



Exploring the Stability of Money Demand Function for GCC Countries

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ARTICLE INFO

Article History:

Received: March 30, 2022

Revised: June 12, 2022

Accepted: June 12, 2022

Available Online: June 30, 2022

Keywords:

Money Demand Function

GCC

Stability

ARDL

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

It is imperative to explore the stability of the money demand function (MDF) due to its effectiveness in the strength of monetary policy. This paper employs the ARDL approach to examine whether the M3 MDF is stable for the Gulf Cooperation Council (GCC) consisting of six Arabian Gulf countries. The paper also uses CUSUMSQ and CUSUM tests for this purpose. Unit root test results indicate that variables have unit roots with varying degrees. The results reveal that M3 has a cointegration relation with inflation and real output, however, the interest rate is statistically insignificant for most countries across the period under study. However, the CUSUM and CUSUMSQ tests indicate that M3 MDF is unstable across all the GCC countries. It implies that the governments in GCC countries have to be very careful in implementing monetary policy to achieve stability and growth targets.

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1. Introduction

There has been a long standing debate between Keynesian and Monetarists regarding the stability of Money Demand Function (MDF). It has been a popular topic of research to discover the determinants of Money Demand (MDD) in macroeconomic theory. MDD is an essential component in drawing the monetary policy. The main determinants of money value by the Friedman (1988) school of thought are the money supply and demand that control money value and therefore the price levels and inflation and therefore Friedman school also considers the MDF to be stable. The Keynesians propose that interest rate is determined by interaction of money supply and demand and they believe that MDF is not stable.

A great deal of attention has been paid to MDF in macroeconomics due to its effects on monetary policy and the huge role of money in any given economy. According to Duca and VanHoose (2004), MDF also provides information about the portfolio distribution. According to Baharumshah, Mohd, and Masih (2009), success of monetary policy in an economy essentially depends on the existence of a steady-state relationship between MDD and its determinants. The importance of studying the GCC countries' MDF comes from the largeness of the GCC countries' gross domestic product, while not having a vastly diversified economies the GCC countries have adopted plans to diversify their economies by increasing the non-oil revenues. The GCC countries started a custom union and the central Gulf Cooperation Council bank has started in Riyadh dedicated to construct a unified currency, which means more expanded studies on money role an economy, and monetary policies in the council.

The objective of current paper is to investigate the short-run and long-run MDF in the GCC countries and assess the stability of MDD. Effectiveness of monetary policy instruments to stimulate the economy depends on accurately estimating the MDD and its determinants. There are very few previous studies trying to assess the stability of MDF for GCC countries. However, all these studies use pooled data for all GCC countries and analyze them as one entity. Whereas present study analyzes the MDF stability for each member country of GCC

individually. It is more appropriate to analyze the results for each country separately since they significantly differ in terms of size and importance of the economy.

The economies of GCC countries have developed in a relatively short period due to aggregate oil revenues. This research focuses on the GCC countries because they share similar historical, traditional and geographical characteristics. The research applies the ARDL model to explore whether the MDF for the GCC countries is steady. The research analyzes the newly recorded data for the time series from 1978 to 2020. Secondly, the research uses the ARDL model. Similarly, the research will contribute to the MDD literature in the GCC countries since it is not a much researched problem for this specific set of countries. Some work has already been carried out using the GCC data; however, this paper differs from papers like Hamdi, Said, and Sbia (2015) in the methodology by employing ARDL approach in assessing the MDF in the GCC countries. Also, this paper use relatively newly recorded quarterly data from 1968-2020.

Rest of the paper has been organized as follows: Important papers discussing the topic have been reviewed in the second section. Section 3 gives details about methodology and data. Econometric analysis and interpretation of results is carried out in section 4. Finally, summary and conclusions are presented in the last section.

2. Review of Literature

Important literature related to demand for money has been review under the classification of studies consisting of developed countries and research that relates to regional countries.

2.1 Studies related to Developed Countries

The effect of government expenditure (GE) on MDD in the US has been explored by Ebadi (2019) by employing ARDL technique. The paper finds positive elasticity of MDD with respect to GE, showing significant impact of government expenditure on money demand in the US. MDF is found to be unstable. The paper recommends against switching to interest rate targeting policy in place of money targeting policy.

Daniele, Foresti, and Napolitano (2017) apply ARDL technique to test the stability of MDF for Italy. The empirical results conclude that while estimating standard MDF, instability cannot be excluded in broad and narrow definitions of money. The results show a fully stable demand for narrow money M1 in the augmented MDF but not stable in case of M2 in the same function.

The research by Avouyi-Dovi, Drumetz, and Sahuc (2012) re-examines the euro area MDF from 1997-2005. The stationarity tests reveal the values to have unit root of order one. These outcomes show that inflation and the short-term interest rate are co-integrated and this means that it does not have to be included in the function. The results show a unitary elasticity of income to MDD. The results reveal that MDD is strongly dependent on its determinants.

