Empirical Evidence on the Long-Run Money Demand Function in the GCC Countries

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

Keywords: Money Demand; GCC, Panel Cointegration; Toda-Yamamoto
JEL Classifications: C22, C23, E52, E41, F41

1. INTRODUCTION

Since the pioneering work by Friedman (1956), the money demand function has received a great deal of attention by scholars, policymakers and governors. This is mainly due to the role of money in economy, notably in the implementation of monetary policy. Since a long time, Central bankers have used money demand to control inflation through the appropriate and adjustment of the money supply (Hayo, 1999). Money demand function provides information about the portfolio distribution (Duca and VanHoose 2004) and it plays an important role in creating an efficient and effective monetary policy strategy (Friedman, 1959; Friedman and Schwartz, 1982; Laidler, 1977; Laidler, 1982). The monetary policies can be suitable to give a clear indication about inflation in medium and long term. Kaldor (1982) showed that money supply is considered of being a causal in the process of inflation. However, Valadkhani (2006) showed the importance of not focusing on a single policy instrument and neglect other information and variables such interest rate. Hence, interest rate and monetary aggregates are both important to select an effective monetary policy action. Further studies that have examined the wealth variable as other variable that influence money demand such as (Boone and van den Noord 2008; de Bondt 2009; Dreger and Wolters 2010). Kumar, Webber and Fargher (2010) analyzed the level and stability of money demand in Nigeria between 1960 and 2008. The study showed that Nigeria could efficiently use the demand of money as an instrument of monetary policy.

Recently, there has been a great resurgence of interest in the issue of the role of money demand function in conducting effective monetary policy. One symptom of this phenomenon is the huge academic research on the topic investigating the demand of money at both single country level and panel or groups of countries. Hence, the aim of this study is to investigate the importance of money demand in conducting a sound monetary policy in the Gulf Cooperation Council Countries. We are interested in GCC area for different reasons. First, during the past decade GCC countries have been witnessing an unprecedented economic performance thanks to the windfall of oil revenues. The growth was on par with other emerging markets with an average rates exceeding 5-6% and much faster than advanced economies. Second, GCC governments have adopted development strategies that prioritize the modernization of their financial systems within a large economic diversification plan (Hamdi *et al* 2014). Third, the region as a whole has become a hub of finance, notably center of Islamic finance and Islamic insurance, and the preferred destination of international financial companies (Hamdi and Sbia 2013). Fourth, these countries have fixed their national currencies in the past to the US dollar and they are planning to move toward a single currency in the few coming months. The GCC regional bank was already implemented in Riyadh and it started executing the required first step for the formation of monetary Union. In addition, those countries have started a custom union and a common market grants national treatment to all GCC firms and citizens in any other GCC country, which by doing so, they have removed all barriers to cross country investment and services trade which in an effort moving closer and closer towards an economic union for those counties.

The remainder of the paper is organized as follows. Section 2 provides a brief review of literature, section 3 gives data description and methodology, section 4 presents the results and finally section 5 concludes.

2. LITERATURE REVIEW

Literature on money demand function is rich and huge. Researchers investigated this topic at both country level case study and panel of countries. For example, at single country level, Ghartey (1998) investigated the demand for money in Ghana using the Engle-Granger (1987) and Johansen's (1988) co-integration and error-correction modeling approach. The results showed that money demand in Ghana is stable. Cheong (2003) examined the impact of financial liberalization on demand of money stability in Korea. Unlike the previous studies, he demonstrated that the stability of money demand function has not been affected by the set of financial measures over the sample period. However, the author suggested that results should be taken carefully as they depend heavily on statistical properties of the model and the suitable interpretation. He concluded that the ECM model is interpreted solely as backward-looking and is also invariant to shifts in regime and various policy reforms. Lee and Chien (2008) showed that money demand in China has a significant effect on the economic and financial stability, while Baharumshah *et al.* (2009) and Wu (2009) demonstrate that a stability of money demand function would exist as long as there is proper accounting in use. Recently, Jawadi and Sousa (2013) estimated money demand equations for the euro area, the US and the UK using a quantile regression framework and a smooth-transition regression. The two approaches provided different findings. The quantile regression approach revealed that the income and the interest rate semi-elasticities are meaningfully different from the OLS estimates and the reaction of money demand to inflation tends to be greater when real money holdings are particularly low. The smooth transition model revealed also two motivating results. First, it captured soundly the nonlinear dynamics of the money demand function. Second, it showed that the elasticity of money demand with respect to inflation rate, interest rate, GDP and exchange rate diverges not only according to the regime considered, but also across the countries chosen in the sample.

