

Estimate And Analysis the Money Demand Function and Testing Its Stability In The Libyan Economic During The Period (1990-2023)

Dr: Elmashat Essadq Ali Aboud

Associate Professor

Gharyan University Faculty of Accounting

تقدير وتحليل دالة الطلب على النقود واختبار استقرارها في الاقتصاد الليبي خلال الفترة (1990-2023).

د. المشاط الصادق على عبود

أستاذ مشارك، قسم الاقتصاد، كلية المحاسبة - جامعة غريان

ملخص:

: هدفت هذه الدراسة إلى تقدير وتحليل دالة الطلب على النقود، وتحديد مدى استقرارها في ليبيا. حددت أربعة متغيرات تفسيرية (النمو الاقتصادي، التضخم، سرعة دوران النقود، سعر الصرف) لهذه الدراسة بناءً على الأسس النظرية الاقتصادية خلال الفترة (1990-2023). أجري اختبار الثبات، وكانت جميع المتغيرات مستقرة عند الفرق الأول، مع معادلة تكامل مشترك واحدة بعد استخدام اختبار التكامل المشترك لجوهانسن. أظهرت النتائج التجريبية وجود علاقة تكامل مشترك واحدة بين متغيرات الدراسة على المدى الطويل. كما كشفت نتائج نموذج تصحيح الخطأ المتجهي (VECM) أن الطلب على النقود يرتبط ارتباطاً مباشراً بالنمو الاقتصادي على المدى الطويل. كان معامل النمو الاقتصادي ذا إشارة موجبة ذا دلالة إحصائية عند مستوى 5%. أما معامل التضخم فكان ذا دلالة سالبة، وكان ذا دلالة إحصائية. أما معامل سرعة دوران النقود فكان ذا دلالة سالبة، وكان ذا دلالة إحصائية. أما سعر الصرف فكان ذا إشارة موجبة ولكنه غير ذي دلالة إحصائية. بالإضافة إلى ذلك، تشير نتائج نموذج تصحيح الخطأ المتجهي على المدى القصير إلى عدم وجود علاقة قصيرة الأجل بين متغيرات الدراسة الخمسة. فيما يتعلق بالمعاملات (الطلب على النقود، التضخم، سرعة النقود، سعر الصرف) سلبية في العام الماضي والعامين السابقين. فيما يتعلق بمعامل النمو الاقتصادي إيجابية في

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العام الماضي والعامين السابقين، ولكن جميعها غير ذات دلالة إحصائية. بالنسبة لمصطلح سرعة التعديل، تُظهر الإشارة السلبية لمصطلح سرعة التعديل أن الاقتصاد سيتقارب نحو التوازن على المدى الطويل بعد إجراء تعديلات سنوية بنسبة 0.66 في المائة في المدى القصير وأن قيمة المعامل ذات دلالة إحصائية. وقد وجدت نتائج اختبارات السببية لجرانجر نتائج مثيرة للاهتمام لسببية جرانجر. تُظهر هذه النتائج وجود علاقة سببية أحادية الاتجاه تمتد من الطلب على النقود إلى النمو الاقتصادي. ولكن لا توجد أي علاقة سببية بين التضخم والطلب على النقود. كما توجد علاقة سببية أحادية الاتجاه تمتد من الطلب على النقود إلى سرعة النقود. توجد أيضاً علاقة سببية أحادية الاتجاه بين الطلب على النقود وسعر الصرف. وقد أظهرت هذه النتيجة تحديداً أن الطلب على النقود يُسبب تغييراً في سعر الصرف عند مستوى دلالة 5%. وأخيراً، أظهرت الاختبارات التشخيصية الإحصائية على نموذج VECM أن النموذج لا يُعاني من أي مشاكل في الاقتصاد القياسي. ويؤكد اختبارا CUSUM وCUSUMQ للذاتان أجريا أن النتائج التجريبية تُشير إلى استقرار دالة الطلب على النقود في ليبيا. الاستقرار.

Abstract:

This study aimed to estimate and analyze the demand money function, and to determine whether it is stable in Libya. Four explanatory variables (economic growth, inflation, velocity of money, exchange rate) were specified for this study based on economic theoretical underpinning during the period (1990-2023). Stationary test were conducted and all variables were stationary at first difference, with one cointegrating equation after using the Johansen Cointegration test. The empirical results show that one cointegrated long-run relationship study variables. Also, the results Vector Error Correction Model (VECM) reveal in the long-run that money of demand is found to be directly related to the economic growth. The coefficient economic growth having positive sign is significant at 5 percent level. Respect to the coefficient of