The paper by Hossain (2012) estimates the stability of the M1 MDF relationship in Australia employing ARDL technique. The ARDL cointegration results show that the narrow MDD relationships are unstable despite innovation and financial deregulation in Australia since the decade of 1980s. The stability tests show no indication of random or systematic variations in the regression coefficients (Jianjun et al., 2021).

Dreger, Reimers, and Roffia (2007) estimate the long-run MDF for the new member countries of European Union (EU). The tests fail to reject the null hypothesis of no cointegration for this panel. The Pedroni tests results support alternative hypothesis of existence of cointegration relationship. The results of FM, DOLS, and the two-step approach show that MDF is elastic for all countries studied. Both interest rate as well as the exchange rate elasticities is negative and statistically significant.

Bahmani-Oskooee, Bahmani, Kutun, and Xi (2019) employ cointegration technique to test MDD for selected Western industrial countries. The empirical results reveal that across 11 OECD countries there is a minor instability in MDF for Switzerland and United Kingdom. In the

remaining nine countries: Australia, Austria, France, Canada, Japan, Italy, Sweden, United States of America and Norway the M2 MDF is stable.

2.2 Regional Studies

Saudi Arabia is the largest and most important economy in GCC countries. There are several studies exploring the stability of MDF in Saudi Arabia including Al Rasasi (2020); Al Samara, Mrabet, Dombrecht, and Barkat (2017); Al Yousef (2014); (Chien, Hsu, Zhang, Vu, & Nawaz, 2022); Mahmood and Alkhateeb (2018); Mohammad and Al Hajhoj (2009). All of these studies conclude the stability of MDF in Saudi Arabia during different time periods. Al Rasasi (2020) assesses the stability of MDF using data from Saudi Arabia. The tests illustrate stability of MDF at 5% significance level of parameter estimates over long run and also Hansen's tests verify the existence of co-integration relationship.

Mahmood and Alkhateeb (2018) employ ARDL technique to examine the MDF for Saudi Arabia. They also explore how the exchange rate has asymmetrical effects on the MDF. The results reject the null hypothesis of no cointegration. The CUSUM and CUSUMSQ results show the stability of MDF for Saudi Arabia.

Al Samara et al. (2017) investigate the disproportionate effects of oil price shocks on the MDD for Saudi Arabia. Evidence on the long-run equilibrium of MDF is estimated using non-linear ARDL model, which is mostly caused by the prices of oil. The study by Al Yousef (2014) uses the ARDL model to conclude the relation among MDD (M2) and its determinants in Saudi Arabia. The MDD (M2) determinants in this research all have large effect on the MDD in Saudi Arabia over both long-term and short-term. The research finds a positive and significant correlation between the real GDP and MDD, a positive and significant correlation between the financial innovation and the MDD, a negative and significant correlation between interest rates and the MDD and a negative and insignificant correlation between stock prices and the MDD. The ARDL results indicate a stable M2 MDD for Saudi Arabia.

Mohammad and Al Hajhoj (2009) analyze the MDF for Saudi Arabia. The Trace and Max-Eigen statistics reject the null hypothesis of no cointegration between the MDD and its determinants. MDF has been shown to be stable using CUSUM and CUSUMSQ tests for Saudi Arabia. There are very few studies that estimate the MDF for GCC countries. All of these studies use the panel data approach to estimate the relationship. The results of paper by Mahmood (2016) conclude that income is an important determinant of MDD in the short-run for GCC countries. Moreover, exchange rate and income have positive influence on MDD in the long-run relationships while inflation and interest rates negatively impact the MDD. CUSUM and CUSUMSQ tests show that MDF is stable in the GCC countries.

Similarly Hamdi et al. (2015) also find that the MDF for GCC countries is stable. Strong cointegration relation has been found between the variables of the model. There is bidirectional causality between the model variables. An older study by Lee, Chang, and Chen (2008) runs panel cointegration technique to estimate overall MDF for GCC countries. The Results of panel test show that at least two cointegrated vectors for the MDF exist in GCC countries. Based on the cointegration tests, the paper recognizes that MDF is stable in the long- run in GCC countries.

Roussel, Ali, and Audi (2021) explore the factors affecting MDF in Pakistan using ARDL technique. According to the results, socioeconomic factors including CPI, foreign remittances, and population growth are the most important determinants of MDD in Pakistan. Ahad (2017) investigates determinants of MDF for Pakistan. The results show a long-run relationship among MDD, income, exchange rate, industrial production, and financial development. In short run as well as long run, financial development is a major determinant of MDF. A recent study by Dritsaki and Dritsaki (2022) explores the stability of MDF for South Korean economy. The study finds long run relationship using cointegration. One way causation runs from industrial production to MDD with long run elasticity close to unity.