In comparison to a large number of empirical works on the demand for money for other countries and group of countries, there are only a handful of empirical studies on GCC countries. At single country level, Darrat and Mutawa (1996) have used the cointegration and error-correction model to measure the money demand in the United Arab Emirates. The result of the study confirmed the support of the use of M1 as an intermediate target for monetary policy in the United Arab Emirates. Khatib and Towaijari (1999) have studies money demand in Saudi Arabia. They regressed the log of real M1 on the log of non-oil GDP, local interest rate, expected inflation rate and real exchange rate during the instable period of 1977-1997. They used the residuals to estimate an error correction model. The result showed that influence of the interest rate is low and statistically insignificant and the researchers explained that due to Islamic values and cultural in Saudi Arabia.

In panel framework, Harb (2004) found that cointegration between money and non-oil GDP for the period of 1979-2000. The study has used Pedroni's (1999) panel cointegration method. The study found significant negative the semi elasticity of money demand in connection to interest rate. The other study by Lee et al. (2008) estimated money demand function for six selected countries of the Gulf Cooperation Council (GCC) for the same period of Harb (2004) using Likelihood-based cointegration tests in heterogeneous panels. The study findings were at least two cointegrated correlation in the fourdimensional vector error-correction model for the variables of the real money balance, the real scale variable, the nominal interest rate, and the exchange rate.

Basher and Fachin (2012) estimated the long-run demand for broad money at the Gulf Cooperation Council area level and at single country level over the 1980–2009 period using times series and panel techniques. First results confirmed the stability of money demand in the long-run both nationally and regionally. Further, the estimated income and interest elasticities in Qatar, Saudi Arabia and the UAE offered an authentication for the Baumol-Tobin version of the inventory analysis of the transactions demand for money. However, income elasticities in the other GCC economies reflected portfolio demand more strongly than transaction demand with lower interest rate (semi-)elasticities. They discussed how the movements in income velocity could resolve the varying elasticities documented across the six countries.

3. DATA AND METHODOLOGY

3.1. Data

We follow the pioneering works on money demand function (Arango and Nadiri (1981) Laidler (1985), Hoffman and Rasche (1991), Miller (1991), Baba et al. (1992), Stock and Watson (1993), Mehra (1993), Ball (2001), Mark and Sul 2003, Dickey *et al.* (1991), Miller (1991), Mehra (1992), Bahmani-Oskooee and Shabsigh (1996), Valadkhani and Alauddin (2003), Harb (2004), among others) in which a basic representation of the long-run money demand can be described as follows:

$$\frac{M^d}{P} = f\left(\underset{(+)}{Y_P}, \underset{(-)}{r_s}\right) \tag{1}$$

Where $\frac{M^d}{P}$ represents real money proxied by M2, where nominal money stocks M^d are deflated by the CPIs $(P_{i,t})$;

$(Y_{i,t})$ is the scale variable proxied by the country's income,

$(r_{i,t})$ is a domestic interest rate[1] which represents the opportunity cost of holding money.

Our sample covers the six GCC countries i;e Bahrain, Kuwait, Oman, Qatar, Arabia and UAE and data used is quarterly and covers the period 1980Q1-2011Q4. Data was obtained from different sources such as the International Financial Statistics (IFS), the World Bank (2012) as well as the Arab Monetary Fund statistical book. We use non-oil GDP (Y) as a scale variable for the 4 most oil producing countries: Kuwait, Qatar, Arabia and UAE and GDP for Oman and Bahrain.

