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Analysis of the Money Demand Function in MENA Countries: The Role of Macroeconomic Variables

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Abstract

This study investigates the factors affecting money demand in selected MENA countries including Iraq, Iran, Qatar, the United Arab Emirates, Saudi Arabia, Algeria, Turkey, Morocco, and Egypt from 1993 to 2023 using the CS-ARDL model. Cross-sectional dependence and heterogeneity of slope coefficients were examined to provide the initial conditions of the model. The results confirmed both of them. Westerlund test also showed the existence of a long-run relationship (cointegration) between variables in some countries and the entire panel. The final model examined the effect of variables such as oil revenues, government expenditures, inflation, exchange rate, domestic interest rate, and foreign interest rate on money demand. The results revealed that oil revenues have a positive and significant effect in the short and long run, while government expenditure has no effect. Inflation and domestic and foreign interest rates have a negative and significant effect, and the exchange rate has a positive and significant effect on money demand in both periods. The negative and significant adjustment coefficient (67.4 percent) indicates a rapid return to long-run equilibrium. The unit root test also confirmed the persistence of the residuals, indicating the validity of the long-run relationship between the variables I (0) and I (1). The results can be used to formulate coordinated monetary and fiscal policies, especially in countries dependent on oil revenues.

Keywords: Money demand, MENA, Macroeconomic Variables.

1. Introduction

The money demand function is one of the most central and enduring constructs in monetary economics. It provides a framework for understanding how households, firms, and governments decide on the portion of their wealth to hold in liquid form, balancing the trade-off between money's utility as a medium of exchange and store of value against the opportunity cost of holding it. Stable money demand is essential for the effectiveness of monetary policy, since predictable relationships between money, income, interest rates, and other macroeconomic variables enable policymakers to forecast the impacts of policy interventions and guide economies toward price stability and sustainable growth (McLeay et al., 2014). Conversely, instability in the demand for money may weaken the monetary transmission mechanism, undermine inflation control, and complicate liquidity management (Barnett et al., 2022).

Historically, classical theories such as Fisher's quantity theory of money highlighted the proportional link between money and nominal income, while the Cambridge cash-balance approach stressed the role of individual preferences in holding cash. Later, Keynesian and monetarist traditions emphasized interest rates and permanent income as determinants of money demand. Modern developments further expanded the framework to include expectations, exchange rate regimes, and international capital flows (Fuentes et al., 2015; Mundell, 2014). These perspectives underscore that the determinants of money demand are dynamic, reflecting both domestic structures and external shocks.

A critical question for both theoretical and empirical research is whether the money demand function remains stable under changing macroeconomic conditions. If stable, money demand can act as a reliable anchor for monetary policy, helping central banks in controlling inflation and guiding output fluctuations. If unstable, however, reliance on monetary aggregates becomes problematic, particularly in economies exposed to financial innovation, currency substitution, and external volatility (Adil et al., 2020; Awad & Soliman, 2016; Randrianarisoa, 2024).

Research across diverse contexts has demonstrated mixed evidence on stability. In some advanced and emerging economies, money demand appears to follow a stable cointegrating relationship with income, prices, and interest rates (Albulescu & Pepin, 2018; Saed & Al-Shawaqfeh, 2017), while in others structural breaks, exchange rate crises, or inflationary shocks have led to instability (Banafea, 2014; Özdemir & Saygılı, 2010). This debate is especially salient in regions such as the Middle East and North Africa (MENA), where heavy dependence on oil revenues, volatile exchange rate systems, and frequent macroeconomic disturbances raise questions about the persistence of money demand stability (Hodan & Kareem, 2023; Menshad, 2022).

In the case of oil-exporting economies, fluctuations in oil prices introduce significant exogenous shocks that directly impact liquidity and fiscal balances. Higher oil revenues often translate into expanded government spending and increased monetary circulation, influencing money demand both in the short and long run (Al Rasasi, 2020; Hatam & Abdul Sahib, 2017). For instance, studies on Saudi Arabia have shown that oil-related structural breaks play a central role in determining money demand stability (Banafea, 2014). Similarly, evidence from Iraq suggests that fiscal expansions financed by oil windfalls alter the dynamics of monetary variables, complicating policy coordination (Al Imari & Aljebory, 2021; Menshad, 2022).

Moreover, exchange rate regimes remain a crucial determinant of money demand. According to the Mundell-Fleming framework, currency depreciation may raise precautionary demand for money in open economies, while also promoting substitution into foreign currencies under conditions of high inflation (Mundell, 2014; Peng et al., 2015). Empirical findings from Jordan, Turkey, and South Asia confirm that exchange rate volatility and currency substitution significantly affect the predictability of money demand (Azimi, 2023; Khan & Ahmed, 2016; Özdemir & Saygılı, 2010; Saed & Al-Shawaqfeh, 2017). In countries with histories of currency crises, individuals often diversify their portfolios into foreign assets, destabilizing domestic money demand (Fuentes et al., 2015).