Similarly, Odeleye and Akam (2022) use panel ARDL and panel cointegration techniques to assess the MDF in Sub Saharan African countries. A cointegrating relationship has been found between MDD and its determinants. Price level is the major determinant of MDD in the selected countries. Siklar and Siklar (2021) study changes in the stability of MDF in

Turkey over time and find out that it is not stable. However, if the data is analyzed in two periods it is found that MDF is stable during each period with failure of stability during the transition. Long term relationship has been found between MDF and its determinants.

Omar and Hussein (2020) employ cointegration and VEC to test the stability of MDF in South Africa. MDF is unstable according to the results. There is exists long run relation between MDD and its determinants and the short run causality runs from the determinants to MDD. Bahmani-Oskooee et al. (2019) estimate the long run effects of exchange rate changes on MDD for emerging economies using Non-Linear ARDL. The study finds significant, however, asymmetric effect of exchange rate on MDD. Achsani (2010) uses ARDL approach and VECM to estimate the M2 MDF in Indonesia. The testing uses Max-Eigen and trace tests that reveal that there are at least two cointegrating vectors between the variables by rejecting the null hypothesis of no cointegration. CUSUM and CUSUMSQ test results reveal a stability problem in the MDF. Therefore, according to the VECM results, M2 MDF in Indonesia is unstable throughout the period under study. The results also reveal the existence of a significant cointegration among the variables.

The article by Baharumshah et al. (2009) estimates the Chinese MDF using ARDL approach with CUSUM and CUSUMSQ tests. The results show that there is a long-run relationship between MDD (M2) and its determinants. In primary analysis, the study finds that domestic interest rate elasticity was insignificant at 10% significance level. Results in the paper indicate the long-term income elasticity equal unity at 5% significance level. The model parameters are not stable as illustrated by the tests results. Bahmani-Oskooee* and Rehman (2005) explore the stability of MDD for selected Asian developing countries by applying cointegration technique and the CUSUM and CUSUMSQ tests. The results reveal the instability of estimated parameters despite the cointegration relationship between real M1 or M2 monetary aggregates with their determinants, in some Asian countries.

3. Methodology and Data

This is a quantitative study based on time series of GCC countries data with a varying range for different countries from 1975 to 2020.

$$\frac{M}{P} = f(Y, i, inf) \tag{1}$$

$\frac{M}{P}$: Real MDD (M3) deflated by CPIs (P).

Y : Gross domestic product GDP.

i : Domestic interest rate.

inf : Inflation rate.

In the literature, the MDD model is calculated in log-linear form. Gross domestic product and MDD are in logarithms whereas inflation and interest rate are in levels. The MDF for GCC countries has been specified as:

$$\ln(M)_t = \beta_0 + \beta_1 \ln(y_t) + \beta_2 i_t + \beta_3 inf_t + u_t \tag{2}$$

This study employs the autoregressive distributed lag (ARDL) model. A major benefit of ARDL methodology is that it is not necessary for the order of integration to be same for all variables. Moreover, pre-testing of unit roots is not require. The specification of error correction version of the ARDL model affecting the variables is given as:

$$\Delta \ln M_t = a_0 + \sum_{i=1}^p b_i \Delta m_{t-i} + \sum_{i=1}^p c_i \Delta y_{t-i} + \sum_{i=1}^p d_i \Delta i_{t-i} + \sum_{i=1}^p e_i \Delta inf_{t-i} + \delta_1 m_{t-1} + \delta_2 y_{t-1} + \delta_3 i_{t-1} + \delta_4 inf_{t-1} + \varepsilon_t \tag{3}$$

The ARDL approach handles single cointegration presented by Pesaran and Shin (1998) and extended by Pesaran, Shin, and Smith (2001). The benefit of ARDL approach is that integration of same order for all variables is not needed as required by the Johansen (1991); Johansen and Juselius (1990) framework and it is still appropriate if the model has stationary and no stationary series in the set. The bounds test method of cointegration is superior as

compared to other cointegration techniques due to endogeneity of all variables. It not only estimates long-run but also short-run estimates of coefficients.

This paper employs autoregressive distributed lag (ARDL) approach. ARDL approach has been employed since long time in order to express the relationship between economic variables in a time-series single-equation format. It is popular because cointegration of nonstationary variables is the same as an error-correction (EC) process, and ARDL has a re-parameterization in Error Correction model. The study has applied Philips - Perron (PP) and Augmented Dickey-Fuller (ADF) techniques to test for the stationarity of variables understudy. The null hypothesis is commonly stated as the existence of a unit root and the alternative hypothesis is either stationarity or trend stationarity. Standard Akaike information criterion (AIC) has been used to set the lag order. The paper will also test the stability of parameters by using both CUSUM and CUSUMSQ tests. The study will also determine the short-term and long-term relationship between the parameters.

