The Influencing Factors of Money Supply in Libya: An Application of ARDL Bounds Testing Approach to Cointegration

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1- Introduction:

The Libyan economy has witnessed many structural changes during the recent period as a result of tribal, political and military conflicts, which began with the closure of the main ports exporting crude oil in August 2013, and then turned into a civil war between Libyan cities and eventually led to the division of all state institutions. These events led to political and economic chaos that disrupted economic activity and led to decline oil revenues, which represent more than 90% of government revenue.

The decline in public revenues led to the emergence of permanent public budget deficits and also led to a rapidly decline in the Libyan Central Bank's foreign currency reserves from 113.2 billion USD in the fourth quarter of 2012 to 49.9 billion USD in the fourth quarter of 2020, (Central Bank of Libya, 2021). This sharp drop was also due to the political dispute between the National Oil Corporation (NOC) and the Central Bank of Libya (CBL).
In light of the continuing conflict between Parliament and Government and the lack of approval of the budget for the

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government, the Central Bank had no choice but to use the lending policy to finance the public deficit. According to Libyan Audit Bureau report (2020) the government's debt balance with the Central Bank increased rapidly from 1.81 billion LYD in 2012 to 87.66 billion LYD in 2020.

The limited ability of economic policies to deal with the exceptional situation of the Libyan economy began to appear clearly through the lack of cash liquidity in the banking system and the low exchange rate of the Libyan dinar and consequently clear rise in the general level of prices. All these elements imposed the Central Bank to print more currency to meet the money demand as a result of an increase in the general price level and the inability of commercial banks to provide cash liquidity, which led to an increase in the stock of the money supply.

All these events show the importance of studying the influencing factors of money supply by adopting money supply function includes the set of key variables controlling the money supply in Libya, quarterly time series data was applied for the analysis of data from 2013 to 2020.

The main objectives of this study are to conduct a theoretical analysis to find formula that has ability to describe the key factors affecting the money supply in Libya, and conduct an empirical analysis to estimate the influencing factors of Libyan money supply using ARDL bounds testing approach to cointegration. This study contributes to the literature in different way of analysing the factors of the money supply in Libya for the first time, where, the previous studies analysed factors that reproduced from previous studies conducted on countries that enjoy a kind of economic stability different from Libya.

The rest of the paper is organised as follows: Section 2 is the literature review; study model is in Section 3, and data and methodology are presented in Section 4 while Sections 5 and 6 are for the empirical results and conclusion respectively.

2- Literature Review

This section is classified into two parts: a) review of money supply thoughts, and b) review of empirical studies. A review of the money multiplier theory of money supply is based on Classics, Monetarists and post-Keynesians. Similarly, under a review of empirical studies, the study has reviewed some previous studies conducted on the Libyan economy and used money supply in its economic models after 2011.

2.1 Rreview of the money multiplier theory of money supply:

As mentioned in literature, money has three functions: i) store of value, ii) unit of account, iii) medium of exchange. The function of money as a unit of account is important in conducting accounts, keeping records and making decisions and money performs its function as a store of value where families keep all or part of their savings in the form of cash. However, the function of money as a medium of exchange distinguishes it from previous two functions is called quasi-money, since money can be used to buy goods and services and settle debts. The most common definition of money is that any object is obtaining general acceptance and using as a final means of paying for goods and services and settling debts (Edgmand, 1983).

According to money definition, coins and caurrency in circulation (CC) are considered money, and demand deposits (DD) are also considered money and this money is called aNarrow definition of money (M1). However, time deposits and savings deposits (TD) are not considered money in M1 definition because they are not accepted as a medium for trading and should be converted into demand deposits or any other form of money, therefore are called

quasi money and are included in Broad definition of money (M2) [1], (Edgmand, 1983):

M1 = C + D   &   M2 = M1 + TD

The Central bank is responsible for currency issuance operations, it can control the nominal supply of money MS by three basic tools such as open market operations, changes in the reserve requirements ratio and changes in the discount rates, These three tools enable the central bank to control the money supply by changing in MB, Brunner and Meltzer (1964). The commercial banks also have a great role in determining the money supply by increasing demand deposits by granting credit, and any changing in reserve requirements ratio by the central bank has an impact on the commercial banking system, considering demand deposits (DD) as part of the money supply (MS), the successive increase caused by commercial banks in DD through the use excess reserves from required reserves in granting credit is considered as a successive increase in MS.

$\Delta IR = \Delta R$

(ΔR) the change in required reserves R and (ΔIR) the initial change in Banks' reserves. Accordingly, the change in required reserves R is equivalent to the required reserve ratio of demand deposits (r) multiplied by the total change in demand deposits DD, and substituting that into the previous equation to obtain:

$\Delta R = r\Delta D$

Dividing both sides of the equation by r and rearranging the equation to get: $\Delta DD = \Delta IR/r$ ⟶ (1)

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1 In order to achieve the objectives of this study, it will adopt the definition of money supply used by the Central Bank of Libya (CBL), which is narrow definition M1 and broad definition M2.

(ΔDD) proxy for the total change in demand deposits (checkable deposit), (ΔIR) the initial change in Banks' reserves, and (r) the ratio of reserve requirements to DD, since demand deposits are considered part of the money supply, the total change in money supply is equal to the change in demand deposits.

