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Estimating Money Demand function in Saudi Arabia: Evidence from Cash in Advance Model

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Abstract

This paper empirically investigates the stability of money demand function in Saudi Arabia based on the cash-in-advance model using quarterly data covering the time period 2000-2016. With aid of various econometric testing procedures, we find evidence suggesting the presence of stable long and short run relationship between money demand, M2, and its determinants. Understanding how money demand behaves in Saudi Arabia would be useful for policymakers to set the appropriate monetary policy.

Keywords: Money Demand; Cointegration; Stability; ARDL model, Saudi Arabia

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

1. Introduction

Money demand is one of the essential topics that have not lost its interest from economic researchers due to its importance for monetary policymakers. By understanding the behavior of money demand, policymakers would be able to mitigate the inflationary pressures in countries adopting inflation targeting policy or maintaining stable exchange rate in countries such as Saudi Arabia adopting exchange rate targeting policy. Consequently, there has been continuous research on investigating the stability of money demand function notably with either the new development in theoretical models or the new development of econometric techniques.

An intensive review of literature assessing the demand for money in Saudi Arabia reveals that most of these studies do not rely on theoretical models (Abdulkheir, 2013; Alyousef, 2014; Al Rasasi, 2016). In fact, most of these studies added other variables as determinants of money demand beside income and domestic interest rates based on the literature but not on theories, therefore, they reported mixed results related to the long run estimates. For instance, Abdulkheir (2013) indicates that the presence of a negative and statistically significant cointegration relationship between money demand and the exchange rate while Al Rasasi (2016) finds a positive and insignificant relationship. Also, Alyousef (2014) and Al Rasasi (2016) show that there is a negative, small and statistically significant impact of domestic interest rate on money demand in Saudi Arabia in the long run which contradicting Abdulkheir (2013).

The current paper differs from the previous work by utilizing the cash in advance specification derived by Hueng (1998) along with time series analysis in an open economy framework, which takes into account the effect of foreign interest rates along with exchange rates on domestic money demand. It seems that

the majority of empirical studies evaluating how stable the demand for money in Saudi Arabia do not provide a theoretical model to justify the specifications of their empirical money demand functions, which may causes misspecification problems.

Moreover, this paper would provide monetary policymakers in Saudi Arabia some insight regarding the behavior of money demand in recent years and whether it is stable in the long and short run or not; the stability is a key requirement in maintaining a stable nominal exchange rate for Saudi Arabia as suggested by the flexible monetary model of exchange rate.

The reminder of the paper is outlined as follows: section 2 provides an overview of the literature on the stability of the money demand in Saudi Arabia. Section 3 provides the theoretical framework while section 4 describes the methodology and employed dataset. Section 5 presents the empirical results. Section 6 concludes the paper.

2. **Literature Review**

By reviewing the existing literature on money demand, we find that a large share of the existing literature is devoted to investigate the stability of money demand functions for various countries including well-developed economies, emerging markets economies, and less-developed economies. Banafea (2011) provides an exclusive literature review covering recent empirical papers assessing the stability of money demand function in developing countries. Tables (1.1) and (1.2) summarize the existing literature concentrating on Saudi Arabia.

The existing studies have analyzed money demand relationship with its determinants in Saudi Arabia based on two approaches either a time series

approach or a panel data approach. Starting with the time series approach, an earlier study conducted by Alkaswani and Al-Towaijri (1999) probing the stability of Saudi money demand function over the time period 1977-1997 concludes that there exists a long run relationship between the demand for money and its determinants. Particularly, the authors document that inflation and interest rate play significant role in influencing the money demand negatively, whereas income and real exchange rate have a positive and significant impact on money demand. Furthermore, they examine the short run dynamics of money demand; in other words, they find that within a quarter about 35% of money demand fluctuations adjust to long run equilibrium.

Likewise, Bahmani (2008) adopts a bounding test cointegration approach to investigate the stability of money demand using annual data spanning from 1971 to 2004 for fourteen Middle Eastern countries including Saudi Arabia. Bahmani concludes that for most countries considered in the sample there is evidence revealing the existence of a stable long run relationship between money demand and its determinants. With the respect to Saudi Arabia, Bahmani documents that over long run both income and inflation rate influence significantly the money demand in Saudi Arabia. Also, in the short run, Bahmani finds evidence suggesting that when money demand deviates from its long run equilibrium, it adjusts by 38% per year.

Similarly, Abdulkheir (2013) utilizes annual data going back to 1987 until 2009 in order to examine the key factors influencing money demand in Saudi Arabia; the author reached a conclusion indicating that income, exchange rate, inflation, and interest rate are essential determinants of money demand in Saudi Arabia over long run. Furthermore, he finds that it takes about a year and nine month for money demand to return to its steady state when it deviates from its long run equilibrium level.

