	17	1.46781	0.2980
MS does not Granger Cause INF		6.99625	0.0100
INF does not Granger Cause ER	17	1.14235	0.4027
ER does not Granger Cause INF		7.73352	0.0074

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It appears from Table (5) at the level of significance (5%), that there is a one-direction causal from (Money Supply to Inflation Rate), as well as the existence of a one-direction from (Exchange Rate to Inflation rate).

Short and long run Estimation:

The results of the stationary, co-integration and causality tests support the correct estimation of the proposed model, in order to measure and analyze the short and long run Interchangeable Relationship between Exchange Rate, Money Supply and Inflation rate in Iraq, the (ARDL) model was chosen to give it better results in terms of economic, statistical and econometrics indicators, and the results of short and long-term impact as follows:

1: Short and long run Estimation of Money Supply Model:

To illustrate the impact of the exchange rate and inflation rate on the money supply, the following table is presented.

Table (6): Results of short and long run estimation using ARDL for Money Supply

ARDL -Bounds Test	Value	Significant Level	I(0) Lower	I(1) Upper
	29.74	10%	2.17	3.19
		5%	2.72	3.83
		1%	3.88	5.30
Variables	Short run		Long run	
	Coefficient	Prob.	Coefficient	Prob.
Exchange Rate	0.0032	0.0015	0.0097	0.0003
Inflation Rate	0.0228	0.0056	- 0.0643	0.0000
Coint Eq(-1)	-0.3333	0.0000		

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It is clear from table (6) that:

A: From the table above and the (Bounds Test) results, it is evident variables included in the model exhibit long-term co-integration. The (ARDL -Bounds Test) value of (29.74) is greater than (3.83), supporting the accurate long-term estimation of all variables.

B: The (error correction coefficient), it is expected to be negative and significant, and it reached (-0.33), which indicates the validity of the error correction model and indicating the speed of adjustment from the short term to the long term.

C: Based on the (volume) of the estimated parameters and their special signs, which increase the (Exchange rate) by one unit led to an increase in (Money Supply) in the short term by (0.0032), but this increased to (0.0097) in the long run .Moreover, increase the (Inflation Rate) by one unit led to an increase in (Money Supply) in the short term by (0.0228), but this effect in long term is opposite and due to decreased money supply by (- 0.0543) in the long run, may be this because that most on goods come from outside through imports .

2: Short and long run Estimation of Exchange Rate Model:

To illustrate the impact of the money supply and inflation rate on the exchange rate, the following table is presented.

Table (7): Results of short and long run estimation using ARDL for **Exchange Rate**

ARDL -Bounds Test	Value	Significant Level	I(0) Lower	I(1) Upper
	78.25	10%	3.17	4.14
		5%	3.79	4.85
		1%	5.15	6.36
Variables	Short run		Long run	
	Coefficient	Prob.	Coefficient	Prob.
Money Supply	- 0.0440	0.0087	- 0.0349	0.0086
Inflation Rate	- 0.0093	0.0762	- 0.0222	0.0040
Coint Eq(-1)	-0.4222	0.0000		

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It is clear from table (7) that:

A: From the table above and the (Bounds Test) results, it is evident that there are variables included in the model with a long-term co-integration, because the value of (ARDL -Bounds Test) is equal (78.25) is greater than (4.85), supporting the accurate long-term estimating of all variables.

B: The (error correction coefficient), it is expected to be negative and significant, and it reached (-0.42), which indicates the validity of the error correction model and indicating the speed of adjustment from the short term to the long term.

C: Based on the (volume) of the estimated parameters and their special signs, which increase the (Money Supply) by one unit led to an decrease in (Exchange Rate) in the short term by (0.0440), but this increased to (0.0349) in the long run .Moreover, increase the (Inflation Rate) by one unit led to an decrease in (Exchange Rate) in the short term by (0.0093), but this effect in long term is (- 0.0222) in the long run.

3: Short and long run Estimation of Inflation Rate Model:

To illustrate the impact of the money supply and exchange rate on the inflation rate, the following table is presented.

Table (8): Results of short and long run estimation using ARDL for **Inflation Rate**

ARDL -Bounds Test	Value	Significant Level	I(0)Lower	I(1)Upper
	11.0171	10%	3.17	4.14
		5%	3.79	4.85
		1%	5.15	6.36
Variables	Short run		Long run	
	Coefficient	Prob.	Coefficient	Prob.
Money Supply	2.8808	0.2500	2.4107	0.0015

Exchange Rate	0.0145	0.0092	0.0122	0.0020
Coint Eq(-1)	-1.1949	0.0021		

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

It is clear from table (8) that:

A: From the table above and the (Bounds Test) test, it is evident that there are variables included in the model with a long-term co-integration, because the value of (ARDL -Bounds Test) is equal (11.01) is greater than (4.85), and thus supports these results make long-term estimates correctly for all variables.