Most investigations of factors affecting the money supply take as a starting point total reserves which constrains maximum volume of the money stock for given reserve requirements. However, the increase in money supply that was mentioned in equation (1) represents the maximum possible amount in creating deposits. It is assumed that commercial banks do not maintain excess reserves and individuals do not add to their CC or TD during the expansion process. These assumptions usually are unfulfilled on the practise, since commercial banks keep a percentage of the DD as the excess reserve and public also keep cash in their possession and their time deposits, (Fand, 1967).

Karl and Allan (1964) developed a money supply function in case where the two previous assumptions are not available: when commercial banks maintain excess reserves, they lend less money, and thus the opportunity for increasing in DD is also less when the individuals hold cash and time deposits during the expansion process of creating deposits, thus banks lose their reserves, that lead to limit the amount of loans granted by commercial banks and lose the opportunity to increase in demand deposits. So other factors included in the function are currency held by the public (CC), time deposits at commercial banks (TD), and bank excess reserves (ER).

Cagan (1965) used the same money supply framework as Friedman and Schwartz (1963), however, he arranged the three proximate determinants in a different form. Cagan supposed that commercial banks maintain a constant percentage of excess reserves (e) from demand deposits, the leakage equals eΔDD, the individuals maintain a constant ratio between cash in hand (CC) and their demand deposits (DD), then the leakage or withdrawal is equivalent

to cΔDD, i.e. the ratio multiplied by the change in DD and the individuals add to their time deposits (TD) during the process of expanding deposits, the commercial banks will not lose their reserves, because banks must maintain reserves to cover TD as well as demand deposits, then a fraction of IR be used as a reserve for TD, then there will be less reserves to cover required reserves for demand deposits, and there will be less increase in DD. If the individuals keep their TD in the form of (t) percentage of their DD, and if (r) represents the required reserve ratio for TD then the leakage is equal to rtΔDD, i.e. legal required reserve (r) multiplied by the change in time deposits tΔDD. Finally IR will be divided into:

$$\Delta IR = r\Delta DD + e\Delta DD + c\Delta DD + rt\Delta DD$$

Rewrite the factors by dividing both sides of the equation by (r + e + c + rt), to obtain the following equation:

$$\Delta DD = \frac{\Delta IR}{r + e + c + rt} \longrightarrow \quad (2)$$

Since the money supply MS_1 includes very liquid money such as cash held by the non-banking public and demand deposits, the change in money stock ΔMS_1 equals the change in demand deposits ΔDD plus the change in the money balance or:

$$\Delta Ms = \Delta D + c\Delta D \longrightarrow \quad \Delta Ms = (1 + c)\ \Delta D$$
$$(\Delta CC = c\Delta D)$$

Substituting the value of ΔD, the equation (2) would be:

$$\Delta Ms = \frac{(1 + c)\ \Delta IR}{r + e + c + rt} \longrightarrow \quad (3)$$

In principle, the change IR represents the change in reserves R, but if the non-banking public added to the currency in its possession during the expansion period in creating deposits, then fraction of the reserves would leak out from the banks system, and since the

increase in the currency held by the public is fraction of the money supply, IR can be interpreted as the change in the monetary base MB. All principles level textbooks prefer to define the monetary base is the sum of total currency in circulation and the amount held by banks as reserves, and thus equation (3) can be reformulated as follows:

$$\Delta Ms = \frac{(1 + c)}{r + e + c + rt} \, \Delta MB \longrightarrow \quad \textbf{(4)}$$

Where Ms is the narrow money supply, MB is the monetary base, and equation (4) represents the money supply formula, and the change in money stock is positively related to the change in the monetary base, and is inversely related to other factors.

Using a multiplier, the equation (4) would be:

$$\Delta Ms = mm \, \Delta MB \longrightarrow \quad (5)$$

Where:

$$mm = \frac{(1 + c)}{r + e + c + rt}$$

Where mm is the money supply multiplier and equation 5 represents the money supply formula by multiplier. Since the ratios of: excess reserves, currency in circulation, and time deposits to demand deposits change with the interest rate (i), so the money supply multiplier changes with the interest rate, and this relation helps in determining the effectiveness of the banking system's role in influencing the money supply (Hosek, 1970; Rasche, 1972).

$$Ms = \int(MB, i)$$

2.2 Review of the money supply studies in Libya

This section divided previous studies according to their objectives into three types: Studies aimed to measure the impact of money

supply as a tool of monetary policy on some macroeconomic variables, and other studies applied Pairwise Granger Causality Test between nominal money supply and other economic variables, while the third type aimed to estimate the money supply multiplier formula. The following is a review of the most important findings of previous studies:

Al-Maghribi (2018|) used a descriptive approach in analysing the economic relationships between money supply and some macroeconomic variables rather an economic model. The important finding is that monetary policy was floundering and the central bank was unable to influence the exchange rate of the Libyan dinar on the black market in the period 2011-2017, where the difference between the official and unofficial exchange rate was very large during that period.

Al-Jaroushi and Aburawi (2017) has also used a descriptive approach, but rather they have used some economic measures mentioned in literature, such as velocity of money circulation, the monetary stability and the inflationary gap. They found that all the results of monetary stability indicators indicate the existence of monetary instability due to the mismatch between money supply and real GDP growth, which is clearly reflected in the general price level and inflation in the Libyan economy.

