

**SAMA Working Paper:**

**On The Stability of Money Demand in Saudi  
Arabia**

**November 2016**

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# **On the Stability of Money Demand in Saudi Arabia\***

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## **Abstract**

This paper assesses the stability of money demand function for Saudi Arabia over the period 1993:Q1-2015:Q3. This paper finds evidence indicating the stability of money demand function over the long run. Likewise, it finds the parameter estimates of the long run relationship are consistent with theory expectations. In other words, a rise in income by one percent is associated with higher demand for money by 2.47 percent. On other hand, money demand falls by 0.15 percent due to the increase of the interest rate by one percent; likewise, money demand declines by 0.5 percent when the nominal effective exchange rate increases by one percent.

**Keywords:** Money Demand; Stability; Cointegration; Saudi Arabia.

**JEL Classification:** C13, C22, E41, E52, F41

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## 1. Introduction

Analyzing the behavior of money demand has been one of the substantial subjects in both theoretical and empirical research due to its importance for monetary policymakers. In other words, sustaining a stable money demand is crucial because it enables monetary policymakers for some countries<sup>1</sup> to fight inflationary pressures and to stimulate the economy through targeting money growth. Likewise, maintaining stable money demand is essential for other countries adopting fixed exchange rate regime (e.g. Saudi Arabia) to sustain stable nominal exchange rate. As a result, there has been ongoing research examining the stability of money demand function for advanced and less advanced economies. However, the findings of these studies on particular countries seem to be conflicting, in which some studies conclude the stability of money demand whereas other studies do not.

Hence, in order to avoid conflicting results and to implement the appropriate monetary policy, it is necessary to understand the source of instability for money demand. The existing literature points out to some factors that may lead to instable demand for money. The sources of instability might be due to financial innovations (i.e. Arrau and Gregorio 1993), shifts in exchange rate regime (i.e. Boughton 1981), currency substitution (i.e. Girton and Roper 1981), and output uncertainty (i.e. Choi and Oh 2003). Likewise, some economists point out to some econometric issues leading to the existence of instable money demand function. Cheong (2003) indicates that the misspecification of money demand function is a

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<sup>1</sup> According to the 2014 IMF annual report on Exchange Arrangements and Exchange Restrictions, there are 25 countries adopting monetary aggregate targeting to eliminate inflationary pressures; for instance, some of these countries are China, Uzbekistan, Sierra Leone, Ukraine, and Uruguay.

key factor leading to instability. Additional factor playing essential role in arising instability is the frequency of data as implied by Gregory and Hansen (1996). Changes in regulations, global uncertainty or oil price volatility are other elements contributing to money demand instability.

Therefore, there is a large body of the literature focusing on examining the money demand function over long run. The existing studies not only aim to identify factors leading to instability, but also to provide monetary policymakers with the appropriate policy averting money demand instability. Nonetheless, despite the numerous studies on money demand, the existing literature focusing on Saudi Arabia is very limited. This limitation might be due to lack of interest from researchers or due to the lack of data availability or both.

This in turn motivates us to fill the gap by re-examining the stability of money demand relationship with its determinants over long run. Additional motivation for this study is the recent research paper of Banafea (2014) who documents evidence in favor of the instability of Saudi money demand function via the implementation of various structural break tests. In sum, the main objective of this research paper is to investigate the relationship between money demand and its determinants in Saudi Arabia and whether this relationship is stable over long run or not.

The outline of the paper is as follows: section 2 presents the framework of money demand function while section 3 overviews the existing literature on Saudi Arabia. Section 4 describes the data; section 5 outlines the empirical methodology alongside the discussion of the results; the conclusion of the paper is contained in section 6.

## 2. Money Demand Framework

In modeling the demand for money, it is common in practice to assume that both real output and nominal interest rate as main factors determining the demand for money in any economy, in which the nominal interest rate reflects the opportunity cost of holding money while the real output is a scale variable. Thus, the general form representing long run demand for money can be specified as follows:

$$\left(\frac{m}{p}\right) = f(y, i) \quad (1)$$

where  $\left(\frac{m}{p}\right)$  or  $m^d$  represents the real money balance; in which  $m$  denotes the monetary aggregate deflated by the consumer price index ( $p$ );  $y$ , and  $i$  denote the real output, and nominal interest rate respectively.