Empirical papers mainly rely on equation (1), but in many cases researchers employ an augmented money demand function by adding some variables (Foresti and Napolitano 2012). In our case, as GCC countries are open economies, therefore we will add to equation 1 a foreign opportunity cost of holding domestic money in the GCC countries proxied by two indicators which are the UK three-month Treasury-Bill rate and the US Libor rate. Moreover, unlike Darrat and Al-Sowaidy (2009) our money demand equation includes the exchange rate variable. Exchange rate is the amount of the local currency per one unit of SDR (Harb 2003). In fact, as the GCC currencies are highly linked to the US economy through the fixed exchange rate (peg), therefore, any depreciation or depreciation of the US dollar would impact automatically the local currencies of GCC countries. The inclusion of exchange rate variable in the standard function of money demand is first suggested by Mundell (1963) and later by the works of Bahmani-Oskooee (1996), Bahmani-Oskooee and Techaratanachai (2001), Harb (2004), Bahmani-Oskooee and Tanku (2006).

According to what cited above, the money demand function could be expressed as follows

$$\frac{M^d}{P} = f\left(\underset{(+)}{Y_P}, \underset{(-)}{r_s}, \underset{(-)}{E_s}\ \underset{(-)}{Tbill_s}\ \underset{(-)}{Libor_s}\right) \tag{2}$$

[1] Given the lack of data in GCC countries, we followed Harb (2004) and we proxied interest rates by average time deposit rates.

Where E is the exchange rate variable. Tbill and Libor are the UK three-month Treasury-Bill rate and the US Libor rate.

The volatility of *E* leads to volatility of the domestic currency against foreign currency (or SDR).

The estimation of the semi-logarithmic linear specification of long-run money demand takes the following form. In empirical analyses, is typically preferred.

$$\ln \frac{M^d}{P} = \alpha_0 + \alpha_1 \ln y_{i,t} + \alpha_2 r_{s,i} + \varepsilon_t \tag{3}$$

α_i refers to specific effects in a country, α_1 is the income elasticity, and α_2 is the interest rate semi-elasticity; for i = 1, 2, . . . N; t = 1, 2, . . . T; where N = 6 and T = 124 which gives us 6* 31= 744 observations. ε represents the error term.

The augmented money demand function is expressed as follows

$$\ln \frac{M^d}{P} = \alpha_0 + \alpha_1 \ln y_{i,t} + \alpha_2 r_{s,i} + \alpha_3 \ln E_{t,i} + \alpha_4 Tbill_{i,t} + \alpha_5 Libor_{i,t} + \varepsilon_t \tag{4}$$

Economic theory reveals that scale variable should have a positive effect on money holdings. Therefore, the income elasticity coefficient α_i is expected to be positive. Regarding the opportunity cost, it should have a negative impact on money demand; thus α_2 is expected to be negative. For the elasticity coefficient on the exchange rate variable α_3 it can be either positive or negative (Arango and Nadiri, 1981). In fact, a depreciation of exchange rate is associated with an increase in income which in turn would rise of domestic money. In this case, the coefficient of exchange rate is positive. However, an appreciation in exchange rate is associated with a decrease in domestic money demand (currency substitution. In this case, we could expect a negative sign of the coefficient of exchange rate.

3.2. Methodology

Our empirical study is divided in three steps. The first step is to test whether the variables contain a panel unit root to confirm the stationarity of M2, NOG (or GDP), Drate, Tbill, and Xrate. This is done by performing five type of panel unit root tests which are: Levin-Lin-Chu (LLC, 2002), Im, Pesaran and Shin (IPS, 2003), the Augmented Dickey–Fuller (F-ADF), Philips–Perron (PP, 1998) and finally Breitung (2000). The second step is to check for panel cointegration tests using Kao (1999) and Pedroni (2004) to establish a cointegrating long-term equilibrium relationship between money demand and its determinants. Finally, the third step, we test for panel cointegration by using three different techniques: fully-modified ordinary least squares (FM-OLS) of Phillips and Hansen (1990) Kao and Chiang (2000), and Pedroni (2004) dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993) and canonical cointegrating regression (CCR) proposed by Park (1992).

4. EMPIRICAL RESULTS

4.1. *Panel unit roots and panel cointegration tests*

The properties of the five variables' time series are verified through the use of four types of panel unit root tests for balanced GCC panel data. These tests are the LLC, Breitung, IPS and F-ADF panel unit root tests. The two former tests assume that there is a common unit root process across cross-sections while the alternative hypothesis does not have a unit root. However, the two later tests assume that there are individual unit root processes across the cross-sections, while the alternative hypothesis of some cross sections does not contain a unit root.

