Relationship Between Money Supply and Some Macroeconomic Variables in The Libyan Economy During Period (1990- 2022)

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■ **ABSTRACT**

This study objective to examine the relationship between money supply and some macroeconomic variables (inflation, government expenditure, exchange rate, and economic growth) in Libya from 1990 to 2022. To achieve that above objective, the study employs the Augmented Dickey Fuller (ADF) and Autoregressive Distributed Lag (ARDL), Bounds Testing Approach" for "Co-integration were applied to study the cointegration among, the above-mentioned variables, Granger causality test and error correction mechanism to estimation of the relevant equations. The results of the cointegration tests showed that there is a long-run relationship among the macroeconomic variables in the model and money supply. And the coefficient of the the inflation (LNIFLT) and coefficient of the government expenditure (NEXPN) have positive significant effect on money supply in long--run , But the other variables coefficients (economic growth and exchange rate) have not positive significant effect on money supply in long--run . While in short run the coefficient of the lagged economic growth (GDP-1), lagged inflation (LNIFLT-1) and exchange rate (LNEXCH), government expenditure (LNEXPN) have significant effect on money supply in short--run . With the speed of adjustment is fast from short-run to long-run which slightly more than -.82 %. Furthermore, the results of the granger causality test showed that the existence of bi-directional causality relationship between inflation and money supply. Also, and bi-directional causality relationship between government expenditure and money supply. In addition to that there is uni-directional causality from money supply to exchange rate. but there is no any causality relationship between money supply and economic growth.

● **KEY WORDS**: Money supply, Macroeconomic Variables, Autoregressive Distributed Lag (ARDL), Granger Causality Test

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العلاقة بين المعروض النقدي وبعض المتغيرات الاقتصادية الكلية في الاقتصاد الليبي خلال الفترة (1990-2022)

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■ **ملخص البحث**

هدفت هذه الدراسة إلى دراسة العلاقة بين المعروض النقدي وبعض المتغيرات الاقتصادية الكلية (التضخم، الإنفاق الحكومي، سعر الصرف، والنمو الاقتصادي) في ليبيا من عام 1990 إلى عام 2022. ولتحقيق هذا الهدف أعلاه، استخدمت الدراسة اختبار ديكي فولر الموسع (ADF) ونموذج الانحدار الذاتي الموزع (ARDL)، واختبار الحدود "لاختبار التكامل المشترك بين المتغيرات المذكورة أعلاه والعلاقة بينها في المدى الطويل والقصير، واختبار السببية جرينجر وتقدير المعادلات ذات الصلة. وأظهرت نتائج الاختبارات وجود تكامل مشترك وعلاقة طويلة وقصيرة الأجل بين المتغيرات الاقتصادية الكلية المستقلة في النموذج والمعروض النقدي. ومعامل لوغاريتم التضخم (LNIFLT) ولوغاريتم الإنفاق الحكومي (LNEXPN) لهما تأثير إيجابي معنوي على المعروض النقدي في المدى الطويل، ولكن معاملات المتغيرات الأخرى لوغاريتم النمو الاقتصادي (GDP-1) ولوغاريتم وسعر الصرف (LNEXCH) ليس لها تأثير إيجابي معنوي على المعروض النقدي في المدى الطويل. بينما في المدى القصير فإن معامل النمو الاقتصادي المتأخر (GDP-1) و لوغاريتم التضخم المتأخر (LNIFLT-1) و لوغاريتم سعر الصرف (LNEXCH) لوغاريتم والإنفاق الحكومي (LNEXPN) لها تأثير معنوي على المعروض النقدي في المدى القصير. مع سرعة التعديل سريعة من المدى القصير إلى المدى الطويل والتي تزيد قليلاً عن -.82 ٪. علاوة على ذلك، أظهرت نتائج اختبار السببية غرانجر وجود علاقة سببية ثنائية الاتجاه بين التضخم والمعروض النقدي. أيضا، وعلاقة سببية ثنائية الاتجاه بين الإنفاق الحكومي والمعروض النقدي. بالإضافة إلى ذلك هناك سببية أحادية الاتجاه من المعروض النقدي إلى سعر الصرف. ولكن لا توجد أي علاقة سببية بين المعروض النقدي والنمو الاقتصادي

الكلمات المفتاحية: المعروض النقدي، المتغيرات الاقتصادية الكلية، الانحدار الذاتي ذو التأخير الموزع (ARDL)، اختبار السببية لجرانجر.

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■ Introduction 1

An important the issues for policy makers and economists is the special role of the money supply in any economy, due to its large role and because a change in its quantity can have a significant positively and /or negative effect on the main macroeconomic indicators example economic growth, inflation, unemployment, exchange rates (Ifionu, E., & Akinpelumi, O. F. (2015). So, the link between the aggregate money supply, and Macroeconomic variables has sparked a great academic debate in the field of economics and finance. The money supply is a highly sensitive variable the size and velocity of it .it determine the pace of any economic activity. In addition to being a powerful instrument of monetary policy, its expansion or contraction dictates the growth of investment and output in any economy. Therefore, the usual motto of the monetarist school of thought is that the money supply matters to any developing or developed economy economic. The Libyan economy is beset by several challenges. as an increase in general price levels and the civil war which that lead to important economic distortions, as a consequence, wage increases and excessive public spending.