Financial innovation and institutional development further complicate the traditional determinants of money demand. Innovations in payment systems, digital banking, and financial instruments alter the opportunity cost and velocity of money, potentially reducing the relevance of conventional aggregates (Adil et al., 2020; Barnett et al., 2022). For example, empirical work in India demonstrated that new financial instruments significantly reshaped the money demand function, making it less predictable under standard models (Adil et al., 2020). Likewise, Divisia monetary aggregates, which account for the differing services provided by various assets, have been proposed to restore stability in money demand estimation (Barnett et al., 2022).

Regional evidence across emerging and transitional economies suggests heterogeneity in money demand behavior. Nepal and Paija (Nepal & Paija, 2020) showed that money demand in the SAARC region exhibits long-run cointegration but is sensitive to structural breaks, reflecting the fragility of monetary frameworks in South Asia. Azimi (Azimi, 2023) reinforced these findings, showing that domestic interest rates and inflation consistently exert negative effects on money demand, while income and exchange rates generally have positive roles. Meanwhile, studies in Iran employing micro-foundations approaches reveal that sanctions, inflationary expectations, and liquidity composition significantly undermine the stability of money demand (Orooji & Dargahi, 2023).

Similarly, in North African economies, research points to varying patterns. In Morocco, Erraiteb (Erraiteb, 2020) found that monetary policy effectiveness hinges on the stability of money demand, with inflation and exchange rates playing key roles. In contrast, evidence from Egypt and Islamic banking contexts indicates divergent outcomes across regimes, suggesting that institutional frameworks matter for monetary stability (Awad & Soliman, 2016). In Russia, the post-crisis analysis confirmed the reemergence of a stable long-run relationship between money demand and income, demonstrating how economic recovery can restore predictability (Gilenko, 2018).

Prior findings suggest strong theoretical and empirical reasons to expect significant effects from these variables: oil revenues expand liquidity (Al Rasasi, 2020; Hatam & Abdul Sahib, 2017), inflation reduces real balances (Albulescu & Pepin, 2018; Peng et al., 2015), interest rates serve as opportunity costs (Kumar et al., 2013; Narayan, 2010), and exchange rate movements exert dual substitution and wealth effects (Fuentes et al., 2015; Mundell, 2014). Foreign interest rates also shape capital flows and currency substitution, linking domestic money demand to international conditions (Temizsoy & Montes-Rojas, 2019).

These diverse findings highlight that money demand stability is not uniform across countries or periods but is contingent on institutional quality, exposure to shocks, and structural characteristics. For MENA countries, where oil dependence, fiscal dominance, and exchange rate volatility are common, understanding money demand requires models that incorporate these unique factors (Hatam & Abdul Sahib, 2017; Hodan & Kareem, 2023). Furthermore, global events such as the 2008 financial crisis and COVID-19 pandemic underscored the susceptibility of money demand to extraordinary shocks, reinforcing the need for robust modeling approaches (Meo et al., 2020).

This study builds on this growing body of literature by focusing on the money demand function in selected MENA countries from 1993 to 2023. Using the CS-ARDL framework, it investigates the role of macroeconomic variables including oil revenues, government expenditure, inflation, exchange rate, domestic interest rate, and foreign interest rate.

2. Methods and Materials

The CS-ARDL model was used in this study to examine the money demand function in the MENA countries including Iraq, Iran, Qatar, UAE, Saudi Arabia, Algeria, Turkey, Morocco, and Egypt. This model was selected due to its capability to deal with problems arising from cross-sectional correlation between units and to provide more accurate results in panel data, especially in small samples (Chudik and Pesaran, 2015). The CS-ARDL model is expressed as follows:

$$\ln y_{it} = \varphi_i \ln y_{i.t-1} + \lambda_i \ln x_{i.t-1} + \sum_{P=0}^{P_T} \vartheta_{xip} \ln \bar{X}_{t-p} + \sum_{P=0}^{P_T} \vartheta_{yip} \ln \bar{Y}_{t-p} + e_{it} \quad (1)$$

Where φi is the lag coefficient of the dependent variable. P_T is the limit of the number of lags included in the cross-sectional area $(P_T \sqrt[3]{T})$ λ_i is the coefficient of the explanatory variables and e_{it} is the model error. The CS-ARDL method has several advantages over conventional techniques for estimating panel data. The existence of cross-sectional correlations between units is one of the major problems in panel data.

Using special methods, this model adjusts for cross-sectional correlations between units, leading to more accurate estimates of the model parameters. The CS-ARDL model can examine the effects of different time lags on the dependent and explanatory variables. This feature is especially important for economic and financial analyses since economic relationships often affected indirectly and with delays over time. Another unique feature of the CS-ARDL model is its capability to provide more accurate results even in small samples. The number of sample units may be limited in many economic studies, especially in developing countries or specific geographical areas. This model increases the accuracy of the model coefficients by using the jackknife correction method and contributes to more reliable analyses.