B: The (error correction coefficient), it is expected to be negative and significant, and it reached (-1.19), which indicates the validity of the error correction model and indicating the speed of adjustment from the short term to the long term.

C: Based on the (volume) of the estimated parameters and their special signs, which increase the (Money Supply) by one unit led to an increase in (Inflation Rate) in the short term by (2.88) but insignificant, but this increased to (2.41) in the long run with significant level .Moreover, increase the (Exchange Rate) by one unit led to an increase in (Inflation Rate) in the short term by (0.0145), but this effect in long term is (0.0122) in the long run.

Diagnostic tests:

The last step in completing the stages of building the econometrics model, which is the stage of evaluating the estimated model, in order to be more accurate. In this context, several statistic indicators were used, including (R^2 , Adjusted R^2 , F, Std. Error, SSR, AIC), as well as several econometrics test including (Autocorrelation, Multicollinearity, Heteroskedasticity, Non-normal distribution of data), thus, the result of these indicators and tests.

Table (9): Results of Diagnostic tests for estimation models

First Model : Money Supply :			
Statistic tests	Prob.	Econometrics tests	Prob.
R-Squared	0.99	Durbin-Watson test for Autocorrelation	2.42
Adjusted R^2	0.98	LM/Breusch-Godfrey test for Serial correlation	0.0799
F-statistic Prob.(F-statistic)	142.10 (0.0000)	Variance Inflation Factors test for Multicollinearity	) 2.78-1.29 (
S.E. of regression	0.0512	ARCH test for Heteroskedasticity	0.4411
Sum Squared Residual	0.0209	Ramsey Reset Test for Identification	0.4211
AIC	-2.8004	Jarque – Bera test for Normality	0.6908
Second Model : Exchange Rate :			
Statistic tests	Prob.	Econometrics tests	Prob.
R-Squared	0.997	Durbin-Watson test for Autocorrelation	2.30
Adjusted R^2	0.993	LM/Breusch-Godfrey test for Serial correlation	0.5820
F-statistic Prob.(F-statistic)	213.23 (0.0000)	Variance Inflation Factors test for Multicollinearity	) 3.07-1.08 (
S.E. of regression	0.0054	ARCH test for Heteroskedasticity	0.6760
Sum Squared Residual	0.0001	Ramsey Reset Test for Identification	0.8547
AIC	-7.4031	Jarque – Bera test for Normality	0.0010
Third Model : Inflation Rate :			

Statistic tests	Prob.	Econometrics tests	Prob.
R-Squared	0.98	Durbin-Watson test for Autocorrelation	2.61
Adjusted R ²	0.95	LM/Breusch-Godfrey test for Serial correlation	0.1966
F-statistic Prob.(F-statistic)	30.5974 (0.0024)	Variance Inflation Factors test for Multicollinearity	) 2.18-1.37 (
S.E. of regression	0.4693	ARCH test for Heteroscedasticity	0.4212
Sum Squared Residual	0.8812	Ramsey Reset Test for Identification	0.3660
AIC	1.5010	Jarque – Bera test for Normality	0.4511

Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

From table (9) we note following:

A: The value of (R^2) and (Adjusted R^2) are very high for the entire estimator model, with a value of (95%, 99%) respectively. This means that all independent variables included in the models have a strong relationship with the dependent variables, and on the other hand, the difference between (R^2 and Adjusted R^2) is very small for all models, this means that all the variables included in the estimated models are necessary and important.

B: The ARDL estimation passed all diagnostic tests, because the value of the estimated parameters is greater than (0.05) and the value of the (VIF) is less than (10) after removing the logarithms from variables.