There is another study conducted by Al-Lahdi and Abukrish (2018) and aimed to analyse the effect of the exchange rate, money supply and inflation on the rates of economic growth in Libya during the period (1980-2014). They used a simple model relies on the assumption that there is a relationship between money supply, inflation, exchange rates and economic crises and real GDP as dependent variable. They conclude that the Libyan economy suffered from instability and financial crisis led to an increase in the amount of money supply in the post 2010, and the deterioration of the Libyan dinar value against other foreign currencies.

Hamida and Mahfouz (2019) examined the impact of the economic policy using an economic simple model in a logarithmic form. Their model attempts to provide an explanation of the relationship between GDP as an indicator of economic growth in the Libyan economy and money supply, the exchange rate and the general level of consumer prices. The results of the study revealed the existence of a bi-directional (two-way causality) moving from the exchange rate to the money supply and one-way causal relationship moving from MS towards the general level of consumer prices. These results conform to the conclusion of the study of Nooruddin (2013) that there is uni-directional (one-way causality) between the official exchange rate of the Libyan dinar and broad money supply.

Note-taking on both previous studies is: the studies did not explain theoretically the effect of the exchange rate on the money supply, but rather they were satisfied with establishing the causal relationship statistically without clarifying the mechanisms of the relationship according to economic theory.

Bazinah (2020) aims to estimate the money supply multiplier formula in Libya during the period (2008-2018). He found that the money supply multiplier is less than one during most of the study period and the large percentage of demand deposits goes to the currency in circulation and commercial banks' excess reserves, which reduces their ability for creating money.

There are few notes taking on Bazinah's study: in the one hand the study based on model that reproduced from previous studies conducted on countries that enjoy a kind of economic stability different from the Libyan economy for example, KSA (Rasas et al., 2016) Algeria (Mohamed and Mukhtar, 2017) and Kenya (Susan, 2018), on the other hand, the study concluded that the model was unstable due to the critical situation that Libya is going through.

The theoretical framework of this study relied on the money supply function that found by the Ben-Taher (2021), which expresses the special case that characterizes the Libyan economy making the

basic factors affecting the money supply different from factors that mentioned in previous studies. He proved theoretically that there is a relationship between the balance of the claim on government with central bank and exchange rate of Libyan dinar and money supply.

3. Study Model:

After discussing the theoretical and empirical work, this section is concerned with evaluating the efficiency of the theoretical money supply multiplier approach or model and the efficiency of the Libyan banking system in influencing the money supply function[2].

3.1 The role of Libyan commercial banks in the expansion of money supply:

According to the money supply multiplier model the central bank can influence the money supply through a change in the monetary base MB, and also by changing the value of the money supply multiplier by changing the required reserve ratio for deposits r, and the public can also influence the money supply multiplier through an increase or decrease in: holding the currency outside commercial banks and their time deposit balances.

All of these factors affect the ability of commercial banks to expand the creation of money supply, basing on the money multiplier theory of money supply, the multiplier depends on the commercial banks granting loans such as mortgages, auto loans, business loans, and personal loans and banks make profit from making loans by charging interest as the latter is directly related to the expansion of banks in creating money, and this relation has been clarified in the previous sections.

Since the interest rate is the main determinant of the profits of banks resulting from lending operations, and it is also the main determinant for cost that banks afford to maintain excess reserves from deposits and thus the banks are unwished to grant loans with

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2 This section draws enormously from Ben-Taher (2021).

low interest rate and the money multiplier will be collapsed (Ennis and Weinberg, 2007; Seghezza, 2020), and undermining the role of the central bank in influencing on multiplier by changing the required reserve ratio of deposits, the following are the factors affecting the decisions of commercial banks for a change in the money supply multiplier according to the money supply multiplier function in Libya:

3.1.1 The interest rate on loans granted by commercial banks is equal to zero by Law No. (1):

- In practice:

    a) The efficiency of the tool for changing the required reserve ratio of deposits is very weak (r) is Constant & $(\Delta r) = 0$

    b) The cost of commercial banks maintaining excess reserves $(ER) = 0$.

    c) The cost of holding the currency in circulation $(c) = 0$.

    d) The change in reserves required on time deposits $(rt) = 0$.

    e) The public holding time deposits to demand deposits = 0.

3.1.2 The inability of commercial banks to provide liquidity to the public:

- In practice:

    a) Increasing in demand deposits with commercial banks (DD).

    b) Increasing in the ratio of private agents holding currency to deposits (c) and decreasing in the ratio of individuals' currency holdings to deposits (c)[3].

    c) Maintaining commercial Banks large excess reserves (ER).

The data shown in Table (1) proves the hypotheses outlined above. The reserve ratio imposed by the CBL on all banks' deposits is 20% (constant since 2008), the ratio of the excess reserves of commercial

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3 The effect of the inability of commercial banks to provide liquidity on (c) is unclear, as the theoretical relationship is still ambiguous and requires practical evidence.

banks reached to about 74% of the total reserves with CBL and the ratio of the public holding the currency in circulation reached about 95% of the total issued currency (CI). These ratios are very large and reflect to the low cost of commercial banks maintaining excess reserves and low cost of public holding the currency in circulation and the latter also indicates to inability of commercial banks to provide liquidity to the public, where the proportion of the currency in the commercial banks (CV) did not exceed 4.1% of the total issued currency as average annual percentage during the period post 2013 and reaching a minimum of 1.7% in 2017, as shown in the table.