The CS-ARDL model is specifically designed for panel data that includes a combination of cross-sectional and temporal data. This model can well examine the effects of different variables based on different time periods and different units (countries) (Meo et al., 2020). It is necessary to examine the prerequisites for using this method before estimating the CS-ARDL model. First, the cross-sectional dependence between the countries is assessed since the presence of cross-sectional

correlation can affect the accuracy of the results. For this purpose, Pesaran's cross-sectional dependence test (Pesaran, 2004) was used. This test aims to assess whether errors or observations in different cross-sectional units (e.g., countries, firms, or regions) are correlated with each other In panel data, cross-sectional dependence occurs when common shocks or factors (such as economic crises, policy changes, or environmental effects) affect different units simultaneously.

The Pesaran CD test has advantages over other tests such as the Breusch-Pagan LM test. For example, it can be used for panels with small and large time (T) and cross-sectional (N) dimensions and does not rely on the assumption of homogeneity of error variances. The null hypothesis of this test usually indicates “no strong cross-sectional dependence” or “weak cross-sectional dependence,” while the opposite hypothesis indicates the presence of strong cross-sectional dependence. The test statistic is calculated as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \quad (2)$$

Where T is the length of the time period, N is the number of units (countries) and $\hat{\rho}_{ij}$ is the cross-sectional correlation between the balances of countries i and j. Rejection of the null hypothesis indicates the existence of cross-sectional dependence, which is well handled by the CS-ARDL model (Pesaran, 2004). In the next step, the slope heterogeneity in the panel data is examined since assuming the same coefficients in different countries can lead to incorrect results. For this purpose, the slope heterogeneity test of Pesaran and Yamagata (2008) is used. This test tests the null hypothesis of homogeneity of slopes against the hypothesis of heterogeneity.

In this study, the money demand function in the MENA countries including Iraq, Iran, Qatar, UAE, Saudi Arabia, Algeria, Turkey, Morocco, and Egypt will be examined from 1993 to 2023. The CS-ARDL model was used to examine the money demand function in the MENA countries to deal with the problems caused by cross-sectional correlation between units as it provides more accurate results in panel data, especially in small samples, by considering cross-sectional means, lags, and heterogeneous coefficients.

In this model, real money demand (M2) is used as the dependent variable and the independent variables include oil revenues to GDP (OR), government expenditures to GDP (GE), inflation rate (INF), real exchange rate (ER), interest rate (IR), and foreign interest rate (FIR). The data required for this study include panel data for the years 1993 to 2023 and are extracted from reliable economic sources such as the Central Bank of Iraq, statistical data of the Iraqi government, the International Monetary Fund, and the World Bank. EVIEWS. STATA software was also used to analyze the data.

3. Findings and Results

To verify the prerequisites for using the CS-ARDL method in this section, the cross-sectional dependence between the study units and the slope heterogeneity is first assessed. Then, the stationarity order of the variables is examined.

The cross-sectional dependence test of Pesaran (2004) was used to assess the cross-sectional dependence between the data of the study countries. Table 1 presents the results of this test for the model variables.

Table 1. Results of the cross-sectional dependence test

Variable	Statistic CD	p-value	Correlation	Absolute
LnM2	20.52	0.0000	0.615	0.759
LnOR	14.22	0.0000	0.663	0.663
LnGE	12.41	0.0000	0.126	0.349
LnINF	14.61	0.0000	0.192	0.279
LnER	20.59	0.0000	0.676	0.676
LnIR	20.55	0.0000	0.226	0.304
LnFIR	14.33	0.0000	0.001	0.001

The results show that the p-value is less than 0.05 for all variables, so the null hypothesis of no cross-sectional dependence is rejected. This result confirms that the panel data between the nine MENA countries are cross-sectionally dependent. The highest correlation was observed for the foreign interest rate variable (LnFIR) with a value of 1.000, which was expected since this variable was the same for all countries. The variables real exchange rate (LnER) and oil revenues (LnOR) also showed a high correlation (0.676 and 0.663, respectively), which could indicate the joint effects of the foreign exchange and oil markets

in the region. The lowest correlation is for government expenditure (LnGE) with a value of 0.126, indicating differences in the fiscal policies of the countries. The existence of cross-sectional dependence necessitates the use of the CS-ARDL method for panel analysis.