In fact, the existence and persistence of some economic problems and political instability in the Libyan economy usually requires studying the nature of the relationship between the previous macroeconomic variables. It should be noted that the oil production and export stopped due to the closure of oil fields during the civil war damaged the level of economic production and has caused economic rigidity, the irregular increase in the inflation rate and the decrease in the economy's production (GDP) has caused an imbalance in the base monetary, of the Libyan economy, Bourhrous, A. (2022).Also, the economy was characterized by structural rigidities and bottlenecks most of our exports and imports are characterized by inelasticity on the demand side or both. The Libyan economy relies heavily on imports, so the pressure on the demand for foreign exchange will inevitably create an alternative market and therefore different rates. and revenues are barely repatriated to the country,

exacerbating the rigidity of supply and production. The CBL's guidelines on purchasing foreign currency are often cumbersome, causing some frustrated potential currency users to patronize the parallel market, causing leakage which consequently reflects on the inflation rate by raising it and continue with a weak exchange rate for the nation., this and others constitute a problem for the monetary base and a gap between the macroeconomic variables and the level of money supply in the nation.

■ **Problem of the study2**

This relationship has been extensively investigated in both the theoretical and empirical literature by researchers in developed and developing countries over different periods times and provided conflicting evidence on this topic, see for example:

Friedman and Kuttner (1992), Stock and Watson (1993), Boucher and Flynn (1997), Herwartz and Reimers (2006), Saatcioglu and Korap (2008). To the best of our knowledge, there has been little empirical analysis of the long and short-run relationship between the important macroeconomic variables, as real Gross Domestic Product (GDP), money supply (MS), expenditures (EXPEN) , exchange rate (EXCHN), and the inflation (INFL), in the context of the Libyan . To understand the relationship between aforementioned Macroeconomic variables, researchers have worked hard to understand the relationship. However, the existing empirical literature is far from reaching a conclusive agreement on the precise relationship between those Macroeconomic variables. Also, there is also controversy about the direction of causality between that Macroeconomic variables despite the strong positive and / or negative correlation between them. This paper try seeks to fill this gap by modern econometrics, additional empirical evidence on the ongoing debate about the examining type and direction of the relationship causality between study variables in Libya in the short and long-run in Libya, over the period 1990 –2022.

■ **Objective of the paper3**

The main objective of this paper to study the relationship of selected variables and money supply in Libya. This work is specifically aimed at achieving the following objectives:

1 - Determine the relationship of selected macroeconomic variables in Libya economy.

2 - Determine the direction of relationship between selected macroeconomic variables in Libya economy.

3 - the recommendations, based on the findings, are expected to help the government find a lasting solution to the problem of controlling inflation in Libya economy,

4 - would provide a reference material for other researchers who might be interested in conducting research in similar or related areas of study.

■ **Hypothesis of the study 4**

The major hypothesis of this paper Is there any short- and / or long-term relationship between selected macroeconomic variables, in the study and money supply in Libya economy, so the study is guided by the following hypotheses using **H0** (null hypothesis):

$H0_1$: There is no cointegration relationship between selected macroeconomic variables in study.

$H0_2$: There is no significant relationship short- and long-term relationship between selected macroeconomic variables and money supply in Libyan economy.

$H0_3$: There is no any causality relationship between selected macroeconomic variables and money supply in Libyan economy.

■ **The importance of study5**

A clear understanding of the relationship between these selected macroeconomic variables is of crucial importance, particularly for policymakers, to ensure that effective macroeconomic stabilization policies can be effectively designed and implemented in Libyan economy**.**

The present paper has been discussed in 4 sections. In section 1 general framework. In section 2 literature review has been presented, section 3 deals with database and research methodology, major findings from the study and discuss it are presented in section 4.

6- Theoretical Review

This section discusses different theoretical approaches to the relationship between macroeconomic variables. There are several theoretical thoughts related to the money supply, inflation, exchange rate, government spending economic growth, and so on according Classical Monetary Theory, monetarism theory, Neoclassical theory.

Over the years, theories on the nexus between monetary policy (Money Supply) and most macroeconomic variables have flourished, giving rise to differing Opinions lines of opinion among different schools of thought. This was based on the fact that a high rate of economic growth capable of translating into economic development required an appropriate mix of monetary policy variables, therefore this has generated a lot of attention among various schools of thought ranging from classical to neoclassical , Keynesian to neo-Keynesian , et about the impact of the money supply on some macroeconomic variables date back to classical and Keynesian monetary theory, which is also known as the quantity theory of money Allais, M. (1966).

Classical monetary theory is not the contribution of a single economist, rather it is the combined idea of classical economists, namely Adam Smith, David Ricardo, Fisher and Say. They assume the classical quantity theory of money of money associated the money supply is exogenously determined, so that the causation between money supply and price is only in one direction. This theory believes that the real variables of the economy do not depend on the amount of money in circulation. Therefore, money plays no role in determining the output, employment, and income of an economy. This implies that the quantity of money is the main determinant of the price level. Any change in the quantity of money produces an exactly proportional change in the price level, therefore, an increase in the mobilization of savings increases capital, per capita and therefore production and income in the economy. Therefore, the Solow model says that money It is not relevant in economic growth because production does not depend on monetary growth. The Solow

model uses a production function approach to measure the role of money. Production in this model is a function of the capital stock, labor force, and technology.

In classical monetary theory, changes in the money supply do not affect other real values. variable such as employment and economic growth because the classical economy is always in the equilibrium of full employment and only the real factor of production such as technology Niehans, J. (1987), Monetarists believe that the money supply has a lagging effect. They argue that it takes 6 months to 2 years to show its full effect on the economy. Thus, they suggest the principle of the role of constant money supply growth, which means that the central bank should increase the money supply at a constant rate, which is consistent with GDP growth, inflation, and other macroeconomic variables Wibowo, B. P., & Setyowati, E. (2023).