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inflation having negative sign and it is statistically significant. . The coefficient of the velocity of money having negative sign. And it is statistically significant.. For exchange rate has positive signs but statistically insignificant. In addition to that results of Vector Error Correction Model short run is indicates that there is not exists a short -run relationship among the five study variables. Respect to the coefficients (demand money, inflation, velocity of money, exchange rate) are negative sign in last year and two years before. Respect to the coefficient economic growth is positive sign in last year and two years before, but all of them statistically insignificant. For the speed of adjustment term negative sign of speed of adjustment term shows that the economy will converge towards long run equilibrium after taking 0.66 percent annually adjustments in the short run and the value of coefficient is statistically significant. Granger Causality tests results has found interesting results of granger causality . These demonstrate that there was unidirectional causality relationship running running from money demand to economic growth. But there is no any causality relationship between inflation and money demand. As, there is unidirectional causality relationship , running from money demand to the velocity of money. Also there is unidirectional causality relationship from money demand to exchange rate. Specifically this result revealed that money demand. causing change exchange rate at 5 per cent level of significance. Finally the statistical diagnostic tests on the VECM revealed that the model does not suffer from any problems of econometrics problems. The CUSUM and CUSUMQ test conducted confirm that the empirical results indicate that money demand function in Libya is stable .

Key words: function of demand money, Johansen Cointegration, Vector Error Correction Model (VECM), stability.

1-Introduction

The specification of the money demand function, as well as its relationship with different economic variables, has important implications for

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the design of macroeconomic policy and is key to achieving a successful monetary policy. Money plays a fundamental role in the creation, propagation and containment of economic cycles and for this reason it is necessary to identify the mechanisms through which these impacts are produced, in addition to implementing a monetary regime that achieves control and stabilization of economic variables. In Libya. Therefore, it is useful to remember the mechanisms for monetary policy in the period of chronic inflation and the sensitivity of money demand to changes in income. There is data set of this study covering the period from 1990 to 2024. We will try to estimate the money demand and examine it, determine whether there is a stable of this function in Libya, defining a new money demand model is one of the main goals of the study.

The political instability in Libya since the 2011s has revealed the need to reinvestigate the money demand function for Libya and its stability. This required analyzing and estimating the country money demand function and its relationship with macroeconomic variables, thus establishing an efficient monetary policy. After a search for studies on money demand and its stability, it was found that they have been very scarce in recent decades and the last one was published in 2007 by Ali, I. (2017) There is little literature on the stability of money demand, especially in Libya. Although some researchers have estimated the stability of money demand (Bahmani-Oskooee, M., & Wang, Y. (2007) Bahmani-Oskooee, M., & Barry, M. P. (2000) in some developing countries, a limited number of studies have explored the stability of the money demand function Bahmani, S., & Kutan, A. M. (2010); Anwar, S., & Asghar, N. (2012)... To our knowledge, there is no current study that estimates the relationship between money demand and its stability in the Libyan economy, also no study had yet examined the causal relationship between money demand and some macroeconomic variables selected in study. Therefore, we were encouraged to undertake research Using more recent data that would allow us as a new contribution to our country's economy. Therefore, this study will fill this literature gap and reconsider the

that causal relationship, and detecting various causal effects that can have an effect on money demand in this study. In line with previous studies in this area, the purpose of this article is to contribute to the empirical literature on the stability of money demand by investigating and estimating money demand relationships using more up-to-date econometric techniques that allow estimating this relationship in the Libyan economy. the fundamental questions of this study are based on the hypothesis that there is a statistically significant between money demand selected study variables in the short and long run. and the demand money function is stability. This type of research serves a very useful function both in testing the validity of theory-based macroeconomic approaches and in accurately designing the policymaking process for policymakers. Therefore, this study seeks to fill this gap in the literature. Therefore, the main objective is to analysis and investigate the empirical relationship and its stability between money demand and economic growth, inflation, the velocity of money and the exchange rate.

The study was organization as follows: in section I General introduction, followed by section II the theoretical framework consisting of the literature review and section III the methodology in Section II. Next section IV presents the results of the econometric model, the statistical tests performed and the evaluation of the relationship between selected study variables in short and long run and it is stability. Finally, section IIV presents the conclusions and section VI the recommendations of the work carried out.