Slope heterogeneity in panel models is a vital aspect of economic data analysis since the assumption of coefficient homogeneity may not be valid in real conditions, especially in international or regional economic data. This heterogeneity can arise from structural, institutional, or policy differences between units (such as countries) that affect the relationships between variables (Pesaran et al., 1999). Ignoring slope heterogeneity can lead to inefficient estimates, which mislead policy analyses based on these models (Eberhardt and Teal, 2011). Thus, examining slope heterogeneity before selecting an estimation model is an essential step to ensure the validity of the results. The Pesaran and Yamagata (2008) test is one of the valid methods for examining slope heterogeneity in panel data. In this test, the null hypothesis states that the slope coefficients are homogeneous across units. This test is performed by calculating the delta statistic and its adjusted version. The results of this test are reported in Table (2).

Table 2. Results of the slope heterogeneity test

Test statistic	Statistic value	Probability value
Delta	13.440	0.000
Adjusted delta	15.604	0.000

The test results show that the delta statistic is 13.440 and the adjusted statistic is 15.604. The very low p-value significantly rejects the null hypothesis of homogeneity of the slope coefficients. In other words, there is strong evidence of heterogeneity of the slope coefficients in the nine countries. These results indicate that the effect of the explanatory variables on money demand varies across countries and that the use of traditional homogeneous models (such as OLS or fixed effects) is not appropriate for these data.

This heterogeneity can be attributed to various factors, including differences in economic structures, monetary policies, and dependence on oil revenues in the countries studied. For example, countries such as Iran and Saudi Arabia, which are strongly dependent on oil revenues, may respond differently to the oil revenue variable than countries such as Turkey, which have more diversified economies. Thus, it is necessary to use models that consider slope heterogeneity, such as CS-ARDL, to analyze these data.

The CIPS test was used for panel data to examine the stationarity order of variables. This test was introduced by Pesaran in 2007 and is known as a unit root test for panel data that considers cross-sectional dependence. The CIPS test controls the dependence between units and provides more accurate results by adding the cross-sectional average of the variables. Table (3) presents the results of this test.

Table 3. Results of the CIPS unit root test for variables at the first difference and level

Variable	CIPS Statistic (level)	Critical value 5%	CIPS Statistic (first difference)	Critical value 5%
LnM2	-1.126	-2.33	-1.691	-2.33
LnOR	-1.316	-2.33	-1.381	-2.33
LnGE	-1.847	-2.33	-1.055	-2.33
LnINF	-1.393	-2.33	-1.307	-2.33
LnER	-1.041	-2.33	-1.109	-2.33
LnIR	-1.954	-2.33	-1.990	-2.33

The results of the CIPS test showed that the variables of oil revenues and inflation rate are at a stationary level.

In contrast, the other variables were at a non-stationary level. However, after taking the first difference, these variables became stationary. For the variable of foreign interest rate, the ADF test was performed on the data of one country due to the same values in all countries. The results of this test are presented in Table (4). Based on the results, this variable was at a non-stationary level, but it reacheed a stationary level after taking one difference.

Table 4. Results of the ADF test

Variable	Z value	p-value
LnFIR	-2.704	0.733
D.LnFIR	-5.003	0.000

Critical values: -3.730=1%, -2.992=5%, -=2.626 10%

Before estimating the CS-ARDL model, it is crucial to examine the existence of a long-run relationship (cointegration) between variables. This model is based on the assumption that variables can return to equilibrium in the long run through an error correction mechanism if cointegration exists. In this study, Westerlund test (2007) was used to assess the cointegration between the dependent variable (money demand) and independent variables. Westerlund test is designed based on the error correction model (ECM) and provides four statistics (Gt, Ga, Pt, and Pa) to examine cointegration, focusing on the group mean and the entire panel, respectively. Table (5) presents the results of this test.

Table 5. Westerlund test results

Test statistic	Statistic value	z-value	p-value
Gt	-1.935	-3.171	0.000
Ga	0.009	0.498	0.100
Pt	-1.648	-4.174	0.000
Pa	0.188	-3.643	0.100

According to the results of Table (5), Gt and Pt are significant, indicating that some countries and the entire panel have a long-run relationship (cointegration) between the variables. However, Ga and Pa are not significant, indicating that the average error correction coefficients differ significantly between countries and it cannot be stated that cointegration is the same in all countries. Non-uniformity of cointegration between countries can occur for various reasons.

Some countries have strong financial institutions, disciplined monetary and fiscal policies, and developed financial markets, making the long-run relationship between their economic variables more stable. In contrast, countries with weak financial markets, high inflationary fluctuations, strong dependence on a specific industry (such as oil), or irregular economic policies may not have this long-run relationship or it may disappear quickly. For this reason, the mean error correction coefficients are scattered across the entire sample and Ga and Pa are not significant.

Heterogeneity in monetary and fiscal policies can also lead to uneven cointegration across countries. If economic policies do not converge, economic variables cannot be expected to behave exactly the same in the long run. This difference in policy can cause some countries to have a strong cointegration relationship while others do not. Also, error correction coefficients indicate how quickly a country's economy returns to a long-run equilibrium.