Neoclassical economists examine the role of money supply in economic activity argues that change in the money supply leads to change in these macroeconomic variables, as the price level, output, expenditures, exchange rate, and employment; money has a neutral role in the economy. Keynes also disagrees with the older monetary theorists in their conclusion that there is a direct and proportional relationship between the money supply and prices. He made it clear that the effect of the change in the money supply on prices is indirect and not proportional, and changes in the money supply affect only the absolute price level but have no impact on the relative price level. Keynes believes that as long as there is unemployment, production will change in the same proportion as the quantity of money and there will be no change in prices; and when there is full employment, prices will change in the same proportion as the quantity of money (Paul, 2015). In opposition to the Keynesian approach, the monetarist thought affirms that Monetarists hold that money plays an active role leading to changes in income and prices. However, modern quantity theorists led by Friedman and Kuttner (1992), hold that inflation is always and everywhere a monetary phenomenon, arising from

a more rapid expansion in the quantity of money. than in the actual output. According to them, the money is used to buy not only the final product but also intermediate products Therefore, the Monetarists hold that monetary policy is a more powerful instrument than fiscal policy in economic stabilization. They suggest a one-way causation that goes from money to income to prices without any feedback. They suggest a one-way causation that goes from money to income to prices without any feedback. The conclusion monetarists reach is that changes in most macroeconomic variables as income and prices in an economy are mainly due to changes in the quantity of money. The expansion or contraction of monetary policy dictates the growth of investment and output in any economy. Therefore, the usual motto of the monetarist school of thought is that money matters. They argued that changes in the amount of money in circulation is an important determinant of other economic indices. In other words, changes in the size of the money supply have a number of implications for macroeconomic variables.

Although economic theories that were referred to above suggests the relationships between some macroeconomic variables and Money Supply which these might influence each other, the topic has been the subject of considerable debate. Over the years, a number of approaches have been developed that allow us to further explore the causality underlying the connection between these variables.

7- Literature review

Although there is disagreement among economists about the roles of macroeconomic variables and Money Supply, as well as their interrelationship, these variables are considered important, and a large body of literature in economics deals with these macroeconomic variables in particular, the causal relationships between macroeconomic variables and money supply, have been an active area of research in economics. A good number of empirical studies have been carried out both internationally and nationally on those links, the following many studies. The most important of these studies are the following have been carried out.

The study of Batarseh, A. (2021). aimed to investigate the relationship between the money supply and inflation in the Jordanian economy during the period of 1980–2019. The methodology of econometric analysis of time series was used through the following tests: Augmented Dickey-Fuller (ADF) test – to test the stability of the study variables, Johansen's Cointegration Approach – to determine the long-term equilibrium relationship between the study variables, and the Granger Causality Test – to determine the direction of the causal relationship if it exists in the short term. The Cointegration test results indicated that there was no link between the money supply and inflation in the long term. Finally, the results of Granger Causality presented a unidirectional causality running from the money supply to inflation in the short term, meaning that money supply causes inflation, not vice versa; this means that the money supply can explain the changes that occur in the consumer price index in the Jordanian economy.

The study by Long, P. D., Hien, B. Q. & Ngoc, P. T. B. (2021). focused on analyzing the relationship between the money supply, inflation, and production in Vietnam and China. Using the error correction model and vector autoregression model (ECM and VAR) and canonical cointegration regression, the study findings indicated the difference in the estimated coefficients between the two countries with different economic scales. While inflation in Vietnam is strongly influenced by expected inflation and output growth, inflation in China is strongly influenced by money supply growth and output growth.

This study by Nasir, R., Waheed, R., & Nasir, W. (2021. The objective was to analyze the influence of the Monetary Supply, Inflation and the Exchange Rate on economic growth, using Ordinary Least Squares and Vector Autoregressive analysis methods. The results of the multiple regression tests of the Ordinary Least Squares method indicated that the impact of the CPI and ER in the short term (Lag_1) is significantly positive on the changes in economic growth (DLNGDP). But in the long term (Lag_2) it weakens

because the influence is significantly negative. The influence of DLNGDP inaction is negative, both DLNGDP_1 and DLNGDP_2. It gives an indication that economic growth is more determined by economic growth in the past.

The study by Mohsin , K. (2021) sought to clarify and measure the relationship between public spending and the money supply as explanatory variables on inflation expressed in the general price level (as a dependent variable) in the Iraqi economy during the period 2005 -2019. was based on the Autoregressive Distributed Lag (ARDL) model to measure the relationship between the study variables, using annual data, applied the Integration Analysis for Common and Model Stability to estimate the short- and long-term parameters of the model. there is a positive relationship between government spending, the general price level, the money supply, and the general price level.

The paper by Jawo, A., Jebou, M. and Bayo, L. F. (2023) adopted the ARDL model to examine whether the real effective exchange rate, economic growth and money supply cause inflation in The Gambia over the 1985 period to 2021. The finding revealed that all of our variables cause inflation positively and negatively in the long and short run, respectively, at a significant 1% level, except for the real effective exchange rate and money supply, which is significant at the 5% level. % long-term. The recursive cumulative sum showed that the relationship was stable and the squared recursive cumulative sum reveals instability in the relationship of our dependent and independent variables that could be the result of an exogenous shock on output.