It is worthy emphasizing that other studies incorporate the exchange rate as an additional determinant to money demand function due to its influence on money demand (i.e. Bahmani-Oskooee & Shabsigh 1996, Bahmani 2000). Likewise, it is essential to bear in mind that Mundell (1963) was among the pioneers suggesting the incorporation of exchange rate into money demand function. However, he does not provide any convincing reason for the insertion of exchange rate and without presenting any estimates for money demand function. This in turn encourages other researchers to provide intuitive explanations for inserting the exchange rate variable into money demand function. For instance, Arango and Nadiri (1981) provide an argument illustrating how changes in exchange rates may influence the demand for money. Based on their argument, the fall (depreciation) of domestic currency relative to foreign currency would increase the local currency value, which in turn leads to rise domestic individuals' foreign assets. If this increase

considered as an increase of wealth, then the demand for money may increase. Bahmani-Oskooee and Pourheydarian (1990) provide alternative explanation. They argue that the demand for money fluctuates based on the public's expectation. In other words, if the public expects further depreciation of their domestic currency relative to foreign currency, they would reduce their demand for domestic currency and increase their demand for foreign currency resulting in a decline of demand for money. The opposite would occur if the public expects the appreciation of foreign currency relative to their domestic currency.

Therefore, we follow Bahmani-Oskooee & Shabsigh (1996) and Bahmani (2000) and incorporate the exchange rate variable into the money demand function. The motivation for the inclusion of exchange rate into the Saudi money demand function is that Saudi Arabia pegs its currency to the US dollar at fixed exchange rate since 1986, so any fluctuations of the US dollar may influence the currency of Saudi Arabia.

Therefore, the money demand function augmented with nominal effective exchange rate can be formulated as follows:

$$\left(\frac{m}{p}\right) \equiv m^d = f(Y, I, NE) \quad (2)$$

which in turn can be written as follows:

$$m_t^d = \alpha + \beta Y_t + \gamma I_t + \delta NE_t + \varepsilon_t \quad (3)$$

where  $m^d$ ,  $I_t$ ,  $E_t$ , and  $\varepsilon_t$  denote the demand for money, real output proxied by industrial production, nominal interest rate, nominal effective exchange rate, and error term at time  $t$  respectively. Based on economic theory<sup>2</sup>, we expect a positive

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<sup>2</sup> According to the Keynesian theory for money demand, money demand is positively associated with income because people are willing to demand money to for transactional and cautionary (future uncertainty) purposes. Nonetheless, the money demand is negatively associated with interest rate because

relationship between the demand for money and output implying  $\beta > 0$  whereas the demand for money is negatively associated with nominal interest rate implying  $\gamma < 0$ . On the other hand, the sign of  $\delta$  may have either positive or negative impacts on the demand for money as suggested by Bahmani-Oskooee and Pourheydarian (1990).

### **3. Literature Review**

There is a rich literature on money demand function investigating the determinants of money demand as well as assessing the stability of money demand function. The existing literature focuses on both developed and developing countries and applies various econometric methodologies. For example, some studies analyze the behavior of money demand function and its stability on industrial countries (i.e. Bahmani-Oskooee and Chomsisengphet 2002), Asian countries (i.e. Bahmani-Oskooee and Rehman 2005), European countries (i.e. Coenen & Vega 2001), African countries (i.e. Bahmani-Oskooee and Gelan 2009), and Middle Eastern countries (i.e. Bahmani 2008). Sriram (2000) and Banafea (2012) provide a comprehensive review for money demand literature.

Despite the large share of empirical studies on money demand on developed and developing countries, Saudi Arabia's share from the literature is scarce. A handful number of studies analyze how the demand for money in Saudi Arabia behaves over the long run. Starting with Alkaswani and Al-Towaijri (1999) who employ quarterly data starting from 1977-1997 to examine the long run relationship between money demand and its determinants in Saudi Arabia. Their evidence reveals that over long run inflation and interest rates affect the demand

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people prefer to hold financial assets (i.e. bonds) rather than money when the interest rate is high and vice versa.

for money significantly and negatively whereas real income and real exchange rate affect money demand positively and significantly.