The table also shows that the volume of time deposits (TD) has witnessed a reduction during the study period, where decreased by an average annual rate of 10.7% after 2013, the year in which interest rate was abolished and this confirms the hypothesis of a decrease in the desire of private agents and individuals to deposit their money in the banks because there is no interest earned from time deposit operations.

The hypothesis that (c) is very small (c ≈0) due to the large size of the public sector in Libya, according to the Libyan Audit Bureau report (2020), the total transferring balances of individuals and agents to the bank accounts reach more 2.5 billion LYD per month in the form of wages, salaries, bonuses for workers and non-workers, as well as payments for private agents which provide operational services for the public sectors.

$$(e \approx 1) \ \& \ (r = rt = \text{inefficient}) \ \& \ (c \approx 0) \longrightarrow (i = 0)$$

Based on the above combination, the money multiplier is collapsed or at least it is remained very low since 2014, the main reason for this collapse is shown in table (1) where the significant increase in banks' excess reserves and decrease in loans, due to law No. (1) of 2013 bans interest in all civil and commercial transaction.

3.2 The role of the central bank of Libya in the money expansion process:

A low money multiplier indicates a weak role for commercial banks in the processes of expanding money supply by creating deposits and that means any change in money supply is a result of the central bank changes in MB[4]. This is not the only difference of the formula of theoretical MS function, as there is another fundamental difference, which is the determinants affecting the central bank's decisions regarding change in MB and can be identified in the following hypotheses:

3.2.1- Money supply is used for public finance:

- In practice:

   a) The expansion of the money supply came to finance the public budget deficit (BDD).
   b) The change in demand deposits ΔDD is the initial change in commercial bank deposit reserves with CBL (ΔDR).
   c) The expansion in the money supply results from an increase in claims on government with the Central Bank (COG).
   d) The expansion in money supply takes place through the change in MB.

The main motive behind the central bank's expansion in the money supply is to finance the public budget deficit (BDD) and the change in MB results from the change in the balance of the claims on government with CBL (COG). The data in the table (1) confirms that hypothesis, where COG increased rapidly during the study period achieving an average annual rate about 150%. This significant rate of increase has direct positive impact on the reserves

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4 Bazinah (2020) also found that, the commercial banks do not have an effective role in MB. He proved that the money supply multiplier was very low during 21013-2018.

of commercial banks, and thus leads to an increase in MB, consequently, an increase in the money supply.

 In light of the weak role of commercial banks in creating deposit, the change in the balance of commercial banks' reserves comes from transferring Public Treasury advances to public agents' deposits with commercial banks. Figure (1) confirms the hypothesis that there is significant relationship between money supply and commercial banks' DD with CBL. So, it can be concluded, that the change in the COG is the main determinant of the change in MB through changing DR (deposits of commercial banks with the CBL), or: DR= f(COG)

Figure (1) the relationship between M1 and the demand deposits of commercial banks with CBL during the period 2012 – 2020.
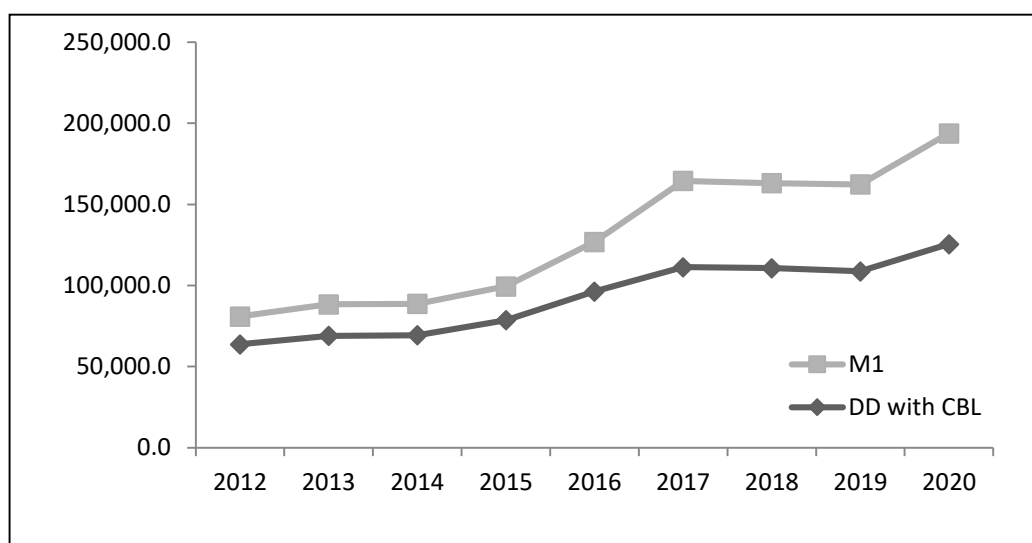
Source: Central Bank of Libya Bulletin 2021 Q2.