The study by George, C., Suoyai, E., Tema, L. and Boloekeye, M. (2018). set out to investigate the impact of money supply on macroeconomic variables in Nigeria from 1985 to 2016. The specific objectives of the paper were to determine the impact of money supply, inflation rate and exchange rate on real gross domestic product, on the one hand, and Tight Money Supply, Wide Money Supply, and the Consumer Price Index Exchange Rate in Nigeria. The ordinary least squares technique was used to determine the magnitude and direction of the variables in the models. It showed that the tight money supply

has a positive and significant impact on inflation and real gross domestic product; by contrast, the ample money supply does not have a significant impact on inflation and real gross domestic product. Empirical evidence also showed that the exchange rate has a negligible impact on inflation and real gross domestic product. The inflation rate, on the other hand, has an inverse and statistically insignificant impact on the real gross domestic product in Nigeria. Ceteris Paribus, the results suggest that economic growth and inflation are a function of the money supply and the exchange rate in Nigeria .

The study by Denbel, F. S., Ayen, Y. W., & Regasa, T. A. (2016). has examined the causal relationship between inflation and money supply and between inflation and economic growth in Ethiopia for the period 1970/71-2010/11. The Johansen cointegration test indicates the presence of a cointegration vector and the VECM shows the existence of long-term bidirectional causality between inflation and the money supply and unidirectional causality from economic growth to inflation. In the short run, a one-way causality was found from money supply and economic growth to inflation. Therefore, based on the results of the study. the study recommends that monetary policy be planned to maintain price stability by controlling the growth of money supply in the economy.

The main objective of the article by Muhammad, S. D., Wasti, S. K. A., Hussain, A. and Lal, I. (2009) is to find out the long-term relationship between the money supply, inflation, government spending and economic growth in the Pakistan case. has used the Johnson cointegration test to discover long-term association and the Granger causality test to discover two-sided and one-sided causation. Using selected annual data from 1977 to 2007, the results show that government spending and inflation are negatively related to long-term economic growth, while the money supply has a positive impact on long-term economic growth. The reason behind the negative association between public spending, inflation, and economic growth is that most public spending is not for development and inflation is due to adverse supply.

The paper of Bello, M. Z., & Saulawa, M. A. (2013). attempted to examine the relationship between money supply, interest rate, income growth and inflation rate in Nigeria over the period 1980-2010. The paper used a cointegration method, VAR, and the Granger causality test to examine the relationship between variables. Based on this approach, the paper found that there is no long-term relationship between the variables and the Granger causality test shows a bidirectional relationship between the money supply and inflation, income growth and inflation, and the rate of interest. interest and inflation. The Granger causality test also revealed that the money supply, interest rate, and income growth cause inflation. Based on these findings, this study recommends proper control and management of the money supply, the interest rate, and the inflation rate.

■ Methodology8

8-1 Variables and data sources

The main objective of this paper is to estimate relationship between money supply (MS), (GDP) Gross Domestic Product (GDP) As an indicator of economic growth , Inflation(INF) and Exchange rate(EXCH) , with respect to the Libyan economy for the period of 1990 and 2022 . The sources of data for this study were mainly from National Bureau of Statistics, Central Bank of Libya statistical Bulletin and World Bank Data Base. In the study, we will employ the cointegration and the causality test. to estimate a cointegration relationship between long-term variables and a causal relationship between previous variables in this study the model can be formulation as:

8-2 Functional Linear Model

The functional linear form of the model is as follows:

$MS = f(GDP, , EXCH, INF, EXPN)$ …….. *(1)*

Transforming equation 1 to equation 2 as:

$LNMS=\beta 0+\beta_1 LNGDP+\beta_2 tLNEXCH+\beta_3 LNINF+\beta_4 LN\ EXPN$ ..... *(2)*

Econometric Linear Model:

$LNMS=\beta 0+\beta 1\ LNGDP+\beta 2t\ LNEXCH+\beta 3t\ LNINF+\beta 4t\ LN\ EXPN+\mu i$ .... (3)

Where:

LNMS = Natural Logarithm *Money Suppl*

LNGDP = Natural Logarithm Gross Domestic Product

LNEXCH = Natural Logarithm *Exchange Rate*

LNINF = *Natural* Logarithm *Inflation*

LN EXPN = Natural Logarithm Government Expenditure

β_0 = *constant* $\beta_1, \beta_2, \beta_3, \beta_4$ = explanatory variables coefficients **μi** = the error item for each estimation.

8-3 Stationarity Test

8-3-1 Dickey Fuller Unit Root Test:

Dickey Fuller (DF) Unit Root Test, developed by Dickey and Fuller in 1979, forms the basis of unit root tests developed to test the stationarity of time series. Dickey and Fuller (1979) consists of T observations and observation values areY1 He showed the Yt time series in the form of Y2,*Y*3…,Yt as an autoregressive process as follows:

$$Y_t = \rho Y_{t-1} + e_t \qquad t = 1,2,3,\ldots$$

If $|\rho| = 1$, the time series is not stationary. Thus, the variance of Yt is σ2. If ρ>1, such a time series is called a "random walk". $|\rho|$ A time series with > 1 is non-stationary and the variance of this series increases as t increases. If $|\rho|$ If < 1, the time series Yt is stationary.