3.1 Data

The data in the paper are secondary data for GCC countries on M3 MDD, real output (GDP), Short-term interest rates and Inflation. The data are obtained from the World Bank Database for the real output, interest rates and from International Financial Statistics Database for real money demand and inflation. The study employs quarterly data for Bahrain (1986:1-2020:4), Kuwait (1992:1-2020:4), Oman (1984:1-2020:4), Qatar (1970:1-2020:4), Saudi Arabia (1986:1-2020:4) and United Arab Emirates (1975:1-2020:4). The research tests the null hypothesis of no cointegration against the alternative using ARDL approach (Pesaran & Shin, 1998; Pesaran, Shin, & Smith, 1996). All calculations are preformed using Eviews10.

4. Analysis and Interpretation

4.1 Unit Root Tests

Table 1 below summarizes the unit root tests results. The study uses Philips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests. The results on Bahrain's data show that all the variables GDP, M and INF are stationary at first difference according to PP test which means they are integrated of order one I(1) while ADF states that GDP and M are non-stationary at level while i is stationary at level. For Kuwait's data PP and ADF unit root tests results show stationarity of i at level while showing that GDP, M and INF have a unit root. PP and ADF tests illustrate that GDP, M and INF are non-stationary at order one or I (1). Oman's data unit root tests ADF and PP results do not differ from previous results which state that i is stationary at 5% significance. GDP, M and INF are integrated of order one or I (1) according to both tests. The results from United Arab Emirates' data show that INF is stationary at level according to PP test while GDP, M and i are integrated of order one. ADF test concludes that i is stationary at level at 5% significance while GDP, M and INF are stationary at first difference.

PP and ADF unit root tests for Qatar's data illustrate that i is stationary at level. PP test conclude that GDP, M and INF are stationary at first difference. ADF test states that GDP and M are integrated of order I (1) while INF is not stationary even at first difference. Saudi Arabian data unit root testing through PP and ADF conclude that GDP, M, INF and i are all stationary at first difference. The following table is a summary of the ADF and PP tests for every variable of every country detailing the order of integration of each variable:

Table 1: Summary of unit root tests

Variable Country	INF		I		GDP		M	
	Order of Unit Root		Order of Unit Root		Order of Unit Root		Order of Unit Root	
	PP	ADF	PP	ADF	PP	ADF	PP	ADF
Bahrain	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)
Kuwait	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)
Oman	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)
Qatar	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)
United Arab Emirates	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
Saudi Arabia	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

4.2 ARDL Results

Employing the ARDL model to the same data, the paper imposes maximum of four lags on each first differenced term in ARDL. The estimate of the model constructed on adjusted R-Squared, Akaike Information Criterion (AIC), Hannan-Quinn (HQ), and Schwarz Bayesian (SB). True dynamic of the model can be detected by only a proper lag selection. The ARDL estimates of each country's MDF are presented below:

Table 2: Full information estimate of the Bahrain ARDL (2,1,0,0) model ((M is the dependent variable)

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
Constant	0.21727	0.047652	4.559494	0.0000
M(-1)	-0.110827	0.02406	-4.606237	0.0000
GDP(-1)	0.005609	0.001208	4.645445	0.0000
I	0.004787	0.00152	3.148644	0.0021
INF	-0.00499	0.007308	-0.682861	0.4961
D(M(-1))	0.461077	0.073186	6.300042	0.0000
D(GDP)	0.014582	0.004149	3.515061	0.0006
Long-Run Coefficients				
GDP	0.050614	0.001272	39.79843	0.0000
I	0.043191	0.012339	3.500436	0.0007
INF	-0.045028	0.062999	-0.71474	0.4763
Constant	1.960435	0.028109	69.74492	0.0000

In case of Bahrain, the table above indicates that there is significant cointegration between Money, GDP, and Interest rate. The coefficient estimates of income (GDP) are positive and statistically significant both in the long-run and short-run. The coefficient estimates of interest rate (I) are also positive and significant. The inflation (INF) coefficient, however, are negatively signed and statistically insignificant both in the long-run and short-run.