Banafea (2014) utilizes both parameters instability tests and cointegration methods to study the cointegration relationship between money demand and its determinants in Saudi Arabia using annual data from 1980 to 2012. Parameters instability tests document that structural breaks are important and need to be accounted when examine the stability of the money demand function in Saudi Arabia, thus the results of the cointegration test namely, Gregory and Hansen (1996) with one unknown structural break, confirms that the money demand in Saudi Arabia is stable in the long run.

Another study by Alyousef (2014) applies bounds test along with Error Correction Model (ECM) to explore the key factors explaining the behavior of money demand over both the long and short runs. Alyousef concludes the stability of money demand function in Saudi Arabia in both long and short runs; however, the effect of interest rate is small but significant. Using quarterly data starting from 1993:Q1 to 2015:Q3, Al Rasasi (2016) re-assesses the issue of stability for Saudi money demand function and finds evidence supporting the stability of money demand over the long run.

Based on panel data approach, few studies such as Harb (2004) and Lee and Chen (2008) explore the behavior of money demand function for the Gulf Cooperation Council (GCC) countries. The outcomes of these studies confirm the influential role of various elements determining the demand for money over the long run despite the variation of panel cointegration techniques.

Table 1.1: Studies on stability of money demand function in Saudi Arabia

Authors	Frequency	Measure of money	Explanatory variables	Unit root tests	Cointegration tests	Stability tests
Alkaswani & Al-Towaijri (1999)	Quarterly: 1977-1997	M1	GDP, domestic interest rate, exchange rate, inflation rate	ADF	Johansen and Juselius (1990)	None
Harb (2004)	Annual: 1979-2000	M1	GDP or consumption, exchange rate, and foreign and domestic interest rates	Panel unit root tests of Im et al. (1997)	Phillips (1992) and Pedroni (2000)	None
Bahmani (2008)	Annual: 1971-2004	M2	GDP, inflation rate, and exchange rate	None	Pesaran et al. (2001)	CUSUM and CUSUM-SQ
Lee & Chen (2008)	Annual: 1979-2000	M1	GDP or consumption, exchange rate and domestic interest rate.	Applied, but results not reported	Larsson et al. (2001)	None
Abdulkheir (2013)	Annual: 1987-2009	M2	GDP, exchange rate, inflation rate, and domestic interest rate.	ADF and PP	Johansen and Juselius (1990)	None

Note: ADF refers to "Augmented Dickey Fuller", PP refers to "Phillips and Perron", ZA refers to "Zivot and Andrews", KPSS refers to "Kwiatkowski-Phillips-Schmidt-Shin" and ERS refers to "Elliott-Rothenberg-Stock."

Table 1.2: Studies on stability of money demand function in Saudi Arabia

Authors	Frequency	Measure of money	Explanatory variables	Unit root tests	Cointegration tests	Stability tests
Banafea (2014)	Annual: 1980-2012	M1	Real GDP, domestic interest rate measured by US treasury bill	PP and ZA	Gregory and Hansen (1996)	Hansen (1992), Andrews (1993), and Andrews & Ploberger (1994)
Al-Yousef (2014)	Quarterly: 1996-2012	M2	Real GDP, domestic interest rate, financial innovations, stock prices	ADF, PP, and Ng-Perron	ARDL, and ECM	CUSUM-SQ
Al Rasasi (2016)	Quarterly: 1993-2015	M3	IP, domestic interest rate, exchange rate	ADF, PP, KPSS, and ERS	Johansen and Juselius (1990)	Hansen (1992), Andrews (1993), and Andrews & Ploberger (1994)

Note: ADF refers to "Augmented Dickey Fuller", PP refers to "Phillips and Perron", ZA refers to "Zivot and Andrews", KPSS refers to "Kwiatkowski-Phillips-Schmidt-Shin" and ERS refers to "Elliott-Rothenberg-Stock."

3. Theoretical Framework

The money demand specification adopted in this study is based on the work of Hueng (1998), which is derived within the framework of the cash in advance model. According to Hueng (1998), adopting the cash in advance model in an open economy framework has three advantages. First, the model provides aboard specification of the money demand function by adding foreign interest rate and real exchange rate to the traditional money demand function. Moreover, it explicitly models the liquidity services provided by money through the agent's budget constraint instead of the utility function, and allows researchers to determine the effect of interest rates on the money demand by doing comparative statics (Banafea, 2012).

Furthermore, Hueng (1998) indicates that the marginal rate of substitution (MRS) between real cash balances and consumption equals the opportunity cost of holding money. In addition, the MRS between domestic and foreign goods equals their relative prices. Therefore, the money demand function in an open economy can be written as follows[1]:

$$\text{In}\,(M/P)_t = \alpha + \gamma \ln y_t + \beta\, ln\, id_t + \delta \ln if_t + \theta \ln reer_t + \varepsilon_t \quad (1)$$

where In $(M/P)_t$ is the real money demand at time t, $\ln y_t$ is the real income proxied by the natural logarithm of the real gross domestic product, $ln\, id_t$ is the short term domestic interest rate at time t, proxied by the natural logarithm of USA

[1] For more details about the derivation of the model, see Hueng (1998).

discount interest rate[2], ln if_t is the short term foreign interest rate at time t, proxied by the natural logarithm of Japan discount interest rate, and ln $reer_t$ is the natural logarithm of real effective exchange rate at time t.