Dickey and Fuller›s` 3different model types and test statistics are expressed asfollows: Model a: $Y_t = \rho Y_{t-1} + e_t \qquad t = 1,2,\ldots$

Model b: $Y_t = \mu + \rho Y_{t-1+} e_t \qquad t = 1,2,\ldots$

Model c: $Y_t = \mu + \beta t + \rho Y_{t-1+} e_t \qquad t = 1,2,\ldots$

Dickey and Fuller (1979) produced test statistics as $\tau, \tau_\mu, \tau_\tau$ for each model, respectively, since the traditional t-distribution cannot be used in these models. .

The critical values of the τ statistic, which does not fit the t-distribution in large samples, tabulated by Dickey and Fuller, were rearranged by Mac

Kinnon (1990). The t table value is compared to the calculated tau statistic. According to the left tail test, the appropriate hypothesis is rejected.

4 - Cointegration and estimation techniques8

There are many methods of cointegration. Engle and Granger (1987) were the first to formalize the idea of cointegration. The use of these methods relies on order, zero-order integrated I (0), one-order integration I (1), or fractionally Since the study used data from the 1990-2022 period (32 years) and the series are not very long, the ARDL method was preferred over other cointegration methods to test the long-term balance relationship between the series. We will estimate, if the dependent variable in the models is shown as Yt and the independent variable is Xt for ease of understanding the ARDL procedure, Pesaran, et al. (1995) proposed ARDL equations with constant term, constant term and trend will be as follows:

$$\Delta Y_t = \alpha + \sum_{i=1}^{m} \beta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta X_{t-i} + \beta_3 Y_{t-1} + \beta_4 X_{t-1} + v_t \quad \text{.....(4)}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{m} \beta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta X_{t-i} + \beta_3 Y_{t-1} + \beta_4 X_{t-1} + \varepsilon_t \quad \text{..... (5) .}$$

we will existence of a long-term equilibrium relationship between variables is tested with the bounds test. In the bounds test, the null hypothesis $H_0 : \beta_3 = \beta_4 = 0$, implies that there is no long-run relationship in equation 4 or equation 5, we will test against the alternative hypothesis $H_1 : \beta_3 \neq \beta_4 \neq 0$. The F test statistics used are from Pesaran, M. H. (2015). suggested, the null hypothesis will be rejected and it will be concluded that there is a long-term equilibrium relationship between the variables. F statistics suggested, the null hypothesis will be accepted if the lower critical value is less than I (0). If the test statistic is between the critical values of I(0) and I(1), long-term equilibrium When a long-term cointegration relationship is found between the series as a result of the bounds test, the long-term ARDL model will be as follows:

$$Y_t = \beta_0 + \sum_{i=0}^{p} \beta_{1i} Y_{t-i} + \sum_{i=1}^{q} \beta_{2i} X_{t-i} + \pi_t \quad \text{.....(6)}$$

Finally, the short-term equation, also known as the error correction model

(ECM), will be found with the help of the following equation:

$$Y_t = \delta_0 + \sum_{i=0}^{p} \delta_{1i} \Delta Y_{t-i} + \sum_{i=1}^{q} \delta_{2i} \Delta X_{t-i} + \lambda ECM_{t-1} + \omega_t \quad \text{.....(7)}$$

In Equation 6, the error correction term is ($ECMt_{-1}$) coefficient (λ) It is known as the error correction coefficient or correction rate parameter. Although this coefficient gives the speed at which short-term imbalances reach long-term balance, the coefficient is expected to have a negative sign and be statistically significant.

5 - Optimum lag

Before proceeding with ARDL, it is important to select the appropriate delay length of the variables. The maximum delay length m is determined with the help of information criteria such as Akaike (AIC), Schwarz (SIC) and Hannan Quinn (HQ). The delay length that gives the minimum information criterion value is selected as the maximum delay length. However, care should be taken to ensure that there is no autocorrelation problem in the model obtained with the selected lag length.

6 - Granger causality test8

The Granger bivariate causality test is carried out with the help of the following models (Granger, C. W. (1969)

$$LY = \beta_0 + \beta_1 Yt\text{-}1 + \beta_2 X\,t\text{-}1 + e \quad \text{.....(8)}$$

$$LX = a_0 + a_1 X\,t\text{-}1 + a_2 Y\,t\text{-}1 + \mu \quad \text{..... (9)}$$

To determine if there is a causality relationship between the series, we will use the causality test of Granger at this stage of the study, we will be examined whether ‘s are equal to zero as a group. If the coefficients are found to be different from zero at a certain significance level, we will decide that there is a causality relationship from to equation 8. Similarly, if the ‘s in equation 9 are found to be different from zero at a certain significance level we will decide that there is a causal relationship from to. If (both) are different from zero, they both affect each other. In this case, we can decide that there is a two-way causality relationship between the variables. If both parameters are equal to zero, we will decide that there is no

causal relationship between the variables. Granger (1969). For the stability test of estimates, we will the CUSUM and CUSUMSQ tests in this study. In addition to these tests, other tests are also we will such as the Lagrange multiplier (LM) test for serial correlation, the Ramsey reset test for functional form misspecification, the Jarque-Berra test for normality and the test for heteroskedasticity.