Table 3: Full information estimate of the Kuwait ARDL (2,0,0,1) model (M is the dependent variable)

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
Constant	0.051303	0.041063	1.249355	0.2147
M(-1)	-0.025588	0.0064	-3.997889	0.0001
GDP	0.02342	0.006109	3.833424	0.0002
I	-0.010877	0.006715	-1.619671	0.1088
INF(-1)	0.036001	0.063459	0.567317	0.5719
D(M(-1))	0.549916	0.077522	7.093689	0.0000
D(INF)	-0.276475	0.106736	-2.590272	0.0112
Long-Run Coefficients				
GDP	0.915268	0.066893	13.68267	0.0000
I	-0.425082	0.271634	-1.564909	0.1211
INF	1.40698	2.56601	0.548314	0.5848
Constant	2.004966	1.536831	1.304611	0.1953

In case of Kuwait, the table above shows a significant cointegration between Money and GDP. The coefficient estimates of income (GDP) are positive and statistically significant in both long-run and short-run. The coefficient estimate of interest rate (I) is negative whereas coefficient of inflation (INF) is positive but both are insignificant at 5% both in the long-run and short-run.

Table 4: Full information estimate of the Oman ARDL (2,0,0,2) model (M is the dependent variable)

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
Constant	-0.228091	0.075578	-3.017938	0.0031
M(-1)	-0.031439	0.010488	-2.997482	0.0033

GDP	0.040339	0.01301	3.100591	0.0024
I	-0.002351	0.012688	-0.185288	0.8533
INF(-1)	-0.049499	0.063635	-0.77786	0.4381
D(M(-1))	0.59396	0.062533	9.498277	0.0000
D(INF)	0.991972	0.211188	4.697101	0.0000
D(INF(-1))	-0.675604	0.229472	-2.944169	0.0039
Long-Run Coefficients				
GDP	1.283075	0.053047	24.18766	0.0000
I	-0.074775	0.416528	-0.17952	0.8578
INF	-1.574442	1.942641	-0.810465	0.4192
Constant	-7.255019	1.194703	-6.072657	0.0000

In case of Oman, the table above indicates that there is significant cointegration between Money and GDP. The coefficient estimates of income (GDP) are positive and statistically significant both in the long-run and short-run. The coefficient estimates of interest rate (I) and inflation (INF) are negative and insignificant both in the long-run and short-run.

Table 5: Full information estimate of the Qatar ARDL (3,0,0,0) model (M is the dependent variable)

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
Constant	-0.0838	0.03765	-2.225755	0.0273
M(-1)	-0.025323	0.0056	-4.522066	0.0000
GDP	0.028703	0.006586	4.357993	0.0000
I	-0.039345	0.021362	-1.841771	0.0671
INF**	-0.092259	0.061618	-1.497271	0.1361
D(M(-1))	0.520038	0.072322	7.190578	0.0000
D(M(-2))	0.099856	0.070185	1.422749	0.1565
Long-run Coefficients				
GDP	1.133466	0.044978	25.20048	0.0000
I	-1.553721	0.884826	-1.755962	0.0808
INF	-3.643321	2.249431	-1.619664	0.107
Constant	-3.309259	1.153204	-2.869622	0.0046

In case of Qatar, the table above shows a significant cointegration between Money and GDP. The coefficient estimates of income (GDP) are positive and statistically significant in both long-run and short-run. The coefficient estimates of interest rate (I) and inflation (INF) are both negative and insignificant at 5% in both the long-run and short-run.

Table 6: Full information estimate of the United Arab Emirates ARDL (3,2,0,0) model (M is the dependent variable)

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
Constant	-0.385293	0.118689	-3.246228	0.0014
M(-1)	-0.039805	0.008324	-4.781655	0.0000
GDP(-1)	0.053501	0.011695	4.574547	0.0000
I(-1)	0.003421	0.111659	0.030639	0.9756
INF(-1)	-0.325099	0.122472	-2.654477	0.0088
D(M(-1))	0.496995	0.075459	6.586312	0.0000
D(M(-2))	0.142498	0.072579	1.963343	0.0514
D(GDP)	0.534542	0.073046	7.31791	0.0000
D(GDP(-1))	-0.330273	0.091166	-3.622745	0.0004
D(GDP(-2))	-0.13962	0.084567	-1.651003	0.1008
D(I)	-1.920519	0.705193	-2.723393	0.0072
D(I(-1))	1.280268	0.708958	1.805845	0.0729
D(INF)	-3.714837	0.747252	-4.971329	0.0000
D(INF(-1))	2.575141	0.854995	3.011879	0.0030
D(INF(-2))	1.549012	0.742331	2.086685	0.0386
Long-Run Coefficients				
GDP	1.344074	0.073761	18.22192	0.0000

I	0.085947	2.805766	0.030632	0.9756
INF	-8.167325	2.81448	-2.901894	0.0043
Constant	-9.679566	2.067171	-4.682518	0.0000

In case of UAE, the table above indicates that there is significant cointegration between Money, GDP, and Inflation. The coefficient estimates of income (GDP) are positive and statistically significant both in the long-run and short-run. The coefficient estimates of interest rate (I) are positive but insignificant in both the long-run and short-run. The inflation (INF) coefficient estimates are negatively signed and statistically significant both in the long-run and short-run.