2-Theoretical Framework

It is noted that empirical studies on whether or not the demand for money is stable and its determinants increased after the 1970s , when instability in the demand for money began to occur in classical economics . Money is demanded as a medium of transaction and exchange. This situation is explained in the quantitative theory of money by assuming that the money supply is external and the velocity of money is constant. By making this

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assumption, a change in the real demand for money is associated with nominal income. Therefore, the demand for money should be stable. In the theory of liquidity preference, in which Rotheim, R. J. (1981) explains the demand for money driven by transaction, precautionary, and speculation, it is stated that the interest rate has an effect on the demand for money and the velocity of money is not constant. In the money demand models they developed, Barro, R. J. (1976) and Leão, P. (2005) show that the velocity of money moves in the correct direction with interest rates. They have shown that this is the case. The basic idea of the Keynesian approach is that there is a negative relationship between the interest rate and the demand for money, with a positive effect of income on the demand for money. Friedman (1956) defines money as the purchasing power that people use to buy various assets. Therefore, the demand for money is relative to individuals' income and the return they earn from holding money. It is expressed in terms of the expected return on other assets. This approach assumes that there is a substitution relationship between money and goods, and that the velocity of circulation of money can be determined. As a result, the monetarist approach holds that the demand for money is stable and insensitive to interest rates. This means that the money demand function can be accurately estimated Kumar, R. C. (1983). Mundell, R. A. (2002) included the exchange rate in the money demand function he constructed for the stability of monetary policy under different fixed and flexible exchange rate systems and found that the exchange rate had an effect on monetary policy under flexible exchange rate systems. In later periods, uncertainty and confidence indicators reflecting the economic situation began to be used to explain the money demand function.

Classical quantity theory accepts that the demand for money is a function of income. Many economists contributed to its creation and development. While Fisher focuses his analysis on technological factors, he ignores the effect of interest rates. Jonung, L. (1979). Economists who support classical quantity theory accept deposits as an alternative to holding money. In particular, according to Marshall, the velocity of money is not a phenomenon that should

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be emphasized. In classical quantity theory, it is expressed as $V = (P \cdot Y) / M$; (V) refers to the velocity of money, (Y) refers to national income, (P) refers to prices, and (M) refers to the money supply. According to classical quantity theory, (V) and (Y) are constants in the short run, and a change in (M) will cause a change in the price level (P) in the same direction and at the same rate.

According to Keynes, real money demand is expressed as in equation (1). $MdP = f(i, Y)$ The velocity of money is not constant and changes depending on the interest rate. In the case that Keynes calls the liquidity preference theory, it is assumed that people primarily keep their wealth as bonds or money, the interest yield of money is zero, in other words, banks do not pay interest on demand deposits and investors who own bonds earn a fixed interest yield every year. Keynes argues that people demand money with speculation, precaution and transaction motives. According to the liquidity preference theory, while money demands with precaution and transaction motives are an increasing function of income, the money motive for speculation is a negative function of the interest rate used in the market. In the modern quantity theory developed by the monetarist school, money is one of the ways of acquiring wealth and represents an active value. Monetarists argue that the demand for money is determined by wealth and the rates of return on forms of wealth. According to Friedman, permanent income is a function of the demand for money. Permanent income is defined as long-term income as the average of present, past and future incomes Friedman, (1959).

and Hueng (1998) added the exchange rate and foreign interest rates to the money demand function. Theoretical plants regarding money demand in the literature have given rise to question the stability of the function of demand both theoretically and empirically. and money demand in the economic literature, it has been concluded that there are no general data variables indicating the demand for money and that each country presents its own variables indicating the money demand function.

3- Literature Review

There is a vast literature devoted to the estimation and analysis of the money demand function in both developed and developing economies. While there are numerous studies on the estimation and analysis of the money demand function and the investigation of its stability, to our knowledge, on the study and analysis of the causal relationship in the long and short term and stability of money demand function in Libya. has been found in the literature. In this section, existing studies in different countries are reviewed based on the methods applied and the results obtained.

The study by Nel, H., Blaauw, D., & Pretorius, A. (2020) examined the demand for money in Hungary using the autoregressive distributed lag (ARDL) cointegration framework. The results, based on the bounds testing procedure, confirm the existence of a stable long-run relationship between the demand for money and its determinants: real income, inflation rate, and nominal exchange rate. The empirical results show a unique, cointegrated, and stable long-run relationship between the real monetary aggregate, real income, the inflation rate, and the nominal exchange rate. The real income elasticity coefficient is found to be positive, while the inflation rate and nominal exchange rate elasticity are negative. The results also revealed that, after incorporating the CUSUM and CUSUMSQ tests, the money demand function is stable.

The paper of Urdaneta Montiel, A., Borgucci Garcia, E. V., & Camino-Mogro, S. (2024) aims to determine causal relationships between the level of productive credit, real deposits and money demand – all of them in real terms – and Gross National Product between 2006 and 2020. The vector autoregressive technique (VAR) was used, where data from real macroeconomic aggregates published by the Central Bank of Ecuador (BCE) are correlated, such as productive credit, gross domestic product (GDP) per capita, deposits and money demand. The results indicate that there is no causal relationship, in the Granger sense, between GDP and financial activity,

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but there is between the growth rate of real money demand per capita and the growth rate of total real deposits per capita.