9 - Empirical analysis and discussion of results

9-1 Dickey Fuller Test Results

The Augmented Dickey Fuller is necessary when dealing with time series data to check if the variables of interest follow a unit root process. To ascertain this, Augmented Dickey Fuller was used since from literature is the most commonly used test for stationarity. Thus, the results of the unit root as seen table 1 below reveals that, LNGDP is- stationary at level using 5% significant level while all the other variables are non-stationary at that level but after taking the first difference, they become stationary. Therefore, LNGDP is the only I (0) series and all other variables such as LNMS, LNEXCH, LNINFT and LNEXPN are I (1) series. This indicates that, we are having both I (0) and I (1) series in our model. This qualifies us to use the Autoregressive Distributed Lag Model (ARDL).

Table 1: Results of (ADF) Dickey Fuller test for level and first differences

Variable	P-value at Level	P-value at 5st Difference	Remark
LNMS	0.0831	0.0000	I(1)
LNGDP	0.0002	—	I(0)
LNEXCH	0.5814	0.0000	I(1)
LNINFT	0.0549	0.0000	I(1)
LNEXPN	0.5814	0.0000	I(1)

Source: Author Computation from STATA16

9-2 ARDL Optimum lags

As soon as the order of integration of the studied variables is in level and first

difference. to specify is there any long or short-term relationship between (LNMS, LNGDP, LNEXCH, LNIFLT, LNEXPN) , or not ? existing in our study , we use the suitable and most effective and suitable test, which is the ARDL (bound test) and we will determine the cointegration between them. But before this step, one must determine the number of delays existing in this estimate for each variable to accomplish this, we will apply method, and matrix list e(lags).

The results of the lag order selection criteria in table 2 show that the number of delays chosen is equal to lags 1 to ARDL model. Therefore, and at this moment, the number of delays existing to estimate the relationship between study variables as in table 2 (1 1 0 1 0 as follows:

Table 2: Numbers lags of ARDL model

```
e(lags)[1,5]
      lnms   lngdp  lnexch  lniflt  lnexpn
r1       1       1       0       1       0
```

now we are ready to process and estimate cointegration for the previous variables existing in our study using Bound test.

9-3 Analysis Cointegration test:

The F-statistical estimation from the ARDL (1 1 0 1 0) model, shows the values of the lower critical bound I (0), and of the upper critical bound I(1) are in table 3. we can summarize that If we compare the F-statistics value (7.833) with the upper critical bound value I (1) at the significance level of 10 %, 5%, 2.5 %, 1 %, (3.52), (4.01), (4.49), (5.06) respectively, then the F-statistic value is larger than the upper critical bound I(1) value at the previous significance levels . Also If we compare the T-statistics value (5.573) with the upper critical bound value I (1) at the significance level of 10 % , 5% , 2.5 % , 1 % , (-3.66) , (-3.99) , (-4.26) , (- 4.60) respectively , then the T-statistic value is larger than the upper critical bound I(1) value at the previous significance levels Thus the null hypothesis stating that no cointegration are rejected . In the other words, there is cointegration between variables of this study. Since the co-integration result in table 3 suggests a long run relationship among these variables. So, we can estimate now the long and short run relationship coefficients

of variables this study as in Table 4.

Table 3 : Result of ARDL Bound Test for Cointegration

```
Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship              F =  7.833
                                        t = -5.573

Critical Values (0.1-0.01), F-statistic, Case 3

        |  [I_0]   [I_1]  |  [I_0]   [I_1]  |  [I_0]   [I_1]  |  [I_0]   [I_1]
        |    L_1     L_1  |    L_05    L_05  |   L_025   L_025  |    L_01    L_01
--------+-----------------+-----------------+-----------------+----------------
  k_4   |   2.45    3.52  |   2.86    4.01  |   3.25    4.49  |   3.74    5.06
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

        |  [I_0]   [I_1]  |  [I_0]   [I_1]  |  [I_0]   [I_1]  |  [I_0]   [I_1]
        |    L_1     L_1  |    L_05    L_05  |   L_025   L_025  |    L_01    L_01
--------+-----------------+-----------------+-----------------+----------------
  k_4   |  -2.57   -3.66  |  -2.86   -3.99  |  -3.13   -4.26  |  -3.43   -4.60
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)
```

Source: Author: Computation from STATA16

9-3-1 Estimating model parameters long and short-term and error correction parameter

After finding the cointegration between the variables study, the next step is to find out the long and short-term relationship between variables of this study as the equation no (10) and table 4 show results was revealed the long-run of the variables coefficients based to the (ARDL). (LNGDP, LNEXCH, LNIFLT, LNEXPN) , (*-0.031154*, -0.0599997 , 0.0341885 , .074362). The coefficients of (LNIFLT, LNEXPN) are significant statistically at 5 per cent significance level as the probability values of is (P = 0.004 , 0.008 < P=0.05) respectively, the sign of the coefficients was positive as expected Accordingly, increase in inflation and public expenditures a 1% will increases money supply by about 00.31% and 0.072 % respectively .But the (LNGDP , and LNEXCH) insignificant coefficients statistically at 5 per cent significance level as the probability values of is (P=0.05< 0.474 , 0.051) respectively, the sign of the coefficients was negative as not expected accordingly, a 1%

increase in economic growth and exchange rate will decreases money supply by about .15% , 0.59 % respectively , this may be due to the political instability in the Libyan economy.

According to Statistical theory, the F-Statistics is which statistically significant measure the on how the parameters estimation are jointly significant we found a strong statistically significance of the variables with the probability value of 0.000 as in table 4, we conclusion that variables of study inflation and public expenditures have significant relationship long-term relationship with money supply in Libyan economy. Furthermore, the R^2 value is (66. 28%). This implies that 66.28 per cent total variation in money supply was explained by the variables Independent in our study. The rest is about 33.72%. It is explained by variables that are not present in the model.