In some countries, this adjustment is very fast (due to disciplined fiscal policies, central bank independence, or economic flexibility). But in some countries, this adjustment is slower or their economic system may not even return to equilibrium properly (for example, in countries with high inflation, financial corruption, or severe currency fluctuations). This difference in the speed of adjustment across countries causes the mean error correction coefficients to be scattered across the entire sample and the Ga and Pa tests to be insignificant.

In this study, the CS-ARDL model was used to examine the short-run and long-run relationships between money demand (as the dependent variable) and independent variables including oil revenues, government expenditure, inflation, exchange rate, domestic interest rate, and foreign interest rate in nine countries. This model, by considering cross-country effects and heterogeneity, allows for the analysis of money demand dynamics in a comprehensive framework. In this section, the short-run and long-run effects of each variable are analyzed separately and interpreted from an economic perspective to provide a deeper understanding of the determinants of money demand in the studied economies. The results of this section are presented in Table (6). The F statistic = (117,153)20.16 with $p < 0.01$ indicates the overall significance of the model. The coefficient of determination of the group mean (R^2 (MG) = 0.99) indicates a very high fit of the model at the group level. The root mean square error (Root MSE=0.10) confirms the acceptable accuracy of the predictions. The cross-dependence statistic CD Statistic=2.48 with p=0.013 indicates the existence of dependence between units, which is controlled by the cross-sectional mean variables.

Table 6. Results of the CS-ARDL model estimation

Variable	Coefficient	Std. Error	z-Statistic	p-value
Short-run Estimates				
L.LnM2	0.326	0.115	2.85	0.004
LnOR	0.041	0.015	2.75	0.006
LnGE	-0.085	0.185	-0.46	0.648
LnINF	-0.179	0.064	-2.81	0.005

LnER	0.357	0.212	1.68	0.092
LnIR	-0.137	0.071	-1.94	0.053
LnFIR	-0.019	0.006	-3.23	0.001
Adjustment Term				
lr_M2	-0.674	0.115	-5.88	0.000
Long-run Estimates				
lr_LnOR	0.064	0.027	2.40	0.016
lr_LnGE	0.057	0.442	0.13	0.898
lr_LnINF	-0.358	0.133	-2.70	0.007
lr_LnER	0.519	0.191	2.72	0.007
lr_LnIR	-0.149	0.081	-1.83	0.067
lr_LnFIR	-0.035	0.010	-3.43	0.001

F-statistic (117,153) = 20.16, $p < 0.01$; CD Statistic = 2.48, $p = 0.013$; R^2 (MG) = 0.99; Root MSE = 0.10

The positive and significant coefficient of oil revenues indicates that an increase in oil revenues increases money demand in the short run. This could be due to the injection of liquidity into the economy through natural resource exports, increasing the demand for money for transactions or stores of value. The positive and significant effect is also confirmed in the long run, indicating a persistent effect of natural resource revenues on money demand. An increase in export revenues can lead to an increase in liquidity and money demand in resource-dependent economies (such as oil-rich countries). Government expenditures do not significantly affect real money demand in the short and long runs. This may be due to heterogeneity in countries' fiscal policies or the contrasting effects of government expenditures in different countries, which neutralized the overall effect.

The studied countries may have different economic structures (e.g., dependence on different monetary or fiscal policies), making the effect of government expenditure variable and neutralized at the group average level. The negative and significant coefficient of inflation in the short run indicates that the demand for money decreases as the general price level increases. This result is consistent with Keynes and Friedman's theory of money demand, as inflation increases the opportunity cost of holding money and pushes people towards non-monetary assets (such as bonds or goods).

In economies with high inflation, this effect can lead to a reduction in confidence in money and an increase in the velocity of money. In the long run, the negative impact of inflation is stronger (-0.358), indicating a persistent inverse relationship between inflation and money demand. This result is consistent with the quantity theory of money, in which an increase in the money supply eventually leads to inflation and reduces the real demand for money.

In the economies studied, this can indicate an attempt by central banks to control inflation by restricting the money supply, leading to a decrease in the nominal demand for money. Generally, inflation as a key factor affects money demand in both the short and long run. In the short run, there is a rapid response to inflationary shocks, while in the long run, this effect reaches a stable equilibrium that puts pressure on monetary policy. A positive and significant coefficient on the exchange rate at the 10% level indicates that an increase in the exchange rate (a depreciation of the domestic currency) increases money demand in the short run. This could be due to increased uncertainty in the foreign exchange market, which encourages people and companies to hold more money as a store of value or for future transactions. In open economies, a depreciation of the domestic currency may increase money demand as a buffer against exchange rate shocks. In the long run, the positive impact of the exchange rate is stronger and more significant.