Table 7: Full information estimate of the Saudi Arabia ARDL (3, 2, 0, 0) model (M is the dependent variable).

Short-Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-0.101965	0.043051	-2.368474	0.0189
M(-1)	-0.018227	0.004117	-4.427201	0.0000
GDP(-1)	0.021807	0.005404	4.035066	0.0001
I	-0.071253	0.050102	-1.422157	0.1566
INF	0.097742	0.030993	3.153651	0.0019
D(M(-1))	0.471536	0.071121	6.630043	0.0000
D(M(-2))	0.094553	0.064976	1.455202	0.1473
D(GDP)	-0.041402	0.018955	-2.18419	0.0302
D(GDP(-1))	0.036032	0.020275	1.777155	0.0772
Long-Run Coefficients				
GDP	1.196358	0.052853	22.63572	0.0000
I	-3.909101	2.736639	-1.428432	0.1548
INF	5.362363	2.168909	2.472378	0.0143
C	-5.594016	1.502217	-3.723839	0.0003

The table above shows a significant cointegration relation between Money, GDP, and Inflation. The coefficient estimates of income (GDP) and inflation (INF) are positive and statistically significant in both long-run and short-run. The coefficient estimates of interest rate (I), however, are negative but insignificant in both the long-run and short-run. In case of all six countries, income (GDP) seems to be a significant determinant of MDD with a positive impact. This result is in favor of transactions demand for money. On the other hand, interest rate shows insignificant relationship with money demand in almost all countries except Bahrain where it shows positive relationship. This shows absence of speculative demand for money. This is not surprising because generally there is small tendency towards demand for money for speculative purposes due to avoidance from interest by most of citizens in Gulf countries. Finally, inflation (INF) coefficients are statistically insignificant for four countries but significant in UAE and Saudi Arabia. This also shows inflation is not a significant determinant of money demand for most countries in Gulf.

4.3 Results of CUSUM and CUSUMSQ

The figures in appendix present the graphical representation of CUSUM and CUSUMSQ for each ARDL model for each GCC country. Bahrain figures in appendix of CUSUM and CUSUMSQ statistics are not in the critical interval in most of the years, which shows that M3 MDF in Bahrain is unstable for the whole period of 1986:1-2020:4. Structural breaks can be seen in the years between 1991 and 2003 and again from 2005 to 2009. The CUSUM and CUSUMSQ of Kuwait are somewhat more in the critical interval, which suggests that M3 MDF in Kuwait is somewhat stable over the period 1992:1-2016:4. The plots of CUSUM and CUSUMSQ for Oman cross the critical interval value especially in CUSUMSQ. This shows that M3MDF is unstable in Oman in the period 1984:1-2020:4. A long break can be seen throughout 1993 till 2015. The CUSUM and CUSUMSQ plots of Qatar's estimates do not stay in the critical interval values, which means that MDF M3 in Qatar is not stable during the period 1970:1-2020:4. The CUSUMSQ illustrate a minimal break between 1988 and 1995. CUSUM and CUSUMSQ of United Arab Emirates cross the critical interval values in several points, which conclude that MDF in United Arab Emirates M3 is unstable in the period (1975:1-2020:4). CUSUMSQ display a cross over the critical interval values throughout the period from 2000 till 2008. Plots of CUSUM and

CUSUMSQ statistics for Saudi Arabia do not stay in the critical intervals at several points. This can mean that MDF in Saudi Arabia M3 during the period (1968:1-2020:4) is not stable. The CUSUMSQ test demonstrates a break in 1974 until 2008. The above results reveal instability in M3MDFs for Bahrain, Oman, United Arab Emirates, Qatar and Saudi Arabia and a nearly stable M3 MDF in Kuwait.

5. Summary and Conclusions

Money demand function has been considered a major tool in measuring the effectiveness of monetary policy imposed by central bank. In order to achieve an effective policy it is important to investigate the MDF and its stability. The study investigates the stability of MDF and its determinants in the Gulf Cooperation Council countries by employing autoregressive disturbed lag (ARDL) approach. It is not required by ARDL method for the variables to be integrated of same order. Results show that most of the M3 MDD determinants i.e. real output, inflation and short-term interest rates to be statistically significant and consistent with the theory in the short-run and long-run.

Unit root testing by using Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) reveal that most variables are integrated of order one. ARDL results show a significant cointegration relation between Money, GDP, and Inflation. However, interest rate coefficients are statistically insignificant. Empirical results based on bounds test indicate an unstable M3 MDF in Bahrain, Qatar, Oman, United Arab Emirates and Saudi Arabia and a nearly stable M3 MDF in Kuwait. Moreover, the study applies CUSUM and CUSUMSQ tests to reveal instability of M3 MDFs in GCC countries. CUSUM and CUSUMSQ tests show a slightly stable M3 MDF in Kuwait. The instability of M3 MDF suggests that controlling money supply M3 would not be effective in stimulating the economy in most of the GCC countries except in Kuwait. It is hard to achieve the target of price stability when MDF is not stable.