Harb (2004) with aid of panel cointegration techniques explores the elements affecting money demand in the Gulf Cooperation Council<sup>3</sup> (GCC) countries using annual data spanning from 1979 to 2000. Harb finds evidence suggesting the long run relationship between money demand and its determinants (real output, interest rate, and nominal exchange rate) is consistent with economic theory expectation. Likewise, Lee et al. (2008) carry out their analysis based on new panel data tests to examine the factors influencing money demand over long run for GCC countries using the dataset of Harb (2004). Their evidence points out to the presence of a stable long run relationship between money demand and its determinants.

On the other hand, Bahmani (2008) employs annual data spanning from 1971 to 2004 for fourteen Middle Eastern countries including Saudi Arabia. Bahmani adopts the autoregressive distributed lag (ARDL) model to examine whether there exists a stable long run relationship between money demand and its determinants (income, inflation, and nominal effective exchange rate) or not. Her results reveal that in most countries including Saudi Arabia there is evidence indicating the stability of money demand function over long run. Results related to Saudi Arabia reveal that over long run the effects of real income and inflation rate on money demand are in line with theory expectation. Furthermore, Masih and Algahtani (2008) rely on annual data covering the period of 1986-2004 and apply the cointegration approach of Pesaran and Shin (2002) to investigate the behavior of money demand over long run in Saudi Arabia. Their analysis suggests that the

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<sup>3</sup> The GCC countries consist of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.



existence of a stable long run relationship between the demand for money and its determinants.

Abdulkheir (2013) analyzes whether there exists a long relationship between the demand of money in Saudi Arabia and its determinants or not through employing annual data from 1987 to 2009. His results indicate the presence of a cointegration relationship between the demand for money, exchange rate, inflation rate, and interest rates. On the other hand, Banafea (2014) focus on the issue of stability of money demand function for Saudi Arabia by employing various structural break tests. Banafea uses annual data over the period 1980 to 2012 for money supply M1, real income, and interest rate. The results of the employed structural break tests indicate the instability of money demand in Saudi Arabia though the parameter estimates of long run relationship agree with theory expectation. Hamdi et al. (2015) re-examine the determinants affecting money demand over long run in the GCC countries based on panel data analysis using quarterly data covering the period of 1980:Q1 - 2010:Q4. Their findings confirm the existence of a long run relationship between money demand and its determinants.

The drawbacks of existing literature on Saudi Arabia can be summarized in three points. First, most studies rely either on annual data or on interpolation techniques to disaggregate data from annual frequencies to quarterly frequencies. Second, most studies interpret the existence of cointegration relationship as a sign of stability. Third, some studies (e.g. Bahmani (2008) and Masih & Algahtani (2008)) rely on old stability tests rather than implementing newly developed tests.

#### **4. Data**

The data used in this paper to outline the determinants of money demand function for Saudi Arabia include industrial production (Y) as a proxy for GDP, money supply (M3), the consumer price index (P), nominal effective exchange rate (ER), and the 3-month US Libor interest rate (R). We use the US interest rate as a proxy for Saudi Arabia interest rate because Saudi Arabia pegs its currency to the US dollar at a fixed rate. The sampling period starts from 1993:Q1 to 2015:Q3, with 91 observations. The interest rate data downloaded from the website of the St. Louis Federal Reserve Bank while the money supply data obtained from various issues of Saudi Arabian Monetary Authority (SAMA) quarterly statistics bulletin. The remaining data sourced from the international Financial Statistics of the International Monetary Fund (IFS-IMF) database. All variables transformed into log form with exception to the interest rate.