This indicates a structural dependence of money demand on the exchange rate. In economies where foreign trade plays a significant role, a depreciation of the domestic currency can increase the demand for money to cover import costs or maintain purchasing power. This result is consistent with models of money demand in open economies (such as the Mundell-Fleming model). The negative and significant coefficient of the domestic interest rate at the 10% level indicates that an increase in the interest rate in the short run reduces the demand for money. This is consistent with Keynes's theory of money demand, in which the interest rate increases the opportunity cost of holding money and encourages people to invest in financial assets (such as bonds). In the short run, this effect can be related to the contractionary monetary policies of the central bank. In the long run, the negative effect of the interest rate is significant with a coefficient of (-0.149) at the 10% level. This indicates a stable inverse relationship between the interest rate and the demand for money. In the long run, an increase in the interest rate can reduce the demand for money through changes in saving and investment behavior, which is consistent with the classical and neoclassical

models of the demand for money. The interest rate, as an instrument of monetary policy, reduces the demand for money in both the short and long runs.

This effect indicates the sensitivity of money demand to changes in opportunity cost and emphasizes the importance of interest rate policies in liquidity management. The significant negative coefficient of the foreign interest rate indicates that short run changes in foreign interest rates reduce money demand. Economically, an increase in foreign interest rates can increase the attractiveness of investing in foreign assets (such as foreign bonds) and reduce the demand for domestic money. In the long run, the negative impact of the foreign interest rate is significant and persistent, indicating that a continuous increase in foreign interest rates reduces the demand for domestic money. This result is consistent with the interest rate parity theory, in which an increase in foreign interest rates can lead to capital outflows and a decrease in domestic money demand. Foreign interest rates reduce domestic money demand both in the short run (through sudden changes) and in the long run (sustainably).

This indicates the sensitivity of money demand to international financial conditions and competition between domestic and foreign assets. Finally, the adjustment coefficient (lr_M2=-0.674) indicates that if there is a deviation from the long-run equilibrium, 67.4 percent of this deviation is adjusted in each period and the system returns to equilibrium. The negative value of this coefficient is in line with economic theory since the imbalance will decrease in the long run. Also, this coefficient is statistically significant given that the p-value=0.000.

In this section, the statistical properties and stationarity of the residuals are examined to assess the validity of the estimated model. The results of this section are presented in Table (7). Based on the results, the mean of the residuals is approximately zero (-1.10-e71) and its standard deviation is 0.0791, indicating a relatively low dispersion around the mean. The range of the residuals varies from a minimum of -0.1906 to a maximum of 0.2485, indicating that the model explains the majority of the variation in the dependent variable with reasonable accuracy.

Then, the stationarity of the residuals was examined, which is a basic condition for the validity of the CS-ARDL framework. For this purpose, the panel unit root test of Pesaran (2007) was used. The null hypothesis of this test states that all cross-sectional units have homogeneous unit roots (i.e., the residuals are non-stationary), while the alternative hypothesis suggests the stationarity of at least some units. The CIPS test results yielded a statistic of -4.785, which is higher than the critical values at the 10% (-2.21), 5% (-2.33), and 1% (-2.57) significance levels. Thus, the null hypothesis of non-stationarity was rejected at the 1% significance level, and strong evidence was obtained that the residuals were stationary. This result confirms the existence of a stable long-run relationship between the model variables as the stationary nature of the residuals is a key condition in models whose variables are a combination of I (0) and I(1) processes and cointegration holds.

Table 7. Statistical features and unit root test of residuals

Statistical features of residuals	Value	Stationary test of residuals (CIPS)	Value
Mean	-1.10e-71	Test statistic	-4.785
Standard Deviation	0.0791	Critical value 10%	-2.21
Minimum	-0.1906	Critical value 5%	-2.33
Maximum	0.2485	Critical value 1%	-2.57

4. Discussion and Conclusion

The findings of this study on the determinants and stability of the money demand function in selected MENA countries reveal a complex but coherent pattern consistent with theoretical expectations and much of the empirical literature. Using the CS-ARDL framework, the results confirm that oil revenues exert a positive and significant influence on money demand in both the short and long run. Inflation and both domestic and foreign interest rates reduce money demand significantly, while the exchange rate increases it. Government expenditure, by contrast, does not exhibit a meaningful effect in either time horizon. The adjustment coefficient of 67.4 percent indicates a rapid speed of adjustment toward long-run equilibrium, underscoring the responsiveness of money demand to macroeconomic shocks.

The strong positive association between oil revenues and money demand across the MENA region reflects the centrality of hydrocarbon rents in these economies. Periods of higher oil prices inject substantial liquidity into domestic markets through fiscal channels, leading to increases in transaction balances and precautionary demand for money. These findings are consistent with evidence from Saudi Arabia, where oil-driven structural breaks were shown to alter the dynamics of money demand (Al

Rasasi, 2020; Banafea, 2014). Likewise, research on Iraq also highlighted how government spending financed by oil windfalls directly affects monetary variables (Al Imari & Aljebory, 2021; Hatam & Abdul Sahib, 2017). The persistence of this effect in both the short and long run underlines the structural dependence of MENA economies on oil revenues, echoing the concerns expressed in earlier studies that resource-driven liquidity expansions complicate the design of monetary policy (Menshad, 2022). Furthermore, similar to results obtained in Madagascar where real income and financial innovation played key roles in stabilizing demand (Randrianarisoa, 2024), the present analysis underscores that resource variables must be incorporated into any comprehensive model of money demand in resource-rich economies.