The broad aim of this paper of Hamdi, H., Said, A., & Sbia, R. (2015). is to estimate the money demand function for the case of six Gulf Cooperation Council countries. By applying panel cointegration tests, the empirical results reveal strong evidence of cointegration between the variables of the model for individual countries as well as for the panel. Moreover, the results support the existence of a stable money function in the long-run estimation. The Granger non-causality test due to Toda and Yamamoto (1995) procedure shows evidence of a bidirectional causal relationship between money demand and income for panel estimation. At an individual level, the results change from one country to another one.

This paper Baharumshah, A. Z. (2004) investigates the money demand function for Malaysia in the 1971-1996 period using the multivariate cointegration and error correction model methodology. The results suggest that a stable long-run relationship exist between real the interest rate differential, income and stock prices. Stock prices have a significant negative substitute effect on long-run as well as short-run. The analysis from the vector error correction model (VECM) and the Toda & Yamamoto, Y. (2020) causality tests find that money is endogenous and that there is at least a unidirectional relationship between stock prices and real M2. Stock prices Granger cause real M2 indirectly through income between interest rates and stock prices and stock prices and money stock

This paper of Barros, C. P., Faria, J. R., & Gil-Alana, L. A. (2017) analyses Angola's long-run and short-run money demand, identifying its determinants using data from January 2000 to August 2013. A theoretical model is presented and the estimated results show that money mass, income, inflation, exchange rate and interest rates are cointegrated, revealing a long-run equilibrium relationship between these variables. The cointegration relationship is unstable in the short run. The results are in line with the monetary policy undertaken by the Central Bank of Angola and also in line

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with published papers on money demand. Policy implication is derived.

The objective of this study Song, K., & Lim, S. (2023) is to analysis a money demand function in Cambodia. The findings obtained using the ARDL approach. Regarding the estimated results derived from the long-run model, it is observed that real income has a statistically significant positive impact on real money demand, while the general price level and the interest rate have a negative impact. The growth rate of real income shows a positive relationship with real money demand, while the inflation rate and changes in the interest rate have a significant negative effect on the demand for real money balances. Stability tests, such as the CUSUM and CUSUMSQ tests, indicate that the real money demand function in Cambodia remains stable over the long run.

In the article by Godana, S. S. (2023), which formulated and estimated the monetary demand function in Ethiopia, this study used quarterly data from the third quarter of 2000 to the second quarter of 2021 and employed the ordinary least squares method and the Engle-Granger two-stage procedure for empirical analysis. The empirical results of the models indicated that, in the long run, all variables (real GDP, CPI inflation, real effective exchange rate, real interest rate, and lagged real money balance) significantly affect monetary demand in Ethiopia. On the other hand, the estimated coefficients of the short-run variable show that the real effective exchange rate, CPI inflation, and lagged real money balance are the main determinants of monetary demand, while real GDP and the real interest rate are insignificant.

We conclude from the above several studies have used the cointegration techniques of ARDL and Johansen (1988) to examine the long and sholrt-run relationship between money demand and its determinants across many countries. A general consensus in most of the studies is that the money demand and is cointegrated with some selected macroeconomic variables. However, the general observation from the literature is that most of the

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studies on the money demand function and its stability have focused on advanced economies and some developing countries. Not many studies based on the cointegration technique on the money demand function and its stability have been published in the Middle East and North Africa. Specifically in Libya. No known study that has estimated and analyzed the money demand function and tested its stability in the Libyan economy in the same time.

4-Materials and methods

4-1 Data sources and Description

We will try to estimate the money demand and examine it, determine whether there is a stable of this function. In parallel to analysis causality relationship between money demand selected study variables in the short and long run, . in Libya defining a new money demand model is one of the main goals of the study. The study is based on variables, described as preferences is among the variables that explain the demand for money in economic theory. According to traditional economic theory, changes in the real demand for money are primarily due to factors that measure the general level of economic activity, such as real GDP or national income, which positively affect the demand for money; they measure the opportunity cost of holding money, such as the interest rate or the inflation rate, and are negatively related to the demand for money; and they are the result of movements in some key macroeconomic variables that measure the rate of return on holding money (the velocity of money) and are positively related with the demand for money (Cuevas, 2002). In this study, we will the estimation and analysis relationships between money demand and gross domestic product (economic growth), the consumer price index(inflation), exchange rates, and the velocity of money, in Libya using time series with data from the period 1990–2023. the sources of data Obtained of were mainly from National f Statistics, Central Bank of Libya statistical Bulletin and World Bank Data Base. Classical Quantity Theory, accepts that money demand is a function of interest rates, many economists contributed to its creation and development.

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While Fisher puts technological factors at the center of the analysis, he ignores the effect of interest rates. Bellofiore, R. (1998). Also, in this study the interest rate will be ignored due to the lack of recent data on it.