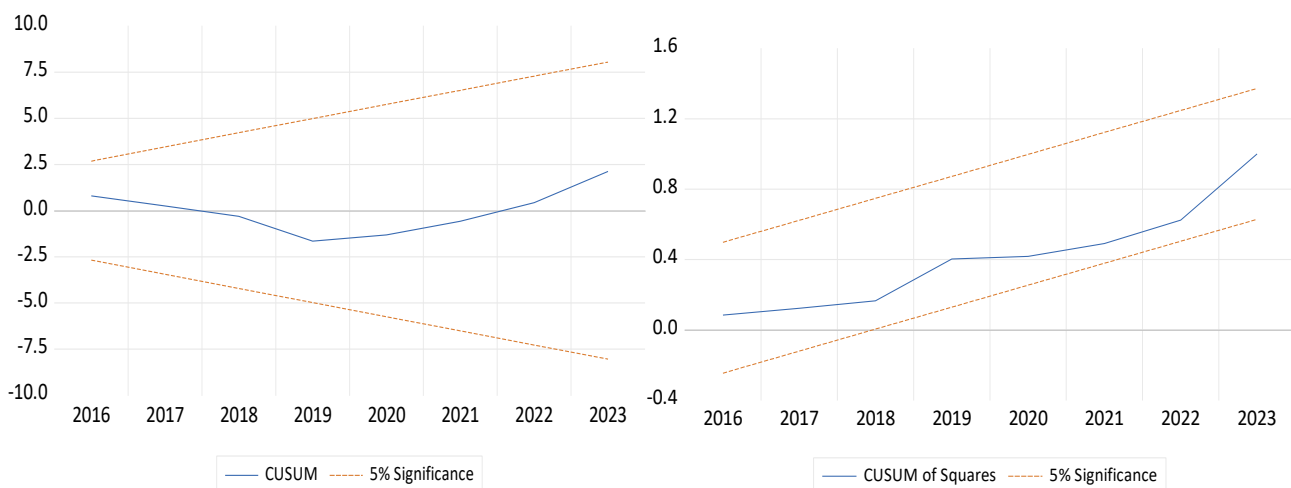
C: The value of (F) for all models which is less than the value of (P-value 0.05), so we reject the null hypothesis that recognizes the lack of relationship between the independent variables and the dependent variable.

D: The value of (S. E /SSR/ AIC) are generally suitable and acceptable, and which indicates the validity and accuracy of the estimation.

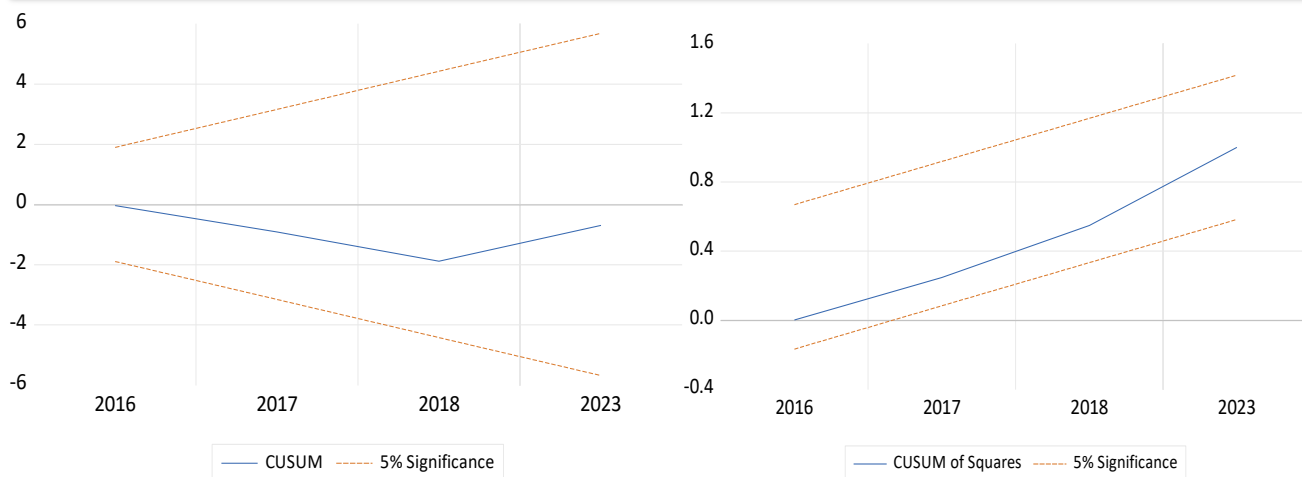
Stability tests (CUSUM and CUSUM of Squares):

To ensure the stability of coefficients, appropriate and reliable tests should be used, such as (CUSUM) and (CUSUM of Squares). This can be depicted through the diagrams as follows:

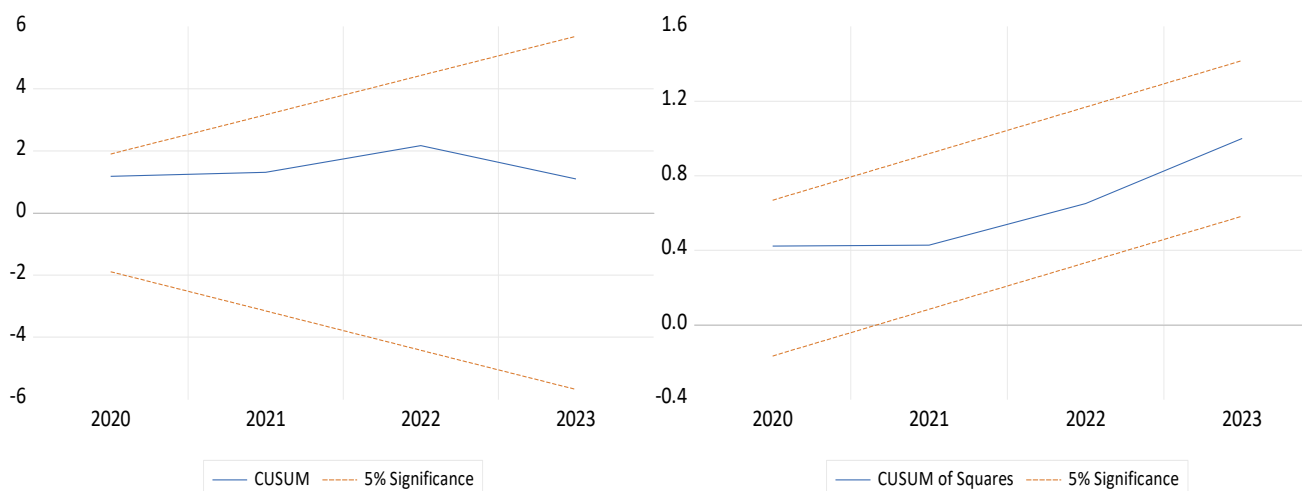
For Money Supply estimation



For Exchange Rate estimation



For Inflation Rate estimation

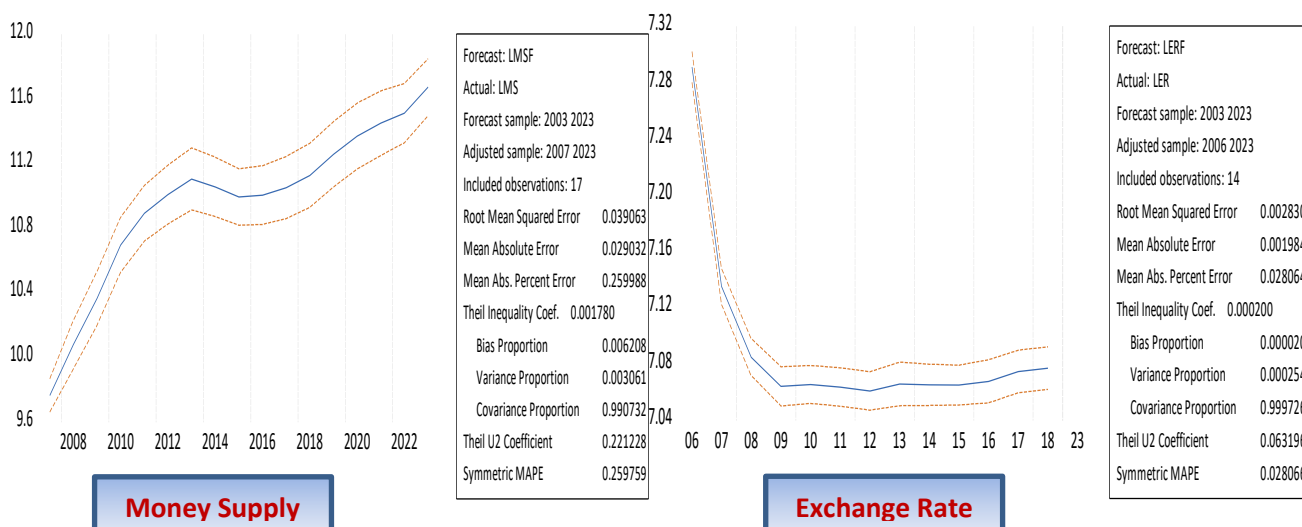


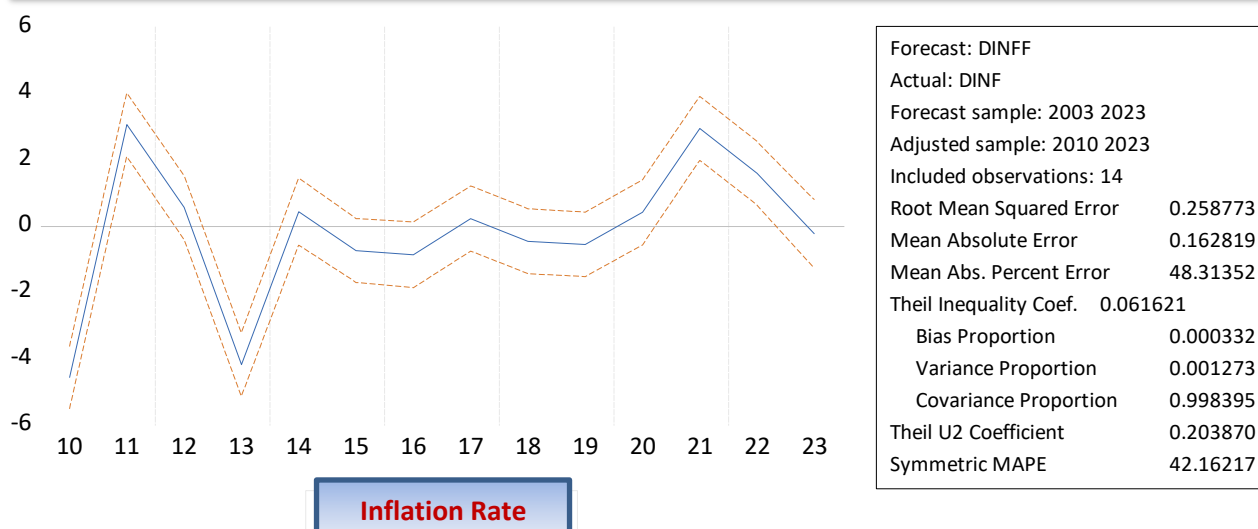
Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

Through the above diagrams, the coefficient estimators are stable, because the blue curve of the data lies between the two lines, and this indicates the stability of the estimated parameters at the level of significance (5%).

Testing the predictive performance of the model estimation:

In fact, there are several tests for checking the ability and performance of **Money Supply**, **Exchange Rate** and **Inflation Rate Estimations** for forecasting purpose, such (RMSE, MAE, MAPE and Theil Inequality coefficient), and the result as following:





Source: Prepared by researchers based on annual data for the period (2003-2023) using the program E-views 12.

The figures above shows that the results of errors for each of (RMSE), (MAE) and (MAPE) are few, and this is indicators of forecasting accuracy. Moreover, the Theil Inequality coefficient, which is considered the best predictive performance indicator, has values of 0.0017, 0.0002, and 0.0616 for Money Supply, Exchange Rate, and Inflation Rate, respectively. This implies that the predictive efficiency of the estimation models is very strong.

Conclusion:

Based on theoretical hypothesis and substantiated through empirical investigation, this study provides comprehensive evidence of the existence of the relationship between money supply, exchange rate and inflation rate in the context of Iraq. To show the interchangeable relationship between the variables, the Autoregressive Distributed Lag (ARDL) model was applied to measure and analyze the subject by using annual data for the period of (2003 -2023) related to Exchange Rate, Money Supply and Inflation rate and give it better results in terms of economic, statistical and econometrics indicators. It