The results of the LLC, Breitung, IPS and F-ADF panel unit root tests for each of the variable are displayed in table 1. We conducted each test for the level and first difference of each variable. The results show that the series are likely to contain a panel unit root in their levels. However, when applying each variable at first difference of the panel unit root test, all tests reject the null hypothesis at the 1% level of significance indicating that they are integrated at order one ,i.e., I(1).

Table 1. Panel Unit Root Test

Variable	LLC		BREITUNG		IPS		F-ADF		F-PP		Order of int.
	Level	1st diff	Level	1st diff	Level	1st diff	Level	1st diff	Level	1st diff	
Lnm2	2.195	-7.201***	0.092	-1.493*	-1.889**	-8.012***	50.205***	150.24***	182.57***	194.567***	I(1)
LnY	-1.993	-4.433***	-2.481***	-2.035**	-2.683***	-7.558***	37.725***	77.868**	35.928***	123.659***	I(1)

Drate	-0.171	-4.925***	-2.622***	-4.527***	-1.880**	-4.260***	18.973**	37.920***	14.204	145.512***	I(1)
Tbill	-1.679	-4.803***	-2.241**	-2.892***	-5.477***	-7.334***	47.194***	68.674***	17.288*	263.397***	I(1)
Ln Xrate	-0.715	-8.001***	-3.990***	-1.878**	-1.314*	-6.302***	12.965	56.387***	8.6788	292.061***	I(1)

Notes: All tests examine the null hypothesis of non-stationary. The tests are: Levin, Lin and Chu, 2002 (LLC); Breitung, 2000; Im, Pesaran and Shin, 2003 (IPS); ADF Fisher (ADF); PP Fisher (PP) due to Maddala and Wu, 1999. *** indicates statistical significance at the 1% level. The optimal lag length is selected automatically using the Schwarz information criteria (SIC). Probabilities for the ADF (Fisher Chi-square) and PP (Fisher chi-square) tests are computed using an asymptotic $\chi 2$ distribution. All other tests assume asymptotic normality.

Following Bacher and Faccini (2012), as Libor is identical for all GCC countries; therefore we can test the statistionarity of the variable using the Augmented Dickey–Fuller (ADF) and Philips and Peron (PP) unit root tests. The results are displayed in table below and they show that we cannot reject the null hypothesis of unit roots for Libor in level forms. However, the null hypothesis is rejected when the ADF and PP tests are applied to the first differences indicating that libor is integrated of order one, *I*(1).

Table 2. Unit Root Test

	ADF		PP	
	Level	First	Level	First
Libor	-1.5775	-10.1552***	-2.2236	-10.1646***

*** indicates statistical significance at the 1% level.

After checking the integration of our six variables at order one, I(1), the Pedroni, Kao and Fisher tests for balanced (GCC) panel date are used in order to verify the presence of a long-run relation between the variables in our dataset. The test results of Pedroni displayed in table 3.

Table 3. Results of the Balanced Panel Cointegration Tests for GCC Countries

	Statistic	Prob.
Panel v-Statistic Weighted Statistic	2.926981	0.0017
Panel rho-Statistic Weighted Statistic	-3.529681	0.0002
Panel PP-Statistic Weighted Statistic	-3.186576	0.0007
Panel ADF-Statistic Weighted Statistic	-2.227194	0.9731
	Statistic	Prob.
Group rho-Statistic	-2.664054	0.0039
Group PP-Statistic	-2.943584	0.0016
Group ADF-Statistic	-2.587459	0.0048

Kao Test.

ADF 1.978329* (0.0239)

Johansen Fisher Panel Cointegration Test

Null Hypo.	Max-Eigen.	Trace
r=o	70.74 (0.000)***	70.16 (0000)***
r<1	12.02 (0.284)	18.95 (0.240)
r<2	8.197 (0.609)	12.05(0.281)
r<3	7.561(0.406)	9.475(0.487)

Note: The optimal lag lengths are selected using SBC. Figures in parenthesis are probability values.
Trace test and Max-eigenvalue test indicate 1cointegrating vector at the 0.01 level
*** Denotes the rejection of the null hypothesis at 1%level of significance.