Assuming a linear relationship between the money demand gross domestic product, inflation, the velocity of money, and exchange rate, we can specification model as:

$$LNMD = f(LNGDP, LNIFLT, LNVRM, LNEXCH)$$

therefore;

$$LNMD = \beta_1 + \beta_2 LNGDP + \beta_3 LNIFLT + \beta_4 LNVRM + \beta_5 LNEXCH + \dots\dots\dots(1)$$

where;

$LNMD$: money demand

$LNGDP$: gross domestic product as the economic growth,

$LNIFLT$: inflation.

$LNVRM$: the velocity of money

$LNEXCH$: exchange rate

$\beta_1, \beta_2, \beta_3, \beta_4$, and β_5 : Parameters and

μ : Error term (white noise)

To estimate equation 1, firstly we will study the stability properties of the study variables to investigate the stability. we will use oneunit root tests in the study, i.e., the Augmented Dickey-Fuller (ADF) . we will test the choice of unit roots by the imperatives of comparison and consistency. According to Hamilton, J. D., & Susmel, R. (1994), ADF is robust in the midst of serial correlation and heteroscedasticity, though they have own shortcomings. one of cointegration test will also employ to test the long and short run relationship between the variables used in the study

In order to analyze the study, firstly the logarithmic values of the variables should be taken and the stationarity levels should be determined.

4-2 Johansen and Juselius Cointegration Test

The procedures use two tests to determine the number of cointegrating vectors: the Trace test. The Automatic Maximum Value statistic tests the null hypothesis of r cointegrating relationships against the alternative of $r + 1$ cointegrating relationships for $r = 0, 1, 2, \text{ etc. } n-1$. This test statistic is calculated as Johansen, S. (1988)

$$LR_{\max}(r/n+1) = -T * \log(1 - \tilde{\lambda}) \quad LR_{\max}(r/n+1) = -T * \log(1 - \tilde{\lambda})$$

Where $\tilde{\lambda}$ is the maximum eigenvalue and T is the sample size. Trace statistics investigates the null hypothesis of r cointegrating relationships against the alternative of n cointegrating relationships, where n is the number of variables in the system for $r = 0, 1, 2, \text{ etc. } n-1$. Its equation is calculated according to the following formula:

$$LR_{tr}(r/n) = -T * \sum_{i=r+1}^n \log(1 - \tilde{\lambda}_i)$$

In some cases, the trace and maximum eigenvalue statistics may produce different results and $[LR_{tr}]$ indicates that in this case the results of the trace test should be preferred Johansen, S. and Juselius, K. (1990).

4-3 Vector Error Correction Model

Based Brooks, C. (2014) a restricted VAR model with cointegration restrictions built into the specification, the so-called vector error correction (equilibrium) model, can be represented by the following equation:

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma x_{t-1}) + u_t$$

The most important part of the model is the error correction (EC) term $y_{t-1} - \gamma x_{t-1}$ and the coefficient β_1 , which represents the gradual adjustment of the system toward long-term equilibrium. The coefficient describes the short-term dynamics of the system.

5-The empirical And Discussion Results

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To is clear from Table 1 that all the variables are not stationary at the level, but become stationary after the first differencing at either the 5% or 1% level of significance. This means that all variables are I(1). According to that , all of these series are not stationary at the level values, but become stationary when the first differences are taken.

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

Variable	P-value at Level	P-value at 5 st Difference	Remark
LNMD	0.9982	0.0001	I(1)
LNGDP	1.3774	0.0000	I(1)
LNINFT	0.1222	0.0000	I(1)
LNVRM	0.6215	0.0000	I(1)
LNEXCH	0.4690	0.0000	I(1)

After determining that all the variables in the model are stationary in the first difference. To ensure proper specification of our models, it is necessary to determine the optimum lags lengths (p), which are determined using five criterions, AIC is best test for medium samples (Lütkepohl, H., & Poskitt, D. S. 1991) , Optimum lag lengths were determined using the AIC it suggests the use of 1 delay in the system .

5-1 Johansen Cointegration Test

The cointegration test results in table 2 indicate the existence of long run relationship between economic growth, inflation, velocity of money, exchange rate in Libya, as indicated by the statistics in the same table. The results show that indicate that the hypothesis of no cointegration among the variables is rejected accepting the alternative hypothesis indicating that there is co integration between the variables at the 5% significance level. and there is one cointegrating equations at the 5 percent level. Consequently, it is possible to estimate the equilibrium long run relationship between money

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demand and its explanatory variables and employ vector error correction in estimating short run relationship.