is documented in the study that Money Supply ranged from 2243 to 122601, with a mean of 59279. - Exchange Rate fluctuated between 1166 and 1470, with a mean of 1263. - Inflation Rate varied from -0.2 to 53.2, with a mean of 9.82, and the results of the stationary, co-integration and causality tests support the correct estimation of the proposed model.

The empirical findings indicate significant co-integration among the variables and provide insights into their short and long-term dynamics. It is shown that Money Supply and Exchange Rate exhibit a positive relationship in both short and long terms, with a stronger impact in the long run. For instance, an increase in Exchange rate by one unit led to an increase in Money Supply in the short term by (0.0032), but this increased to (0.0097) in the long run. However, the impact of money supply on inflation is mixed, inflation Rate is positively influenced by Money Supply in the long term but negatively in the short term. For example, an increase in Inflation Rate by one unit led to an increase in Money Supply in the short term by (0.0228), but this effect in long term is opposite and due to decreased money supply by (- 0.0543) in the long run, this may be because that most of the goods imports. Moreover, Exchange Rate and Inflation Rate show a negative relationship in the short term, but this effect reverses in the long run. As shown from the study, an increase in Inflation Rate by one unit led to a decrease in Exchange Rate in the short term by (0.0093), but this effect in long term is (- 0.0222).

Overall, the study provides a comprehensive analysis of the dynamic relationship between Money Supply, Exchange Rate and Inflation Rate in Iraq, offering valuable insights for policymakers and researchers in the economic landscape. In another word, understanding this relationship can help shape future economic strategies and support the stability of the Iraqi economy.

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