## **5. Empirical Methodology and Results**

### **5.1. Unit Root Tests**

The first stage of the analysis is to check the stationarity of the economic variables in order to determine the order of integration. In doing so, various tests of unit root are applied; in particular, we apply the tests of the Augmented Dickey-Fuller (1981) and Phillips–Peron (1988), which are the most common tests in the literature to ensure the stationarity of the economic variables. However, Schwert (1987) finds that when the true generating process is of order one with a large and negative moving average coefficient, then the ADF and PP tests' performance is poor due to the rejection of the null when it is true. Therefore, we rely on more efficient unit root tests consisting of the KPSS (Kwiatkowski, Phillips, Schmidt and Shin 1992) and ERS (Elliot, Rothenberg and Stock 1996) in order to ensure the

stationarity of the economic variables. The results of all implemented tests, as shown in tables 1.1 and 1.2, confirm the nonstationarity of the economic variables in their levels; however, the variables become stationary when we take the first difference of these variables.

Table 1.1: Augmented Dickey–Fuller (1979) and Phillips-Perron (1988) Unit Root Tests

	ADF Test						PP Test			
	Level Data			First Difference			Level Data		First Difference	
	None	Trend	Drift	None	Trend	Drift	Constant	Trend	Constant	Trend
IP	0.50	-3.41	-2.36	-8.26	-8.29	-8.25	-1.71	-2.73	-7.33	-7.32
CPI	2.75	-0.77	1.60	-3.01	-4.33	-3.83	1.90	-0.48	-5.21	-5.95
M3	5.37	-3.24	1.84	-3.14	-6.13	-5.62	2.01	-2.92	-7.65	-8.22
NEER	0.48	-1.85	-1.85	-6.12	-6.08	-6.10	-1.51	-1.44	-6.67	-6.63
Libro	-1.18	-3.07	-1.52	-4.18	-4.18	-4.17	-1.11	-2.50	-4.93	-4.95

Note: The ADF 5% critical values are for None=-1.95, Trend=-3.43, and Drift=-2.88. The PP 5% critical values for constant=-2.87 and Trend=-3.43.

Table 1.2: Schmidt-Phillips (1992) and Elliott-Rothenberg- Stock (1996) Unit Root Tests

	KPSS Test				ERS Test			
	Level Data		First Difference		Level Data		First Difference	
	Constant	Trend	Constant	Trend	Constant	Trend	Constant	Trend
IP	1.03	0.16	0.09	0.03	-1.72	-2.62	-4.03	-5.00
CPI	0.55	1.89	0.82	0.19	0.32	-1.31	-1.86	-2.08
M3	0.51	2.35	0.30	0.82	-0.52	-1.32	-2.65	-2.54
NEER	0.13	0.45	0.13	0.14	-1.50	-1.55	-1.66	-2.84
Libor	1.45	0.11	0.11	0.07	-1.23	-2.93	-3.35	-3.72

Note: The KPSS 5% critical values for constant = 0.46, and for trend= 0.14. for the Elliott et al. constant = -1.94, and for trend= -3.03.

## 5.2. Cointegration Tests

Since unit root tests confirm that the economic variables are integrated of order one or  $I(1)$ , then it is essential to check whether these variables are cointegrated or not as suggested by Engle and Granger (1987). Hence, we apply the tests of Johansen and Juselius (1990) for multiple cointegration relationships.

The results of both Trace and Eigenvalue tests of Johansen and Juselius (1990) as shown in Table 2 confirm the existence of at least two-cointegration vectors at 10% significance level.

Table 2: Johansen and Juselius (1990) Cointegration Test

Trace Test				
$H_0$	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
Test statistics	73.88*	34.76*	13.55	3.81
Eigenvalue Test				
$H_0$	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
Test statistics	39.12*	21.20†	9.74	3.81
* and † indicate the rejection of the $H_0$ at 5% and 10% significance levels respectively.				

### 5.3. Stability Tests

Before interpreting the parameter estimates of the long-run relationship between money demand and its determinants, as given by equation (3), it is crucial to test that whether these estimates are stable during long run or not. To do so, we apply a series of structural break tests that are similar to those implemented by Banafea (2014). By doing this, we start with Hansen's (1992) stability tests with I (1) series. These tests are Sup F, Mean F, and Lc and have the null hypothesis of parameter stability. Both Mean F and Lc tests are useful if we are interested in assessing the ability of the model in capturing a stable relationship. On the other hand, Sup F is useful if we are interested in testing the existence of a swift shift of the regime. The results of these tests, as presented in table (3), reveal the stability

of parameter estimates over long run at 5% significance level. In addition, these tests can be viewed as cointegration test as noted by Hansen (1992) in which the null of cointegration against the alternative of no cointegration. The results of these tests also verify the previous cointegration results, reported in table (2), since they confirm the existence of cointegration relationship.