Table 2. Johansen Cointegration Test Statistics

Johansen tests for cointegration					
Trend: constant			Number of obs = 32		
Sample: 1992 - 2023			Lags = 2		
<hr/>					
				5%	
maximum				trace	critical
rank	parms	LL	eigenvalue	statistic	value
0	30	86.475534	.	80.7130	68.52
1	39	103.83945	0.66218	45.9851*	47.21
2	46	116.97145	0.55990	19.7211	29.68
3	51	122.81352	0.30589	8.0370	15.41
4	54	125.79555	0.17004	2.0729	3.76
5	55	126.83201	0.06273		

5-2Vector Error Correction Model (Long run Results)

When we found the five variables are cointegrated rated we can run vector Error Correction Model VECM . As equation 2, the results reveal that money demand is found to be directly related to the economic growth. The coefficient having positive sign is significant at 5 percent level of significance suggesting that 1 percent increase in economic growth leads to 0.92 percent increase in money demand on the average in the long run. respect to coefficient inflation is -0.80. suggesting that 1 percent increase in inflation leads to - 0.80 percent decrease in money demand This result does not according to macroeconomic phenomenon of classical economists given in quantity theory of money as increase in inflation leads to increase money demand levels. Due to higher inflation, more funds will be available to invest in the economy, investment will be taken place, more employment will be generated, aggregate demand will increase. Our results are consistent with previous findings of Liu and Adedeji (2000), Mosayed and Bashir, D. F. (2011), Kuijs (1998), , and Abdullah, M., & Kalim, R. (2012). As expected, the velocity of money is inducing money demand. But we do not find that. According to the results

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implying that 1 percent increase in the velocity of money leads to 0.92 percent decrease in money demand on the average in the long run. with respect to exchange rate 1 percent increase in exchange rate leads to 64.66 percent in increase in money demand on the average in the long run.

The F-statistic value of (16.60%), which measures the joint significance of the explanatory variables, is found to be statistically significant at 5 % level as indicated by the corresponding probability value of 0.00001 in Table 3. The R² value of (71.03 %) implies that 71.03 percent variation in money demand is explained. This implies that the study variables taking jointly are statistically significantly responsible for change in money demand 71.03 percent, the remains explained by variables outside the model. The long-run

D(LNMD) equation can be written as:

$$\mathbf{D(LNMD)} = 0.662572*(LNMD(-1) + 0.924633578598*LNGDP(-1) + 0.801865154504*LNIFLT(-1) - 86.9528393403*LNVRM(-1) + 64.6647522168*LNEXCH(-1) + 372.778883796).....(2)$$

R-squared	0.711038
Adjusted R-squared	0.668229
F-statistic	16.60947
Prob(F-statistic)	0.000001

5-3 Vector Error Correction Model (Short run Results)

The equation 3 discusses the short run results using vector error correction model. The most important thing in the short run results. Also results in the table 3 , the statistically significantly and negative value .The coefficient of the error correction term (ECT_1) shows that how much time would be taken by the economy to reach at long run equilibrium. Negative sign of speed of adjustment term shows that the economy will converge towards long run equilibrium after taking 0.66 percent annually adjustments in the short run and it is statistically significant.

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Vector Error Correction equation

$$D(LNMD) = C(1)*(LNMD(-1)) - C(2)*D(LNMD(-1)) + C(3)*D(LNMD(-2)) + C(4)*D(LNGDP(-1)) + C(5)*D(LNGDP(-2)) - C(6)*D(LNIFLT(-1)) - C(7)*D(LNIFLT(-2)) - C(8)*D(LNVRM(-1)) - C(9)*D(LNVRM(-2)) - C(10)*D(LNEXCH(-1)) + C(11)*D(LNEXCH(-2)) + C(12).....(3)$$

Table 3: Short-run estimates

Dependent Variable: D(LNMD)

Method: Least Squares (Gauss-Newton / Marquardt steps)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.662572	0.282657	-2.334084	0.0438
C(2)	-0.009373	0.238077	-0.039371	0.9690
C(3)	0.086949	0.251086	0.346291	0.7329
C(4)	0.373439	0.221371	1.686936	0.1080
C(5)	0.282797	0.213933	1.321898	0.2019
C(6)	-0.053568	0.046323	-1.156409	0.2618
C(7)	-0.022538	0.054240	-0.415525	0.6824
C(8)	-0.045833	2.317120	-0.019780	0.9844
C(9)	-1.028115	1.907999	-0.538845	0.5963
C(10)	-0.593742	1.173334	-0.506030	0.6187
C(11)	0.779433	1.068209	0.729664	0.4745
C(12)	-0.048032	0.051777	-0.927676	0.3652

equation 3 shows the vector error correlation equation. The result of the VECM model indicates that D(LNMD(-1)) of last year (2022) has insignificantly negative impact on LNMD (2025). On the other side, statistically significantly D(LNMD(-2)) of last year two years before (2021) are insignificantly positively affecting LNMD of current year (2023). D(LNGDP(-1)) of last year (2022) has statistically insignificantly positive impact on LNMD (2023). On the other side, D(LNGDP(-2)) of last year two years before (2021) are statistically insignificantly positively affecting LNMD of current year (2023), in the short run. (LNIFLT(-1)) of last year (2022) is decreasing the LNMD. On the other side, (LNIFLT(-2)) of last