The Table 3 reveals the rejections of the null of no cointegration for six of the seven tests at 5 % level of significance Therefore; one may conclude that a long-run money demand exists for the considered panel, as all its variables are cointegrated.

4.2. Long-Run Demand of Money

In this section, we proceed to generate individual long-run estimates for equation 2 of demand of money in GCC countries. However, as foreign opportunity costs are roughly identical to domestic opportunity cost, we use the domestic interest only to avoid multicollinearity. We conduct the procedurally "group-mean" panel fully modified OLS estimator (FMOLS) developed by Pedroni (1999b; 2001) since the basic OLS estimator is a biased and unreliable estimator when applied to cointegrated panels. We also employ the dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993) for aggregated and desagregated panel and the canonical cointegrating regression (CCR) proposed by Park (1992) for the desagregated panel.

4.2.1. Cointegration

FMOLS was firstly designed by the work of Philips and Hansen, (1990); and later by Pedroni, (1995); and, Philips and Moon, (1999) to provide optimal estimates of Co-integration regressions. The method modifies least squares to account for serial correlation effects and for the endogeneity in the regressors that result from the existence of a cointegrating relationship (Phillips 1995). FMLOS not only generates consistent estimates of the parameters in relatively small samples, but also controls for potential endogeneity of the regressors and serial correlation.

Therefore, FMOLS dominates OLS and ML estimation even in small samples in the presence of cointegration (Phillips, 1992). In order to check the robustness of our results, we therefore re-estimate the GCC money demand function applying dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993) and the pooled mean group estimation (PMGE) introduced by Pesaran, Shin and Smith (1999). We compare FMOLS estimates with DOLS and PMGE for the group panel and them we conduct canonical cointegrating regression (CCR) estimations for individual countries level.

The results of the three-cointegration techniques for the bloc of 6 countries are displayed in table 4. All the three estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in long-run relationship.

Table 4. Long Run Money Demand in GCC Countries

	FMOLS			DOLS			PMGE		
Variable	LnY	Dr	Ln E	LnY	Dr	Ln E	LnY	Dr	Ln E
Panel GCC	0.537*** *0.06411*	-0.041** *0.011636*	0.359 *0.227683*	0.496*** *0.069419*	-0.032*** *0.011154*	0.229 *0.248933*	0.616*** *0.001413*	-0.004*** *0.003627*	0.352 *0.010596*

*** Denotes the rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively
Note. Numbers in italic are the standard deviations

Firstly, it appears that FMOLS, DOLS and PMGE outputs reveal consistent and accurate results. As it was expected, income elasticity is positive and significant at 1% level of significance in all three estimations. Moreover, the income coefficient ($\alpha_1 = 0.537, \; 0.496 \; \textit{and} \; 0.616$) is approximately in line with the Baumol-Tobin model in which the income elasticity has to be $\beta 1 = 0.5$ (Baumol, 1952), Tobin (1956). The estimated coefficient of interest rates, which represents the semi-elasticity, is negative and significant at 1% level of significance. This is also in line with standard monetary theory (Friedman 1956) as holding physical assets produce costs. The domestic interest rate represents the opportunity cost of holding money; that interest rates fall when the money supply increases, since the lower interest rates make people more willing to hold the extra cash. However, when interest rates rise, the public would prefer holding more financial assets such as treasury bills, bonds, etc. The recent boom of energy prices was associated with low interest rates have in turn stimulated the GCC economy because affordable money make it more attractive to borrow and to invest and more attractive to spend rather than save. It is worth mentioning that during the previous decade, GCC countries have experienced a buoyant economic growth and the financial sector has witnessed a boom. New financial instruments and policy have been introduced into the GCC financial market and the region has become the hub of finance and insurance industry. Consequently, GCC households tend to adopt more and more new sophisticated interest-bearing assets rather than placing their money is saving account. The change in GCC households' behaviors has simulated money demand in these countries.

Regarding exchange rate, it appears to impact positively money demand in GCC countries but not significant. This shows that the appreciation of GCC currencies could raise money demand but it also shows that the substitution effect does not have serious consequences on GCC economies as they have pegged their currencies to US dollar, except for Kuwait. According to the results above, we can conclude that there is evidence of a cointegrating money demand among Gulf Arab countries. This fact is important since there is the project of a GCC monetary Union is under implementation.
Turing now to individual country level, the estimation results are based on FMOLS, DOLS and CCR. The results are displayed in the table 5.