By contrast, government expenditures are found to have no significant effect on money demand in the short or long term. This null result may reflect heterogeneity across the nine MENA countries: in some economies government spending is highly monetized, while in others it is financed through debt issuance or foreign reserves. The contradictory influences likely cancel each other at the regional level, resulting in statistical insignificance. Similar outcomes were reported in Jordan, where cointegration was observed between money demand and macroeconomic factors, but the explanatory power of fiscal expenditure was limited (Saed & Al-Shawaqfeh, 2017). In the Iranian context, Orooji and Dargahi (Orooji & Dargahi, 2023) also argued that inflationary expectations and the composition of liquidity outweighed the role of direct fiscal spending. These findings collectively suggest that fiscal policy in resource-dependent states is often mediated by oil revenues and exchange rate regimes rather than directly shaping money demand.

The negative and significant impact of inflation on money demand across horizons is in line with both theoretical models and prior empirical evidence. Inflation increases the opportunity cost of holding money by eroding its purchasing power, prompting individuals to shift toward non-monetary assets. This outcome is consistent with the Cagan effect observed in China, where high inflation reduced real money demand in nonlinear ways (Peng et al., 2015). The long-run elasticity of −0.358 in this study confirms that inflation exerts a persistent contractionary effect on monetary balances, echoing results from South Asia (Azimi, 2023) and the SAARC region (Nepal & Paija, 2020). Moreover, Albulescu and Pepin (Albulescu & Pepin, 2018) stressed that money demand stability is undermined in environments with high inflation, as changes in velocity weaken the predictive capacity of monetary aggregates. This convergence of evidence underscores the central importance of inflation control in maintaining monetary stability in MENA economies.

Similarly, domestic interest rates are shown to reduce money demand significantly, confirming the classical Keynesian prediction that interest rates represent the opportunity cost of holding money. Higher domestic rates incentivize households and firms to invest in alternative assets, lowering liquidity preferences. These results align with Narayan's (Narayan, 2010) panel analysis of transitional economies, which found a consistent inverse relationship between interest rates and real balances. Parallel findings were also reported in Nigeria, where Kumar et al. (Kumar et al., 2013) demonstrated that rising interest rates destabilize money demand. The present results reinforce the robustness of this relationship even in oil-dependent economies, suggesting that domestic monetary authorities can influence liquidity conditions through interest rate policies, though the strength of this channel may vary depending on institutional depth.

The negative impact of foreign interest rates on domestic money demand is another crucial finding. Higher returns on foreign assets attract capital outflows, leading to currency substitution and a decline in demand for local money. This is consistent with the interest rate parity framework and aligns with Temizsoy and Montes-Rojas (Temizsoy & Montes-Rojas, 2019), who documented the effects of monetary shocks on sovereign risk in Europe. The present evidence indicates that MENA countries are not insulated from global financial conditions; rather, domestic money demand is sensitive to shifts in foreign rates. This reinforces the arguments advanced by Fuentes et al. (Fuentes et al., 2015) and Mundell (Mundell, 2014) regarding the centrality of capital mobility in shaping monetary outcomes. In addition, evidence from South Asia also suggests that foreign interest rates impose contractionary pressures on money demand (Azimi, 2023), highlighting the cross-regional relevance of this determinant.

The exchange rate is found to have a positive and significant effect on money demand in both the short and long run, though the effect is stronger in the latter. Depreciation of domestic currencies raises uncertainty in external trade and encourages economic agents to hold more money for transaction and precautionary purposes. This outcome reflects the wealth effect

described in the Mundell-Fleming framework, where depreciation increases domestic money demand to safeguard purchasing power (Mundell, 2014). Empirical evidence from Turkey and Jordan corroborates these results, as exchange rate fluctuations were found to significantly alter money demand stability (Özdemir & Saygılı, 2010; Saed & Al-Shawaqfeh, 2017). Similarly, Nepal and Paija (Nepal & Paija, 2020) documented how exchange rate movements shaped the long-run money demand function in South Asia. The results of this study suggest that in MENA economies—where trade exposure and currency volatility are common—exchange rates are central to the predictability of monetary dynamics.