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year two years before (2021) are significantly insignificantly negatively affecting LNMD of current year (2023).. As for impact of (LNVRM(-1)) of last year (2022) is statistically insignificantly negative on LNMD . but (LNVRM(-2)) of last year two years has statistically insignificantly negative parameter coefficient in the short run while (LNEXCH(-1)) of last year (2022) have appeared to be statistically insignificantly negatively Impact but (LNEXCH(-2)) of last two years (2021) have appeared to be statistically insignificantly positively Impact with LNMD of current year (2023)

Consequently, considering the lags of the previous variables, one out of every two lags of the dependent variable DLNMD and the independent variables were statistically insignificant, indicating, the variables do not establish strong short-run causality.

6- Statistical diagnostic tests on the VECM

The VECMs will be subjected to a number of diagnostic tests, namely, the normality, serial correlation, heteroskedasticity (BPG and ARCH) and Ramsey RESET tests. A 5% level of significance will be used in all these tests.

The 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 4 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- 4: The Breusch-Godfrey Serial Correlation LM

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.355010	Prob. F(2,17)	0.1251
Obs*R-squared	6.725494	Prob. Chi-Square(2)	0.0346

The ARCH heteroskedasticity test is used to verify whether a problem of heteroscedasticity , of the error over time. . The test decision rule is based on significance at the 5% level or the assumption of homoscedasticity

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of errors accepted if the probability is greater than 5%. the homoscedasticity hypothesis is accepted, and vice versa, a according to the results obtained from table 5, the homoscedasticity hypothesis is reject, since the probability obtained is more than 5%.

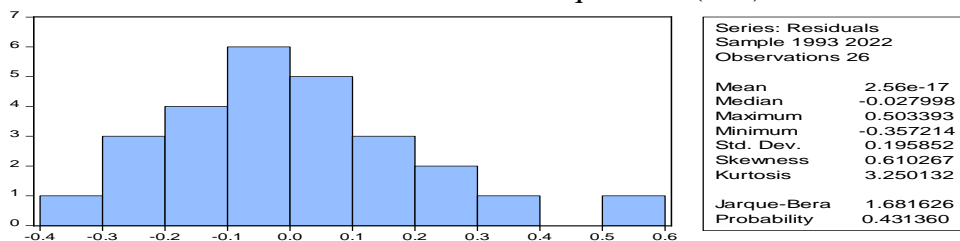
Table- 5: The ARCH heteroskedascity test

Heteroskedasticity Test: ARCH

F-statistic	0.288265	Prob. F(1,28)	0.5956
Obs*R-squared	0.305708	Prob. Chi-Square(1)	0.5803

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 6 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 6: The Jarque-Bera (J.B.) test



We conclude from the above that statistical diagnostic tests on VECM have shown that the model does not suffer from any problems related to econometrics.

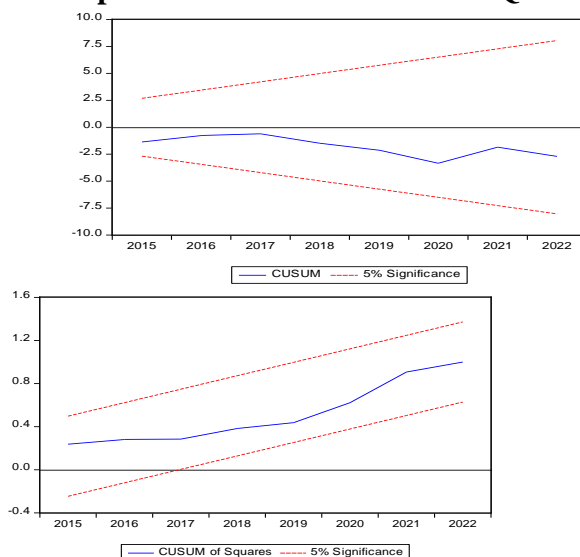
7-Stability Tests

To determine the stability of the estimated coefficients of the real domestics' equation for Nigeria, the cumulative sum of recursive (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests developed by Westlund, A. H., & Törnkvist, B. (1989), were adopted. The CUSUM and CUSUMSQ tests are shown in Figure 1 the CUSUM and

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CUSUMSQ . plots do not cross the 5% critical lines, implying that over the entire sample period of investigation, the stability of the estimated coefficients exist, so that the regression coefficients are reliable and suitable for policy making.