Furthermore, we apply the likelihood ratio F-statistics of structural change in the linear relationship, as proposed by Andrews (1993), and Andrews & Ploberger (1994), to identify endogenously one structural breakpoint in the linear relationship between money demand and its determinants. The main intuition behind these tests is that these tests do not require specifying a particular break date and estimate the structural break date endogenously by comparing the residuals before and after the presumed point of break for every time period. The test statistics are Sup F, Ave F, and Exp F; the null hypothesis of these tests is the absence of structural break. We compute these test statistics based on the following an error correction model estimated via OLS.

$$\Delta m_t^d = \alpha + \sum_{i=1}^k \beta_{i1} \Delta m_{t-i}^d + \sum_{i=1}^k \gamma_{i1} \Delta y_{t-i} + \sum_{i=1}^k \delta_{i1} \Delta NE_{t-i} + \sum_{i=1}^k \theta_{i1} \Delta I_{t-i} + \phi ECT_{t-1} + \varepsilon_t \quad (4)$$

where  $m_t^d$ ,  $y_t$ ,  $NE_t$ ,  $I_t$ , and  $\varepsilon_t$  denote the real money demand  $[\frac{m_3}{p}]$ , real output measured by industrial production, nominal effective exchange rate, nominal interest rate, and error terms respectively at time  $t$ . lag length  $k$  is chosen based on the Akaike information criteria “AIC”; the error correction term,  $ECT_{t-1}$  is the error correction term at time period  $t - 1$  and the error correction term is given as follows:

$$ECT_t = m_t^d - \alpha - \beta Y_t - \delta NE_t - \gamma I_t \quad (5)$$

Table 4 presents the corresponding structural break tests with its asymptotic p-values computed by Hansen’s (1997) approximation alongside the estimated

break date. The test statistics suggest the presence of a stable relationship between money demand and its determinants; in other words, we fail to reject the null hypothesis of no structural break at significance level of 5%.

It is also worthy to note that our evidence suggesting the existence of a stable money demand function contradicts the findings of Banafea (2014). This in turn encourages us to understand the reasons of contradiction, which might be attributed to several factors. One possible factor to the different results might be the money demand specification. In other words, Banafea (2014) defines the demand for money as function of output and interest rate whereas we define money demand with additional variable, which is the nominal exchange rate. The frequency of the data is an additional factor that may lead to instability as suggested by Gregory and Hansen (1996) since we employ quarterly data while Banafea (2014) employs annual data. Moreover, using different measures for output and money supply might be other factor; we use the industrial production as a proxy for GDP and the broad definition for money supply (M3) unlike Banafea (2014) who use the narrow definition for money supply (M1) alongside the GDP. These factors may contribute to the results of instable money demand function.

It is also important to emphasize other essential elements indicating the stability of money demand in Saudi Arabia. For instance, the ratio of broad money supply to GDP is about 74.2% in 2015 for Saudi Arabia. This reflects the velocity of money in the economy and it seems reasonable compared to other oil-exporting and emerging market economies<sup>4</sup>. Moreover, Saudi Arabia succeeded in maintaining a stable fixed exchange rate policy since 1986, which reflects sustaining stable macroeconomic policy during geopolitical and financial crisis

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<sup>4</sup> For Russia 63.8%, Mexico 53.2%, Turkey 63.1%, Oman 56.1%, India 79.2%, these statistics are obtained from the World Bank website;  
[www.data.worldbank.org/indicator/FM.LBL.BMNY.GD](http://www.data.worldbank.org/indicator/FM.LBL.BMNY.GD).

events. In particular, the Saudi Arabian Monetary Authority succeeded during 1993 and 1998 in stabilizing the Saudi nominal exchange rate<sup>5</sup>; this in turn increases foreign investors' credibility in investing in a stabilized economy such as Saudi Arabia. Also, the financial sector exposure is limited in Saudi Arabia<sup>6</sup>, which indicates the availability of liquidity to maintain the demand for money. Lastly, the government did not crowd out the private sectors in borrowing money from financial sectors. All these factors are reasonable indicators reflecting the stability of money demand in Saudi Arabia over time.