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Appendix:

**CUSUM and CUSUMSQ figures of Countries:
Bahrain**

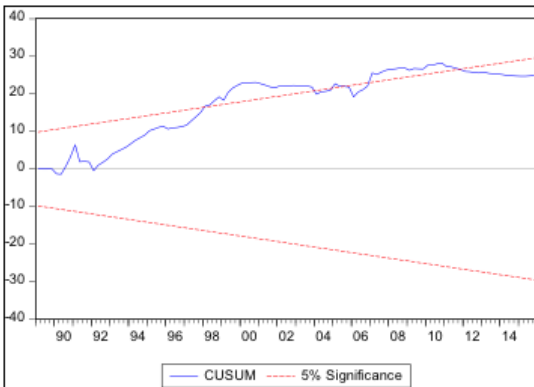


Figure A1. CUSUM of Bahrain

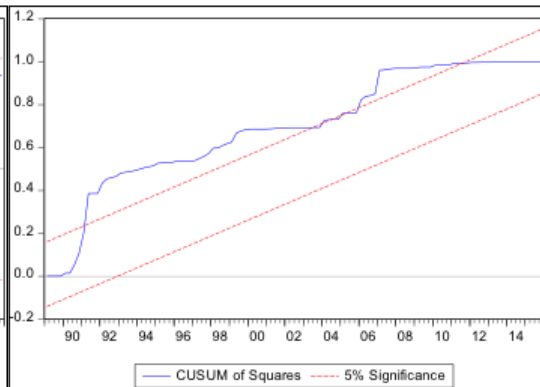


Figure A2. CUSUMSQ of Bahrain

Kuwait

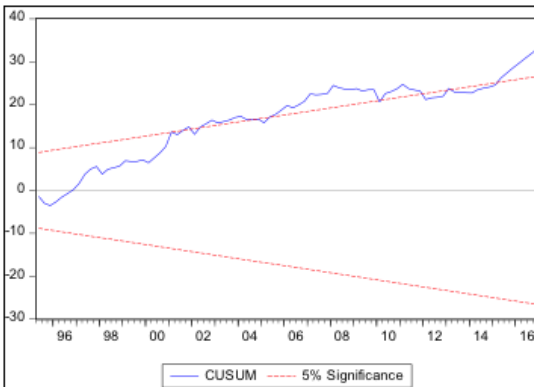


Figure A3. CUSUM of Kuwait

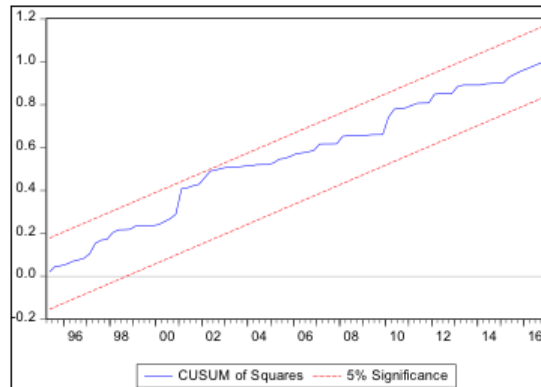


Figure A4. CUSUMSQ of Kuwait

Oman

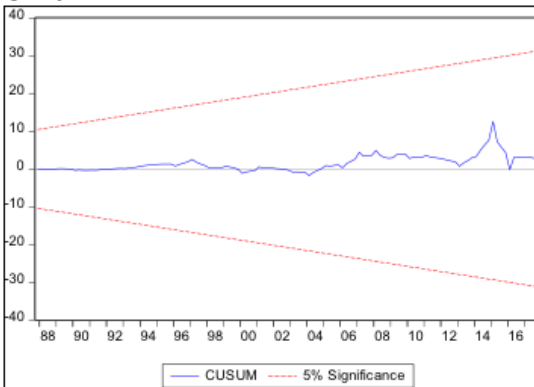


Figure A5. CUSUM of Oman

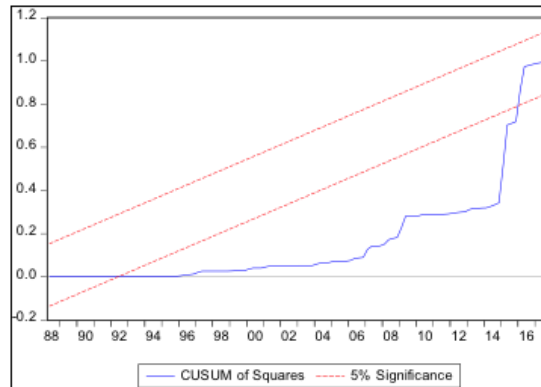