Graph 3: CUSUM and CUSUMSQ tests



The statistical diagnostic tests on the VECM revealed that the model does not suffer from any problems of econometrics problems.

8- Granger Causality Tests Results

The study has found interesting results of granger causality in table 7 based on significant probability values less than or more than to 0.05. These demonstrate that there is unidirectional causality relationship running between LNGDP and LNMD running from LNMD to LNGDP . But, there is no any causality relationship between inflation and LNMD . As, there is unidirectional causality relationship running between LNVRM and LNMD running from LNMD to LNVRM , also there is unidirectional causality relationship running between LNEXCH and LNMD running from LNMD to

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LNEXCH .Specifically, this the result revealed that LNMD . causing change LNEXCH at 5 per cent level of significance .

Table 7. Granger causality test results under VECM

Sample: 1990 2023

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGDP does not Granger Cause LNMD	32	1.06594	0.3585
LNMD does not Granger Cause LNGDP		7.25767	0.0030
LNIFLT does not Granger Cause LNMD	32	1.17994	0.3226
LNMD does not Granger Cause LNIFLT		0.75347	0.4804
LNVRM does not Granger Cause LNMD	32	0.04181	0.9591
LNMD does not Granger Cause LNVRM		4.22130	0.0254
LNEXCH does not Granger Cause LNMD	32	1.06647	0.3583
LNMD does not Granger Cause LNEXCH		4.10077	0.0279

9-CONCLUSIO

This study examined to estimate and analyze the demand function for money. between our explanatory variables (economic growth, inflation, velocity y of money, exchange rate). Accordingly, time series techniques such as Unit Root Test, followed by multivariate cointegration test developed by Johansen (1988), and Johansen and Juselius (1990), Granger causality test in vector error correction model (VECM), on the annual data from 1990 to 2023 for Libya. The results of the unit root test indicate that the all variables are stationary at the first order difference. Moreover, the cointegration test revealed the presence that there is one long-run relationship between that variables.

The results Vector Error Correction Model (VECM) reveal in the long-run that money of demand is found to be directly related to the economic growth. The coefficient economic growth having positive sign is significant at 5

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percent level. Respect to the coefficient of inflation having negative sing and it is statistically significant. This indicates that depreciation of inflation increases the demand for money, this not supporting the wealth effect argument and people prefer to substitute physical assets for money balances that is not supporting our theoretical expectation velocity of money. The coefficient of the velocity of money having negative sing and it is statistically significant. the result is not according to macroeconomic theory of classical economists given in quantity theory of the money. While exchange rate has positive signs but statistically insignificant. Addition to that (VECM) approach also to estimate the short run results is indicates that there is no exists a short -run relationship among the five study variables. Respect to the coefficients (demand money, inflation, velocity of money, exchange rate) are negative sing in last year and two years before. Respect to the coefficient economic growth is positive sing in last year and two years before, but all of them statistically insignificant. For the speed of adjustment term negative sign of speed of adjustment term shows that the economy will converge towards long run equilibrium after taking 0.66 percent annually adjustments in the short run however the value of coefficient is statistically significant. Granger Causality tests results has found interesting results of granger causality based on significant probability values less than or more than to 0.05. These demonstrate that there was unidirectional causality relationship running between economic growth and: money demand running from money demand to economic growth. But there is no any causality relationship between inflation and money demand. As, there is unidirectional causality relationship running between the velocity of money and money demand running from money demand to the velocity of money, also there is unidirectional causality relationship running between exchange rate and money demand running from money demand to exchange rate. Specifically, this the result revealed that money demand. causing change exchange rate at 5 per cent level of significance. The statistical diagnostic tests on the VECM revealed that the error term is normally distributed in the model respectively, that the

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model does not contain autocorrelation, that there is no changing variance in the model. The CUSUM and CUSUMQ test conducted confirm that the empirical results indicate that money demand function in Libya is stable. Finally the study recommends that the Libyan economy need to carry out economic reform policies on different fronts, mainly by liberalizing exchange rates, pricing policies, opening up domestic markets, rationalizing government expenditure, reforming monetary and taxation systems, to promote the economic growth in the short and long-run . Thus, necessary steps have to be taken considering result of this study by concerned authority for maintaining equilibrium in the economy.

- i. The negative effect of the high inflation implies that the Central Bank should maintain a money demand function in Libya stabile. in order to achieve stability in economic.
- ii. The Central Bank of Libya should introduce measures that would improve fiscal discipline by limiting excessive demand for money that attract high inflation in order to promote stability in the money demand function in Libya.
- iii. The positive long-run effect of the real GDP on money demand suggests the need for government through the Central Bank of Libya to diversify the economy by investing more on critical sectors that can help in raising real domestic output and stability in real broad money demand function in Libya.

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