Table 3: Hansen (1992) Stability Tests

	Lc	Mean F	Sup F
Test statistics	0.74	7.40	17.31
P-value	(0.10)	(0.13)	(0.10)

Table 4: Andrews (1993) and Andrews & Ploberger (1994) Structural Break Tests

	Estimated Break Date	Ave F	Exp F	Sup F
Test statistics	1999:Q1	7.95	6.65	19.15
P-value		(0.18)	(0.06)	(0.07)

#### 5.4. Parameter Estimates of Money Demand Function

Now since we confirm the stability of the parameter estimates, we estimate the long-run relationship as given by equation (3) via OLS estimation method. Table (5) summarizes the parameter estimates of the long run money demand function.

<sup>5</sup> For further discussion of SAMA interventions, see Al- Hamidy and Banafe (2005).

<sup>6</sup> For further information, see the financial stability report published on SAMA website.

Evidently, the parameter estimates of money demand function, as given by equation (3), are in line with theory expectation suggesting the positive (negative) relationship between output (interest rate and exchange rate) and demand for money with 5% significance level for both output and interest rate. In other words, changes in output influence the demand for money with statistical significance leading to the rise in money demand by 2.47 percent as a result of an increase in output by one percent. On the other hand, we find the nominal interest rate affects the demand for money negatively with statistical significance leading to the decline of money demand by 0.15 percent due to the rise of interest rate by one percent. Likewise, when the exchange rate increases by one percent, we find the demand for money falls by 0.5 percent though statistically insignificant. Furthermore, the parameter estimate,  $\phi$ , from equation (4) enables us to get some insight into how long-run equilibrium is restored between money demand and its determinants. Clearly, the estimated coefficient ( $\hat{\phi} = -0.014$ ) is negative and statistically significant at 10% level. This in turn implies that it takes the money demand about 1.4% each quarter to adjust to its long run equilibrium when money demand deviates from its long run equilibrium.

Table 4: The Estimates of Long Run Relationship

	$\alpha$	$\beta$	$\gamma$	$\delta$
Parameter estimates	0.01	2.47**	-0.15**	-0.50
t-statistics	(0.003)	(5.81)	(-9.92)	(-1.12)
** denotes the 5% significance level.				

## 6. Conclusion

The goal of this paper is to examine the long run relationship between the demand for money and its determinants and whether this relationship is stable or not. To do



so, this paper employs quarterly data starting from 1993:Q1 to 2015:Q3 for money supply M3 deflated by consumer price index, nominal effective exchange rate, industrial production, and the US Libro interest rate. We find evidence indicating the existence of a stable long run relationship between the money demand and its determinants. In specific, we find evidence supporting economic theory expectations; in other words, a rise in industrial production by one percent leads to higher money demand by 2.5 percent. Likewise, when the nominal exchange rate (interest rate) increases by one percent, we find the demand for money falls by 0.2 (0.5) percent.

The findings of this study have key implications for monetary policymakers in Saudi Arabia. For instance, having stable demand for money would enable monetary policymakers to maintain stable nominal exchange rate policy. In addition, the stability of money demand is necessary in order to forecast the movements of nominal exchange rate since monetary models of exchange rate (i.e. the monetary model of exchange rate under flexible prices) are built on the assumption of stable money demand function. Therefore, it is crucial to maintain stable money demand function in order to have accurate forecast for the nominal exchange rate.

For further research, it is would be interesting to examine the economic consequences of uncertainty shocks on the demand for money in Saudi Arabia; likewise, with the development of econometric techniques, it would be remarkable to rely on nonlinear models rather than linear models to analyze the behavior of money demand in Saudi Arabia.

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