Table 1: Factors affecting Libyan money supply

Year	M1	DD	TD	CC	Issued Currency (CI)	Cash on Vault	Banks' Loans	DD with CBL	Excess Res (ER)	Claim Gov (COG)
2012	63,732	50,340	12,912	13,391	14,825	1,433	9,778	17,203	39,272	1,816
2013	69,006	55,586	21,065	13,420	15,043	1,623	10,301	19,365	46,959	2,171
2014	69,405	52,230	21,669	17,175	18,795	1,620	11,599	19,318	40,610	24,235
2015	78,606	55,599	11,957	23,007	23,752	744	12,269	20,863	30,872	43,378
2016	96,321	69,218	10,645	27,103	27,702	595	11,504	30,628	37,133	47,852
2017	111,339	80,474	10,519	30,865	31,405	538	10,926	53,136	60,364	59,142
2018	110,721	75,988	13,116	34,733	36,307	1,577	10,810	52,385	58,371	64,039
2019	108,741	72,050	10,582	36,692	39,048	2,355	11,887	53,629	51,685	59,982
2020	125,543	85,811	9,226	39,732	40,862	1,129	11,931	68,245	64,924	87,659

Source: Central Bank of Libya Bulletin 2021 Q2.

3.2.2 The exchange rate of the Libyan dinar in the black market (exch) and the Central Bank's decisions to increase MB:

- In practice:

   a) (exch) has negative relationship with the public holding currency (CC).
   b) (exch) has negative relationship with currency issuance decisions (CI).

The decrease in exch leads to a rise in the general level of prices, which increases the public adding the currency in their possession as a result of the increase in the values of transactions and also increase their desire to hold the currency because they expect that the exchange rate of LYD in black market will increase in the future.

In light of the inability of commercial banks to provide cash to public, large cash balances are kept out- banking system, as showed in table (1), the percentage of cash in by bank vault not exceed 4.1% of the total issued currency as average of annual percentage, this situation pushes the CBL to take decision to print more currency to

meet the increasing demanded currency by individuals. It can be seen from table (1) in 2020 the rate of increase in the issued currency (CI) reached to more than 175% compared to 2012, achieving an average annual increase rate of 13.8% during the period 2013-2020, which will lead to an increase in MB and then increase in the money supply MS:

$CI = f(Exch)$

3.3 The influencing factors of Libyan Money Supply:

It can be concluded from the previous discussion that the decisions of CBL to expand MB for the purpose of increasing MS came in order to mitigate the negative effects resulting from the financial crisis and not to serve the macroeconomic goals according to the economic literature. So it is obvious that the theoretical money supply formula by multiplier does not fully express the money supply in the Libyan economy. Based on the previous assumptions, the appropriate formula can express on the influencing factors of money supply in Libya as follows:

$\Delta DD = \Delta DR$ & $\Delta PR = \Delta DR + \Delta CV$

$\Delta Ms = \Delta R + \Delta CC$ & $\Delta Ms = \Delta MB \longrightarrow$ ($\Delta MB = \Delta DR + \Delta CC$)

$\Delta MB = \Delta DR + \Delta CV + \Delta CI - \Delta CV \longrightarrow$ ($\Delta R = \Delta DR + \Delta CV$ & $\Delta CC = \Delta CI - \Delta CV$)

         $\Delta MB = \Delta DR + \Delta CI \longrightarrow$ (1)

CV = cash in vault with banking system.	R = reserves of commercial banks with CBL.
DD = commercial banks' demand deposits	DR = demand deposits of commercial banks with CBL
MB = monetary base.	CC = cash with public.
MS = narrow money supply.	CI = issued currency.

It can be analysed the components of definitional equation 1 as follows:

a) Any change in DD is caused by a change in the reserves of commercial banks, not by creating deposits.
b) The change in MS equals the change in the reserves of commercial banks with CBL plus the change in CC, (the change in the MB)
c) The change in MB equals the sum of the change in the total issued currency (CI) and the change in demand deposits commercial banks with CBL (DR).

The importance of COG and exch as key influence on monetary base, and then the money supply function in Libya can be written as follows:

$$\text{Ms} = f(\text{COG, Exch}) \longrightarrow \qquad (2) \qquad \Delta\text{Ms} = \Delta\text{MB}$$

The above function shows the expansion in MS is linked to financial policy not to monetary policy, in other words, if the relation between COG and MS is strong, it means that monetary policy is less effective and dependent on financial policy. Therefore, it is important to identify the power of the relation between COG and nominal money supply in the Libyan economy.

4. Data and Methodology

The study uses quarterly time series data from the first quarter of 2013 to the fourth quarter of 2020. The timeframe is crucial to the study following the issuance of the law to abolish bank interest and the emergence of a deficit in the public budget. The data on money supply and the claims on government with the CBL are obtained from the CBL Quarter Statistical Bulletins. As for the data on exchange rate of the Libyan dinar in the black market against the US dollar published by the Faculty of Economics and Commerce at the University of Al-Marqab.

The study relied on the Autoregressive Distributed Lag Model, which was presented by Pesaran and Smith (1998), and developed

by Pesaran et al. (2001). This technique has a number of advantages over other techniques such as Johansen cointegration:

- Suitable for model estimation in case the sample size is small.
- Valid in estimating the model whether the variables in the regression are purely of I(I) or purely I(0) or a mixture of both.
- Valid in measure the effect of independent variables on the dependent variable in the short and long term.
- The ARDL technique can determine the optimal lag years without need to use the VAR model; the model also allows using different lag years, whereas in other cointegration techniques this is not possible.