Tabel 4. Results of Long -Term ARDL Model Estimation

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
LNGDP	*-0.031154*	*.0219404*	*-73.0*	*0.474*
LNEXCH	*-0.0599997*	*.0291404*	*-2.06*	*0.051*
LNIFLT	*0.0341885*	*.0100936*	*3.19*	*0.004*
LNEXPN	*0.071976*	*.0257016*	*2.89*	*0.008*
c	*01734239*	*.1217253*	*1.42*	*0.168*

R- squared = 66. 37.
Adjusted R-squared= 0.62.28
S.E. of regression = 0.051242
F- statistic Log likelihood =61.587191(7,23) = 9.42
prob (F-statistic) = 0.000000

EC = LNMS*=-0.031154*LNGDP - 0.05999997*LNEXCH + 0.0341885*LNIFLT+ 0.071976*LNEXPN + 01734239 …… (10)*

Source: Author Computation from STATA-16

As the table 5, in the short term the coefficients of the lagged value of [LNGDP] and the coefficients of the lagged value of (LNGDP -1) are

(-.0338801) (-.0206548) respectively the signs of the coefficients were negative, a 1% increase in economic growth in current year and economic growth in the previous year will decreases money supply by about -033880 and .0206548 respectively. But only (LNGDP -1) is statistically significant at 5%, also the coefficient of the value of (LNEXCH) is (-.0497059) it is statistically significant a 1% increase in exchange rate will decreases logarithm money supply by about- 0497059 And the coefficients of the value of the value of (LNIFLT) and the lagged value of (LNIFLT -1) are (.0061925) (.0204737-) respectively. but only (LNIFLT -1) is statistically significant. For the coefficient of the value of (LNEXPN) .06152213) and it is statistically significant at 5 % a .1% increase in public expenditures will increases logarithm money supply by about .06152213 .

According to Banerjee et al (1998), the ECM (-1) error correction coefficient is statistical significance of the ECT (-1) has probability values of (0.0000) .at the 5% significance level and it is negative (-.8284262) indicates that changes from short run to long run is corrected by about .8 percent over each about eight . at the end we can concluded from the above that there is statistically significance a short-run relationship between (LNGDP, LNEXC, LNIFLT -1, LNEXPN) and [LNMS]. and there is no relationship statistically significance in short-run between (LNGDP -1, LNIFL and (LNMS).

Tabel 5. Results of Short -Term ARDL Model Estimation

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
LNGDP	-.0338801	.0162489	-2.09	0.048
D1 *LNGDP*	0206548-.	.0162489	1.27	0.217
LNEXCH	-.8497059	.0221164	-2.25	0.034
LNIFLT	.0061925	.0089715	O.69	0.497
LNIFLT D1	.0204737-	.0093246	-2.20	0.038

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
LNEXPN	.06152213	.0195411wq	3.15	0.005
ADJJ	-.8284262	.1496554	5.57-	0.0000

Source: Author Computation from STATA-16

■ Checking the quality of the model10

For the ARDL model, 4 diagnostic tests are employed to check the problem of serial correlation, heteroscedasticity and normal distribution and the stability of model as below:

1- The Breusch-Godfrey LaGrange multiplier (LM) test is used to check for the problem of serial correlation, we use the (Durbin-Watson) and LM auto-correlation test consists of testing the non-auto-correlation nature of the residues. The null hypothesis is that there is no auto-correlation against the alternative hypothesis of the existence of auto-correlation, from the results of the test in table 6 we can see the probability of porb _chi2 is greater than 0.05 %, so we accept the hypothesis that there is no auto-correlation of the errors, so the errors are independent..

Table 6: {D-W and The Breusch-Godfrey LaGrange multiplier (LM)}

```
Number of gaps in sample:  1

Durbin-Watson d-statistic(  8,     31) =  2.041431
```

```
Number of gaps in sample:  1

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	1.344	1	0.2464