Table 5. Long Run Money Demand in GCC Countries

	FMOLS			DOLS			CCR		
Variable	LnY	Dr	Ln E	LnY	Dr	Ln E	LnY	Dr	Ln E
Bahrain (GDP)	0.615*** *0.126*	-0.050* *0.03*	-0.818 *0.562*	0.647*** *0.123385*	-0.033 *0.032331*	-0.158 *0.500457*	0.606*** *0.112164*	-0.05 *0.034405*	-0.844 *0.551134*
Kuwait	0.968*** *0.102306*	-0.008 *0.019762*	-0.002 *0.099245*	0.927*** *0.101759*	0.002 *0.020863*	0.021 *0.088115*	0.832*** *0.085596*	-0.013 *0.017951*	0.08 *0.09882*
Oman (GDP)	0.577165 *0.172664*	0.023174 *0.02054*	1.207942 *2.797811*	1.263*** *0.198265*	-0.043* *0.026708*	-0.569 *1.602292*	1.273*** *0.180169*	-0.041* *0.02372*	-0.733 *1.227877*
KSA	0.597* *0.220735*	-0.088*** *0.019212*	1.199*** *0.130946*	0.721** *0.234913*	-0.069*** *0.014331*	1.267* *0.12454*	0.782** *0.216301*	-0.088*** *0.019556*	1.621* *0.135497*
UAE	1.320*** *0.077236*	-0.023* *0.015711*	1.201 *0.13272*	1.284*** *0.0859*	0.023* *0.017952*	1.259 *0.150672*	1.326*** *0.076778*	-0.024* *0.015785*	1.169 *0.135966*
Qatar	0.933*** *0.109416*	-0.068* *0.031127*	1.462 *0.057314*	0.934*** *0.052956*	-0.054* *0.028601*	1.731 *0.05453*	0.931*** *0.050062*	-0.069** *0.027251*	1.519 *0.04562*

*** Denotes the rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively
Note. Numbers in italic are the standard deviations

The coefficients of FMOLS estimations presented in table 4 show that the income elasticities are positive for all the countries as well as for the panel. These elasticities are ranging from 0.057 for Bahrain to a whopping 1.32 for UAE. The result of an income larger that unit is not surprising. It is even a common finding in both time series and panel data papers on money demand. Income elasticities for Bahrain, Oman and KSA are in line with the Baumol-Tobin model which predict a magnitude of 0.5 for α_1 while Kuwait, Qatar and UAE follow the quantitative theory which predict a magnitude of 1 for α_1. Results also show that all the coefficients are significant except for Oman.

Similarly, the interest semi-elasticity has the expected sign for the six countries as well for the Panel and its coefficient is ranging from -0.08 for Bahrain to -0.068 for Qatar meaning that there exist an inverse relationship between interest rate and demand for money. The sign is consistent with our postulate. However, it is not significant for Kuwait only.
Consistent with the literature on currency substitution, the benchmark money demand function is extended by the real effective exchange rate (*E*). The few panel data studies including exchange rates produce ambiguous results. The coefficients take values between −1.73 (Rao et al. 2009) and +0.31 (Narayan et al. 2009). In this paper, the results show that the coefficient varies between -0.002 for Kuwait to 1.46 for Qatar.

The results of FMOLS and DOLS and CRR are in somewhat identical in our case. All the three procedure reveal on the one hand a positive relationship between output and money demand and a negative relationship between interest rates and money demand on the other hand. Regarding exchange rate, the results diverge among the countries. While it impact negatively money demand in Bahrain and KSA in FMOLS estimations, its coefficient but remains negative for Bahrain but becomes positive for KSA as well as the other countries in DOLS estimation. In CCR, Bahrain and Oman have a negative sign of exchange rate coefficients while the other countries have positive impacts.

4.2.2. Granger Non-Causality Tests: Toda and Yamamoto procedure

In this section we will test for causality between the variables of our study by using Granger causality procedure due to Toda and Yamamoto (1995).