In an econometric form, equation 2 becomes:

$$Ms_t = b_0 + b_1 COG_t - b_2\, Exch_t + e_t \qquad (3)$$

Where: Ms = nominal narrow money supply, COG = claims on government with CBL, Exch = LYD exchange rate in the black market and e = error term

According to the theoretical framework, the nominal money supply is related to a positive relationship to the claims on government with CBL and a negative relationship to the LYD exchange rate in the black market. The Autoregressive Distributed Lag Model (ARDL), where the model shows that the factors affecting the money supply can be explained by its lagged values and the lagged values of the independent variables, and equation 3 can be written as follows:

$$\Delta lnMs_t = \alpha_0 + \alpha_1 lnMs_{t-1} + \alpha_2 lnCOG_{t-1} + \alpha_3 Exch_{t-1} + \sum_{i=1}^{k} \beta_{1i}\, \Delta lnMs_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta lnCOG_{t-i} + \sum_{i=1}^{k} \beta_{3i}\, \Delta Exch_{t-i} + e_t \qquad (4)$$

Here, all variables are as previously defined, α_0 is a constant and the long-term parameters are: $\alpha_1\ \alpha_2\ \alpha_3$, while the short-term parameters are: $\beta_{1i}\ \beta_{2i}\ \beta_{3i}$, according to the theoretical model, the sign of the parameters ($\alpha_2\ \beta_{2i}$) expected positive, while the sign of the parameters ($\alpha_3\ \beta_{3i}$) expected negative. As for (k) is the number of

lagged years, (Δ) is the first difference of the variable and (In) is the logarithm. Note that equation 4 is a semi-log model since the variable Exch is decimal. In the case of decimal variable, taking log of variable may change the nature of data (it will give negative values).

The study methodology adopts the Bound test to establish the existence of cointegration, ARDL Bound test is conducted on equation 4. The calculated F value is compared from the test with the lower and the upper bound of the critical values provided by Pesaran et al. (2001). If the Wald test statistics (F-statistics) are less than the lower bound, it means there is no cointegration or a long-term relationship among variables and called the null hypothesis (H0) In contrast, if the test value is higher than the upper bound; it means there is a long-term cointegration among variables and called the alternative hypothesis (H1). If the F-statistics is within the bounds, it indicates the inconclusive result. Bounds test (F-statistics) for cointegration is carried out:

$H_0: \beta_{1i} = \beta_{2i} = \beta_{3i} = 0$ & $H_1: \beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq 0$

In the case of the existence of a cointegration or a long-term relationship between the variables of the model, equation 4 is broken down into a parsimonious long run and short run models. The parsimonious long run model is expressed below as:

$$InMs_t = \alpha_0 + \alpha_1 InCOG_t - \alpha_2 Exch_t + e_t \qquad (5)$$

In equation 5, α_0; α_1; and α_2 are the long run parameters.

On the other hand, the short run model expressed below as:

$$\Delta lnMs_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} \Delta lnMs_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta lnCOG_{t-i} + \sum_{i=1}^{k} \beta_{3i} \Delta Exch_{t-i} + \delta \varepsilon ct_{t-1} + \mu_t$$

In equation 6, β_0; β_1; and β_2 are the short run parameters. The εct_{t-1} is the error correction term lagged for one period, δ the rate of

correction of the short run disequilibrium in the long run. The coefficient, δ is expected to be less than one, negative and statistically significant.

5. Empirical Results

This section includes four parts: the unit root test to test the stability of the time series, the Bound test to test the existence of a long-term relationship or cointegration among variables, estimating the parameters in the long and short terms, finally conducting a stability test and testing the validity and quality of the model.

5.1. Unit root test

Since the ARDL cointegration technique requires underlying variables of I(0) or I(1) or a combination of both; integration of order I(2) leads to the crashing of the technique, the Augmented Dickey-Fuller Test (ADF) applied for the stationary test, (Nkoro and Uko, 2016). The summary of the ADF stationary test reported in Table (2) indicates that the money supply is non-stationary in level and it is integrated of order one I(1). The results show also the claim on government with CBL and Exch are level-stationary at 5%. Since Exch and COG are stationary at levels and Ms is non-stationary in level and stationary when tested in first difference form, the order of integration is a mixture of I (0) and I (1), making it valid to use Autoregressive distributed lag (ARDL) bound test approach.

Table (2) ADF Stationarity Test (t − Statistics) Results

| Variables	Rank	Level		first difference	
		Level constant	Trend & constant	Level constant	Trend & constant
LMs	I(1)	–0.819	–3.0390	–4.105***	–4.087***
Lg	I(0)	–1.009	–4.177**	–4.792***	–4.374***
Exch	I(0)	–3.177**	–2.662	–1.655	–2.287

(***) imply Prob. < 0.01; (**) imply Prob. < 0.05
Source: Author's own calculation using EViews10

5.2. ARDL Model Selection

The study used Akaike's Information Criteria (AIC) to identify the most suitable ARDL model. As seen from Figure (2), among the top 20 models with lowest AIC values, the optimum model is ARDL (4,4,4). Hence the ARDL (4,4,4) model was chosen as a fitted model.