Figure A6. CUSUMSQ of Oman

Qatar

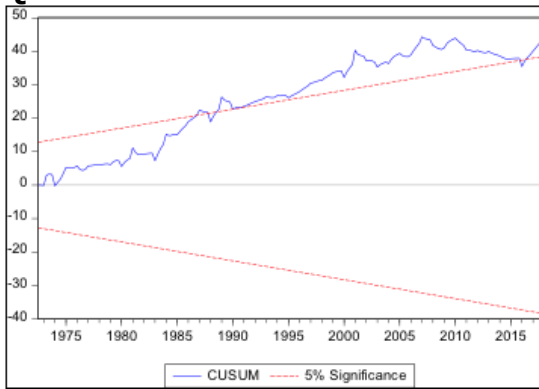


Figure A7. CUSUM of Qatar

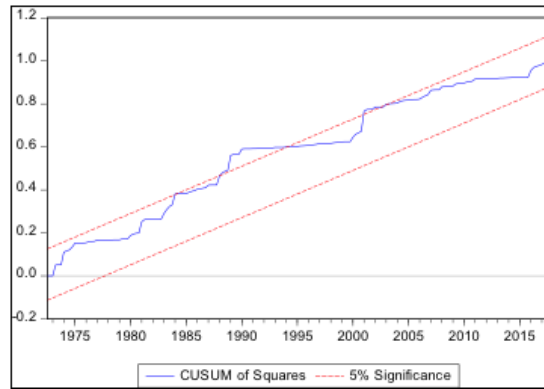


Figure A8. CUSUMS of Qatar

United Arab Emirates

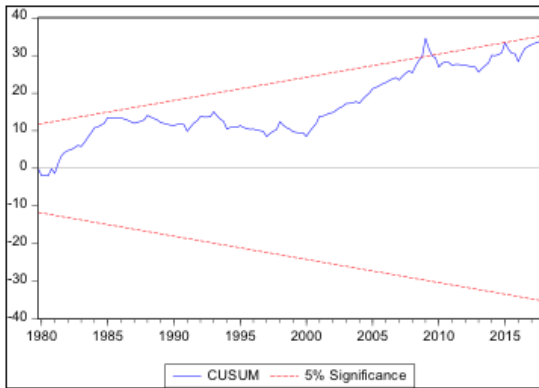


Figure A9. CUSUM of UAE

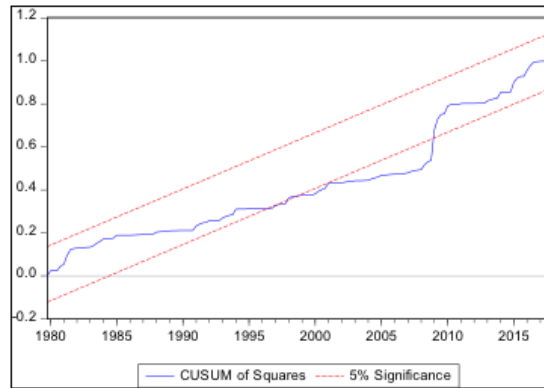


Figure A10. CUSUMS of UAE

Saudi Arabia

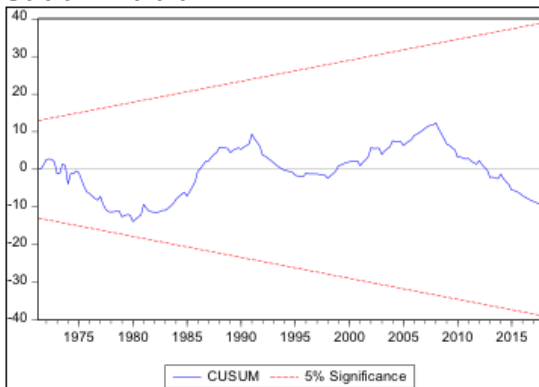


Figure A11. CUSUM of Saudi Arabia

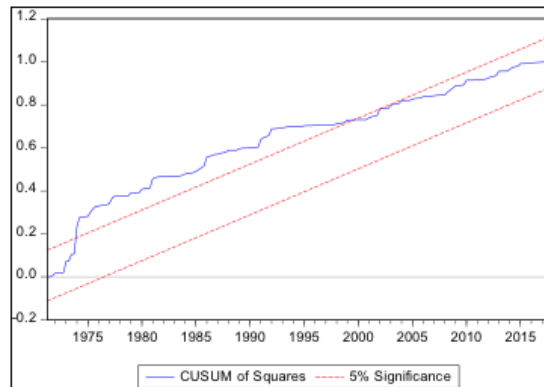


Figure A12. CUSUMS of Saudi Arabia