4.2.2.1. Granger No-Causality Test

Toda and Yamamoto (1995) introduce a method that is used to estimate unrestricted VAR by the use of a Modified Wald test for restrictions on the parameters of the VAR (*k*) model and estimates a VAR [*k+dmax*], where *k* is the lag order of VAR and *dmax* is the maximal order of integration for the series in the system (Hamdi 2013). The multivariate framework of our case study can be expressed as follows:

$$\ln \frac{M^d}{P} = \alpha_1 + \sum_{i=1}^{k+d\max} \beta_{1i} \ln \frac{M^d}{P}_{t-i} + \sum_{i=1}^{k+d\max} \beta_{1i} \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \beta_{1i} Dr_{t-i} + \sum_{i=1}^{k+d\max} \beta_{1i} \ln E_{t-i} + \mu_{1t} \quad (5)\ (6)$$

$$\ln NOG_t = \alpha_2 + \sum_{i=1}^{k+d\max} \beta_{2i} \ln \frac{M^d}{P}_{t-i} + \sum_{i=1}^{k+d\max} \beta_{2i} \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \beta_{2i} Dr_{t-i} + \sum_{i=1}^{k+d\max} \beta_{2i} \ln E_{t-i} \mu_{2t} \quad (7)\ (8)$$

$$\ln Dr_t = \alpha_3 + \sum_{i=1}^{k+d\max} \beta_{3i} \ln \frac{M^d}{P}_{t-i} + \sum_{i=1}^{k+d\max} \beta_{3i} \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \beta_{3i} Dr + \sum_{i=1}^{k+d\max} \beta_{3i} \ln E_{t-i} + \mu_{3t}$$

$$\ln E_t = \alpha_4 + \sum_{i=1}^{k+d\max} \beta_{4i} \ln \frac{M^d}{P}_{t-i} + \sum_{i=1}^{k+d\max} \beta_{4i} \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \beta_{4i} Dr + \sum_{i=1}^{k+d\max} \beta_{4i} \ln E_{t-i} + \mu_{4t}$$

Where $\ln \frac{M^d}{P}$, is the logarithm of real general stock of money, LnY is is the logarithm of real Non-oil GDP for Kuwait, Qatar, Arabia and UAE and it is replaced by GDP for Oman and Bahrain; Dr is the domestic interest rate and finally E is the exchange rate.

The basic procedure of conducting the Toda-Yamamoto method involves two phases. The first step consists in determining the lag length (*k*) of VAR model and the maximum order of integration (*d*) of the time series variables in the system. After the selection of optimum lag length VAR (*k*) and the order of integration *dmax*, a level VAR is estimated with a total of [*k+dmax*] lags. The second step requests the application the standard Wald tests on the first (*k*) VAR coefficient matrix to make Granger causal inference using a chi square (χ^2) distribution1.

4.2.2.2. Results

We already determined the order of integration of the series (*dmax*) and we showed that the series are integrated of order one. Now we determine the optimal lag length of the model using the sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). The result of selecting optimal lag length of VAR indicates that lag order of VAR (k) is 2, for multitrivariate VAR.

Table 6. Lag Length Criteria for Panel GCC

Lag	Log L	LR	FPE	AIC	SC
0	-2668.939	NA	1.378113	11.67222	11.70827
1	1220.622	7694.197	6.21e-08	-5.242890	-5.062677
2	1424.956	400.6386	2.73e-08*	-6.065311*	-5.740929*
3	1440.378	29.96859	2.74e-08	-6.062787	-5.594235
4	1456.002	30.08686*	2.74e-08	-6.061143	-5.448420

* indicates lag order selected by the criterion

As our series are I(1), this means that, *dmax=1*. Further, the result of selecting optimal lag length of VAR indicates that lag order of VAR (k) is 2, for multivariate Panel VAR. Therefore, we can estimate a VAR system in levels with a total of *dmax+k* lags for each country. The results are displayed in table 6.