Figure (2) Model Selection Based on Akaike's Information Criteria (top 20 models)
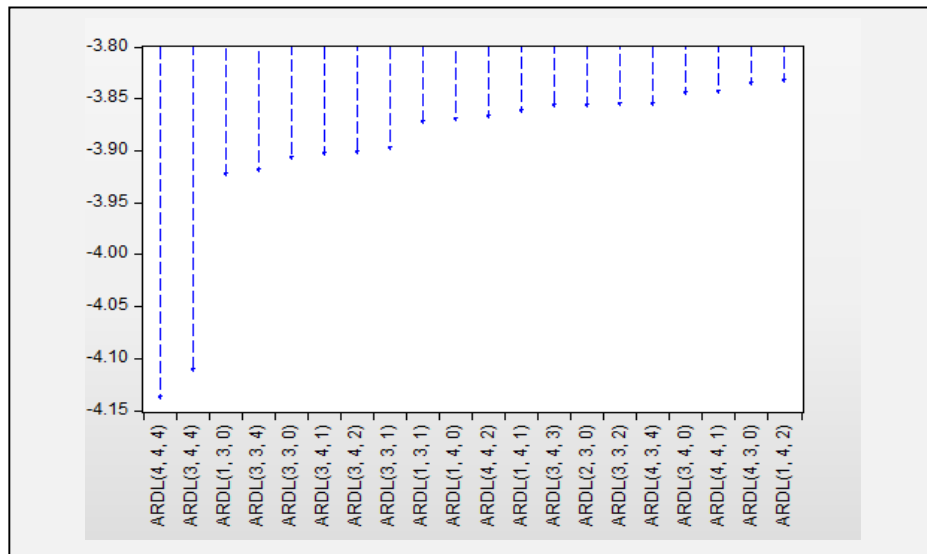
Source: Author's own calculation using EViews10

5.3. ARDL Bound Test of Cointegration

Table (3) shows that the F-statistics value calculated from the bound test is 6.717, and this value is larger than the upper-class limit of 5.00, the outcome of the test, which indicates the existence of a long-term relationship or cointegration among the variables. Hence, the variables trend together in the long run.

Table (3) ARDL Bound Cointegration Test on the Determinants of Money Supply (Restricted intercept with no trend)

Equation 4 [ARDL(4,4,4)]					
F- Bound test statistic	Significance	10%	5%	2.5%	1%
	I(0)	2.63	3.1	3.55	4.13
6.717	I(1)	3.35	3.87	4.38	5.00

Source: Author's own calculation using EViews10

5.4. Long Run and Short Run Analyses

From the long-run result reported in Table (4), the relationship among variables came in line with the theoretical framework, there is sufficient statistical evidence that claim on government with CBL (COG) positively induces money supply in the long run and this relationship is significant at the level of 5%., which means that 1% increase in COG leads to approximately 0.27% increase in the money supply. This result proves the third hypothesis of the study model, which says that the main motivation behind the central bank expanding basic of money supply is to finance the public budget deficit

The results for the long-run estimation show that, there is an inverse relationship between the money supply and the Libyan dinar exchange rate in the black market at a level of significance of 5%, and the long run estimated coefficient of EXCH is about 1.28, that is, a unit increment in the EXCH will reduce money supply by roughly 1.28 % yearly. This also proves the fourth hypothesis of the study model, which says that the decline in the Libyan dinar black market exchange rate has an impact on decisions to expand money supply through the issuance of a new currency, and thus the increase in the value of the Libyan dinar relieves the pressure on the Central

Bank to issue a new currency to meet the demand for money as a result of an increase in the general price level and the inability of commercial banks to provide cash liquidity.

Table 4: Results of Long –run Relationship (Equation 5)

lnMS			
Variables	**Coefficients**	**t–statistics**	**P–value**
lnCOG	0.265953	2.236727	0.04**
EXCH	–1.284205	–2.556760	0.02**
C	8.937705	6.747950	0.00***

(***) and (**) indicates 1% and 5% significance level,

EC = InMS - (0.2660*InCOG -1.2842*EXCH + 8.9377)

Source: Author's own calculation using EViews10

Table (5) reports the short-run coefficient estimates obtained from the ECM version of the ARDL model (4, 4, 4). The short run current and the lagged values of the claim on government with the central bank are positive and statistically significant at the level of 1%, which is consistent with the hypothesis of the study that any change in demand deposits is the initial change in commercial banks deposit reserves with the Central Bank because of an increase the balance of the claims on government with the Central Bank (COG).

The short run current and the immediate lagged value of the black market exchange rates are positive rather than negative and statistically insignificant. However, second and third lagged values of the variable are negative and statistically significant at a 1% level. Therefore, it follows that decrease in the black market exchange rate in the current time leads to an increase in the quantity of money supply after the six months and this result consists with the hypothesis of the study that the effect of the black market

exchange rate on the money supply is indirect through effects the general level of prices first and then affects the decisions of the Central Bank to increase the monetary base, and this requires a period of time at least six months according to the interpretation of the results shown in the table below.