```
H0: no serial correlation
```

Source: Author Computation from STATA16

2- White heteroskedasticity test is used to verify whether a problem of heteroscedasticity exists, the heterodasceticity test consists of verifying the consistency of the variance of the error over time. The series must be homoscedastic

to present the best estimators. The test decision rule is based on significance at the 5% level or the assumption of homoscedasticity of errors accepted if the probability is greater than5%. the homoscedasticity hypothesis is accepted, and vice versa, a according to the results obtained from table 7, the homoscedasticity hypothesis is reject, since the probability obtained is more than 5%**.**

Table 7: White heteroskedasticity test

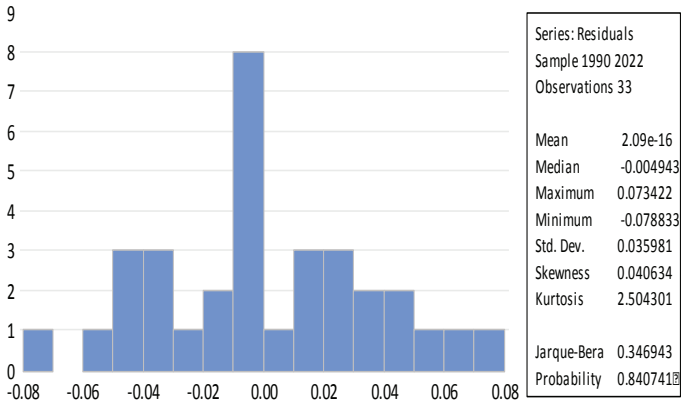
```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(14)      =     16.39
         Prob > chi2   =    0.2902
```

Source: Author Computation from STATA16

3 - We can use three tests Jarque-Bera (J.B.) Skewness (SK) , kurtosis (KU) to check if the error terms are normally distributed, Jarque-Bera (J.B.) The null hypothesis is that the error terms are normally distributed , against the alternative hypothesis not normally distributed, , from The results of the test in table 8 we can see the probabilities is greater than 0.05% , so we accept the hypothesis is terms are normally distributed , so the error terms are normally distributed .

Table 8: Testing residuals for normality

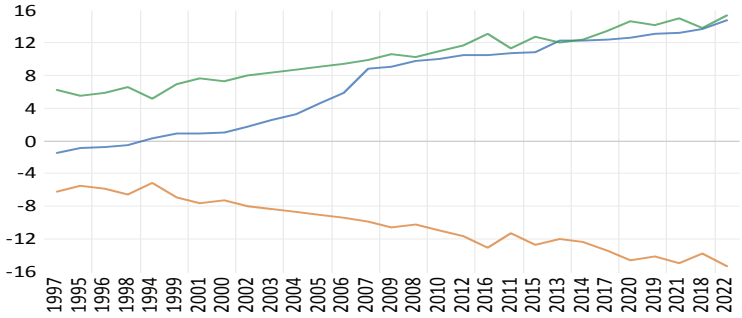


Source: Author Computation from EViews 13

4 -The tables (6 ,7, 8) show results of diagnostic tests the probability

value of the LM version to the diagnostic tests of serial correlation , functional form heteroscedasticity and normality test were more than 5 % that mean indicated that the model has passed the correlation test, functional form test and the heteroscedasticity and normal distribution test , and CUSUM result was shown in the diagram Figure 2 that estimated model was stable.

Graph 2: CUSUM



Source: Author Computation from EViews 13

-Granger Causality Test Results 11

This test is based on the causal relationships between the selected variables, it allows us to indicate the variable which causes the other variable the results are given in the following table 9.

According to the results in the table 9 below. the results of the granger causality test showed that the existence of bi-directional causality relationship between inflation LNIFLT and money supply LNMS, also and bi-directional causality relationship between government expenditure LNEXPN and money supply LNMS, also and bi-directional causality relationship between government expenditure *LNEXPN* and money supply LNMS. In addition to that there is uni-directional causality from money supply LNMS to exchange rate LNEXCH. but there is no any causality relationship between money supply LNMS and economic growth LNGDP.

Granger causality (lags=2). Table 9:

Equation	Excluded	chi2	df	Prob > chi2
lnms	lngdp	8.2571	4	0.083
lnms	lnexch	22.719	4	0.000
lnms	lniflt	15.166	4	0.004
lnms	lnexpn	30.042	4	0.000
lnms	ALL	148.11	16	0.000
lngdp	lnms	8.9046	4	0.064
lngdp	lnexch	14.519	4	0.006
lngdp	lniflt	12.254	4	0.016
lngdp	lnexpn	19.768	4	0.001
lngdp	ALL	80.255	16	0.000
lnexch	lnms	9.2606	4	0.055
lnexch	lngdp	35.918	4	0.000
lnexch	lniflt	51.886	4	0.000
lnexch	lnexpn	.91825	4	0.922
lnexch	ALL	158.68	16	0.000
lniflt	lnms	19.899	4	0.001
lniflt	lngdp	10.216	4	0.037
lniflt	lnexch	14.288	4	0.006
lniflt	lnexpn	15.477	4	0.004
lniflt	ALL	88.661	16	0.000
lnexpn	lnms	23.197	4	0.000
lnexpn	lngdp	24.516	4	0.000
lnexpn	lnexch	14.8	4	0.005
lnexpn	lniflt	50.66	4	0.000
lnexpn	ALL	117.76	16	0.000

Source :Author Computation from EViews -13

12. Conclusion

This study investigated the relationship of money supply Macroeconomic Variables of Libya using annual time series data from 1990 to 2022. The ADF unit root test, ARDL test, ECM , Granger causality tests, were used in this study. The ADF test results indicate that some variables are order at the level *I* (0) and others at the first difference *I* (1). The ARDL test showed that Macroeconomic Variables and money supply have cointegration. and some variables have a positive or/and negative significant relationship effect in short and long-run relationship. Also, we found in our study in our study. Furthermore, the results of the granger causality test showed that the existence of bi-directional causality relationship between inflation and money supply. Also, and bi-directional causality relationship between government expenditure and money supply. In addition to that there is uni-directional causality from money supply to exchange rate. but there is no any causality

relationship between money supply and economic growth Based on these findings The following recommendations were made:

1- Accelerate efforts should be put in place to better the exchange rate between the Dinar and other currencies. This will help avoid the imported inflationary pressure on goods and services in the economy.

2- Concerted effort should be made to ensure that efforts aimed at ensuring price stability do not stifle aggregate demand and hence economic growth.

4- The negative effect and the existence of bi-directional causality relationship between inflation and money supply also calls the Central Bank of Libya (CBL). be committed to the mission of price stability as well as. improving the regulatory and supervisory frameworks to money supply in economy to avoid the inflationary impacts government. and should control the excessive expansion in broad money supply in Libya

5- To achieve the desired growth of money supply that will enhance the growth of the economy, monetary policy needs to be formulated with special consideration of the feedback effect of these key macroeconomic variables on money supply.

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