Table 7. Toda and Yamamoto Granger Causality Results

	Panel GCC	Bahrain	Kuwait	Oman	KSA	UAE	Qatar
LnY => lnM2	9.201***	0.184	0.702	0.0289	1.045	0.258	6.430***
Dr => lnM2	4.046**	0.844	0.008	0.015	2.286	0.950	0.762
E => lnM2	0.008	0.0105	1.224	0.0495	1.681	0.011	1.340
M2 => lnY	4.924**	4.537**	7.576***	2.855**	3.318**	2.972**	5.016**
Dr=> lnY	0.056	0.433	0.129	0.699	5.175**	0.131	0.685
E => lnY	182	1.493	0.000***	1.340	0.021	0.007	0.415
LnM2 => Dr	0.055	3.401**	0.026	76.48***	38.147	0.353	84.322***
LnY=> Dr	0.0765	13.714***	0.023	74.371***	0.715	0.026	17.394***
E => Dr	0.058	0.0294	0.312	0.536	1.241	0.005	3.080
LnM2 => E	0.422	0.353	1.13071	1.255596	0.652	0.299	1.626
LnY=>E	0.0634	0.694	4.470	1.010	0.170	0.014	0.038
Dr => E	0.936	0.008	0.100	7.336***	1.416	0.118	0.068
P=K+dmax	(2)	(2)	(4)	(3)	(2)	(2)	(4)

*** Denotes the rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively

Different interesting conclusions could be drawn from table 7. First, the panel estimation shows the existence of a bidirectional relationship between money demand proxied by M2 and income. This conclusion shows the interdependence between the two variables. A high money demand boosts non-oil GDP sector in GCC which in turn would improve the diversification of GCC economies and would lower their dependency to oil revenue and natural resources rents. During the past few years, GCC governments have undertaken huge structural reforms to diversify their economies as oil and gas are exhaustible resources. The diversification' strategy differs from country to another one. For example, while Bahrain and Qatar focused on the role of the financial sector and they have become hubs of finance in the region, UAE have focused their diversification in infrastructure to attract FDI and tourism. Oman also has become the preferred destination for luxury tourism while KSA is the preferred destination of large international manufactories. Second, the result shows also a unidirectional relationship running from domestic interest rate to money demand M2. This is in line with the Quantity Theory of Money (QTM), which indicates the negative relationship between money demand and interest rate. This result also confirms our finding in table 4.

5. Conclusion and Recommendations

In this paper, we estimated and analyzed the aggregate and individual long-run money demand functions of the six Gulf Cooperation Council countries during the period 1980Q1-2011Q4. After checking for stationarity of the different variables of the model using Panel unit root test, we applied the panel FMOLS, PDOLS and PMGE method to estimate the long-run money demand function for six Gulf Cooperation Council countries. From an aggregated analysis, we found that income elasticity is around 0.5 ($FMOLS - \alpha_1 = 0.537,\ DOLS\alpha_1 = 0.496\ \ and\ PMGE\ \alpha_1 = 0.616$) which is in line with the Baumol-Tobin model in which the income elasticity has to be $\beta 1 = 0.5$ (Baumol, 1952), Tobin (1956). The estimated coefficient of interest rates, which represents the semi-elasticity, is negative and significant at 1% level of significance ($FMOLS - \alpha_2 = -0.04,\ DOLS\ \alpha_2 = 0.03\ \ and\ PMGE\ \alpha_2 = 0.04$). This is also in line with standard monetary theory (Friedman 1956) as holding physical assets produce costs. The empirical literature using aggregated time series data. Panel cointegration tests provided evidence in favor of a stable long-run money demand function. Moreover, similar results were found in the disaggregated analysis (individual countries). The Granger non-causality test due to Toda and Yamamoto (1995) procedure shows evidence of a bidirectional causal relationship between money demand and income. At an individual level, the unique common results between the countries are the evidence of a unidirectional causality running from M2 to income. Finally, the overall results show that exchange rate does not affect long-run money demand functions of the six Gulf Cooperation Council countries. The purpose of this study is to demonstrate the importance of money demand in conducting a sound monetary policy because the central banker in GCC countries would needs to make sure the elasticities are stable throughout time. This is one of the several requirements of a successful monetary Union. The stability of the money demand function plays a central role for the importance of money for the monetary policy; especially because the GCC countries are moving toward a single currency managed by a single central Bank. The goal of having union monetary policy strategies in GCC countries would support the price stability because many of those countries have faced an increase in inflation since 2002, which was accompanied with oil price boom. In fact, inflation decreases the purchasing power of consumers in the GCC countries. This research is important in this period because the GCC countries are trying to move toward creating of a Monetary Council and a single currency.

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