Finally, a highly significant negative error correction term is proof of the existence of a stable long-term relationship. This means that short-run disequilibrium on the system converges to equilibrium at a speed of 40 % per three months

Table 5: **Results of Short –run Relationship** (**Equation** (**6**))

| Variable	Coefficient	t–Statistic	Prob.
D(lnMS(–1))	–0.366238	–2.185545	0.05**
D(lnMS(–2))	–0.467212	–3.449641	0.00***
D(lnMS(–3))	–0.224321	–1.636483	0.13
D(lnCOG)	0.174987	5.641557	0.00***
D(lnCOG(–1))	0.026505	4.276546	0.00***
D(lnCOG(–2))	0.022597	5.015630	0.00***
D(lnCOG(–3))	0.013024	2.710348	0.02**
D(EXCH)	0.292863	1.348011	0.20
D(EXCH(–1))	0.218792	1.324358	0.21
D(EXCH(–2))	–0.500078	–2.811412	0.01***
D(EXCH(–3))	–0.642550	–3.054161	0.00***
EC(–1)	–0.404465	–5.750553	0.00***

(***) and (**) indicates 1% and 5% significance level,
Source: Author's own calculation using EViews10

5.5. Model Stability and diagnostic

The model stability test includes two tests: the cumulative sum of recursive residuals (CUSUM), and the cumulative sum of squared recursive residuals (CUSUMQ), which was introduced by (Brown et al., 1975). The two tests result as shown in Figure (2) clearly

indicates the coefficients of the model are stable during the investigated period because the plot is within the 5% critical bounds.

Figure (2) Plots of CUSUM & CUSUMSQ Statistics
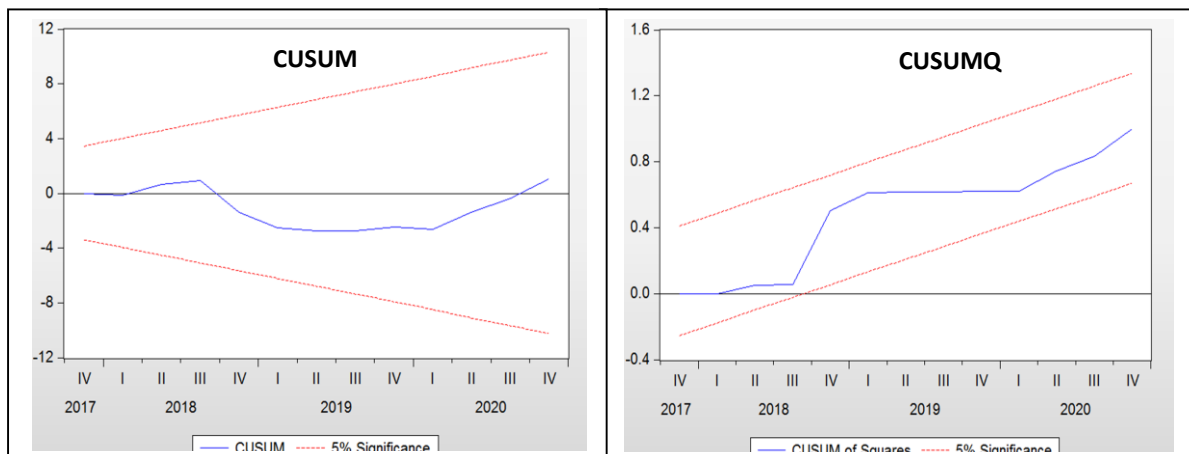
Source: Author's own calculation using EViews10

The diagnostic statistics as shown in Table (6) illustrates that the LM indicates there is no serial correlation in the data because the p-value of F statistics is greater than 10%, as well as the results of the ARCH test and the Breusch-Pagan-Godfrey test are also greater than 10%, which indicate that there is no problem of Heteroskedasticity in the data. As for Ramsey's Reset test for functional form misspecification, the null hypothesis that the model is valid, is accepted because the p-value of F statistics is greater than

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10%. As a result, the estimates of the model are valid for policy analysis.

. **Table 6**: **Diagnostic Tests ARDL** (4, 4, 4)

Test	F–statistic	P value
Heteroskedasticity Test: Breusch–Pagan–Godfrey	1.996	0.111
Heteroskedasticity Test: ARCH	0.619	0.439
Breusch–Godfrey Serial Correlation LM Test	0.997	0.400
Ramsey Test	0.300	0.594

Source: Author's own calculation using EViews10

6. Conclusion

The purpose of this study is to determine and estimate the effect of macroeconomic factors on the money supply in Libya. The theoretical analysis relied on the money supply function found by the previous study, Ben-Taher (2021), which included variables different from those referred to in other previous studies, where assumed the two basic hypotheses when determining the influence factors affecting money supply, namely: the expansion in the money supply came to finance the public budget deficit, and there is a relationship between black market exchange rate of the Libyan dinar and the decisions of the Central Bank to expand the monetary base. The empirical analysis adopted the ARDL bounds testing cointegration approach and investigated the long -run and short -run relationships between money supply and claim on government with CBL and black market exchange rate of Libyan dinar.

The empirical results found that there is a cointegration relationship between variables where money supply was the dependent variable. The results in the long and short run also indicate that the claim on government with CBL has a positive and significant impact on money supply and an inverse relationship between money supply and the black market exchange rate of Libyan dinar. These results reinforce the hypothesis that the main motive behind the Central Bank's expansion in the money supply is to finance the public budget deficit, and confirm the hypothesis that the decrease of the black market exchange rate of Libyan dinar has an impact on CBL decisions to expand the money supply through the issuance of a new currency.

The study concluded there are two motivations that imposed the Central Bank of Libya to increase the money supply during the study period, first: to finance the public budget deficit and the increase or decrease in the monetary base results from the change in the balance of the claims on government with the CBL, and second: to meet the demand for money as a result of an increase in the general price level and the inability of commercial banks to provide cash liquidity by printing new currency.

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