The error correction coefficient of −0.674 further demonstrates the responsiveness of the system, indicating that more than two-thirds of deviations from equilibrium are corrected each period. This high speed of adjustment echoes evidence from Saudi Arabia, where deviations from steady-state demand were found to normalize within fifteen months (Al Rasasi, 2020). In Morocco, Erraiteb (Erraiteb, 2020) also highlighted the importance of strong adjustment mechanisms in restoring long-run equilibrium in monetary relationships. The efficiency of adjustment across MENA countries implies that monetary authorities maintain a degree of policy effectiveness despite structural volatility. It also suggests that money demand remains a useful analytical tool for monetary policy, provided that policymakers account for structural factors like oil revenues and external financial conditions.

The present findings contribute to ongoing debates on the stability of money demand. While earlier studies questioned whether globalization, financial innovation, and structural breaks rendered money demand unstable (Adil et al., 2020; Barnett et al., 2022), the evidence here shows that with proper modeling techniques that account for cross-sectional dependence and heterogeneity, stable long-run relationships can be detected. This resonates with Chudik and Pesaran (Chudik & Pesaran, 2015) and Eberhardt and Teal (Eberhardt & Teal, 2011), who argued that ignoring cross-country heterogeneity leads to misleading conclusions about instability. By employing the CS-ARDL method, this study demonstrates that money demand in MENA countries retains stable determinants, even if short-run fluctuations and structural shocks complicate the picture.

Moreover, the results validate the argument of McLeay et al. (McLeay et al., 2014) that understanding money creation and circulation in the modern economy requires examining how macroeconomic variables jointly shape liquidity. The persistence of oil revenues as a driver, combined with the contractionary role of inflation and interest rates, demonstrates that money demand cannot be understood without reference to structural characteristics of economies. Regional studies such as those by Hodan and Kareem (Hodan & Kareem, 2023) and Menshad (Menshad, 2022) confirm that in Iraq and similar states, inflation and exchange rates dominate money demand dynamics. The present findings extend these insights to a broader MENA panel, reinforcing the policy relevance of monetary aggregates in resource-rich, trade-exposed economies.

Overall, the study illustrates that money demand in MENA countries is shaped by a mix of global and domestic forces. Oil revenues, exchange rates, and inflation remain primary drivers, while domestic and foreign interest rates serve as opportunity costs influencing portfolio decisions. Government expenditures, although theoretically important, appear neutralized by regional heterogeneity. These results are broadly consistent with prior studies across South Asia (Azimi, 2023; Khan & Ahmed, 2016; Nepal & Paija, 2020), North Africa (Erraiteb, 2020), the Middle East (Hodan & Kareem, 2023; Orooji & Dargahi, 2023), and transitional economies (Kumar et al., 2013; Narayan, 2010). They also echo evidence from Russia (Gilenko, 2018) and European states (Temizsoy & Montes-Rojas, 2019), highlighting the universality of key determinants across diverse contexts. The implication is that money demand, though exposed to shocks, remains a meaningful and stable relationship when properly modeled.

Despite its comprehensive design, this study has several limitations. First, the analysis focuses on a selected group of nine MENA countries, which, while representative, may not fully capture the diversity of monetary dynamics across the broader region. Second, the data constraints inherent in long time-series (1993–2023) may limit comparability across countries, especially those that experienced conflict, sanctions, or sudden institutional reforms. Third, while the CS-ARDL model accounts for cross-sectional dependence and slope heterogeneity, it cannot fully capture nonlinearities, threshold effects, or regime shifts that may characterize money demand under extreme shocks such as hyperinflation or currency crises. Finally, the study uses aggregate macroeconomic indicators; micro-level determinants such as household financial inclusion, digital

payments, or informal sector activity are not incorporated, though they are increasingly important in shaping liquidity preferences.

Future studies should extend the analysis in several directions. Incorporating nonlinear models such as panel smooth transition regressions or threshold cointegration could uncover whether money demand reacts differently under low- versus high-inflation regimes. Comparative studies between MENA and other resource-dependent regions, such as Sub-Saharan Africa or Latin America, could further illuminate how natural resource rents influence monetary stability. Moreover, future research should explore the role of digital financial innovations, mobile money, and cryptocurrency adoption in altering liquidity preferences, especially as these technologies expand in developing economies. Finally, country-level microdata on household and firm behavior could complement aggregate analyses, offering a more granular understanding of money demand determinants and stability.

For policymakers, several lessons emerge from this study. Oil revenues should be managed prudently to prevent excessive liquidity injections that destabilize monetary conditions. Inflation control remains paramount for preserving the real value of money holdings and sustaining monetary stability. Exchange rate management policies must mitigate volatility to avoid destabilizing money demand, while domestic interest rate policies should be carefully coordinated with global financial conditions. Governments should recognize that fiscal expenditure alone does not significantly influence money demand and thus should design fiscal strategies in harmony with monetary objectives. Overall, central banks in MENA countries should adopt integrated policy frameworks that account for both domestic structural factors and external financial conditions to ensure stability in money demand and enhance the effectiveness of monetary policy.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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