The expected signs $\gamma > 0$, indicating that there is a positive relation between income and money demand; $\beta < 0$, which indicates that a decrease in the domestic interest rate decreases the opportunity cost of holding money; $\delta > 0$ which indicates that a decrease in the foreign interest rate increase the opportunity cost of holding money; the sign of θ could be positive or negative. Therefore, if the depreciation of the domestic currency leads to an increase in the value of the foreign assets in terms of domestic currency, the effect of real exchange rate is positive, but if the depreciation of the domestic currency leads to more devaluation, then the domestic residents would prefer to hold foreign currency instead of the domestic currency (substitution effect), then the effect of real exchange rate on the domestic money demand is negative.

4. Econometric Methodology and Data

The stability of the money demand function in the long run in Saudi Arabia is investigated by implementing the bounds test within Autoregressive Distributed Lag framework (ARDL). To apply Bounds test, equation 1 can be re-written as a conditional ARDL model as follows:

[2] Due to the limited availability of data, the USA discount rate is used as a proxy of Saudi domestic interest rate since Saudi riyal is pegged to USA dollar.

$$\Delta \ln M_t = \alpha_0 + \beta_1 \ln M_{t-1} + \beta_2 \ln y_{t-1} + \beta_3 \ln id_{t-1} + \beta_4 \ln if_{t-1} + \beta_5 \ln reer_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta \ln M_{t-i} + \sum_{j=0}^{k} \gamma_j \Delta \ln y_{t-j} + \sum_{l=0}^{k} \beta_l \Delta \ln id_{t-l} + \sum_{h=0}^{k} \delta_h \Delta \ln if_{t-h} + \sum_{m=0}^{k} \theta_m \Delta \ln reer_{t-m} + \varepsilon_t \quad (2)$$

where Δ denotes the first difference operator, and the bounds test can be applied to examine the existence of the long run relationship between money demand and its determinants by using F-test. This test examines the joint significance of the coefficients on the one period lagged levels of the variables in equation (2) (Narayan, 2005). Therefore, the null hypothesis $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ is tested by F-test against the alternative hypothesis that H_0 is not true. Thus, if the computed F statistic is higher than the upper bound of the critical values then the null hypothesis H_0 is rejected, indicating that there is a long run relationship between money demand and its determinants in the long run. On other word, if the computed F statistic higher than the upper bound, we conclude that there is a cointegration between money demand and its determinants, but if the F statistic falls below the lower bound, we conclude that there is no cointegration. In the case of F statistic falls between the lower and upper bounds, indicates that the result of bounds test is inconclusive.

Additionally, if the long run relationship exists, the next step is to estimate the long run elasticities of the cointegrated equation (2). Therefore, the ARDL (c, j, l, h, m) specifications can be written as follows:

$$\ln M_t = \alpha_0 + \sum_{i=1}^{c} \alpha_1 \ln M_{t-i} + \sum_{i=0}^{j} \alpha_2 \ln y_{t-i} + \sum_{i=0}^{l} \alpha_3 \ln id_{t-i} + \sum_{i=0}^{h} \alpha_4 \ln if_{t-i} + \sum_{i=0}^{m} \theta_m \ln reer_{t-i} + \varepsilon_t \quad (3)$$

Furthermore, to capture the speed of adjustment of money demand to its long run level, we utilize the following ARDL Error Correction model:

$$\begin{aligned}\Delta \ln M_t &= \alpha_0 \sum_{i=1}^{k} \alpha_1 \Delta \ln M_{t-i} + \sum_{i=0}^{k} \alpha_2 \Delta \ln y_{t-j} + \sum_{i=0}^{k} \alpha_3 \Delta \ln id_{t-l} + \sum_{i=0}^{k} \alpha_4 \Delta \ln if_{t-h} + \sum_{i=0}^{k} \alpha_5 \Delta \ln reer_{t-m} \\ &+ \alpha_6 \varepsilon_{t-1} \\ &+ \mu_t \end{aligned} \quad (4)$$

where ε_{t-1} is the one period lagged error correction term estimated from equation (1). The coefficient of the error correction term (α_6) in equation (4) measures the speed of adjustment of money demand to its long run level. Equation (4) represents the short run determinants of the money demand M2, namely real income, domestic and foreign interest rates, real effective exchange rate, and the lagged valued of the residual from the long run money demand function (1).

This study uses quarterly data ranging from 2000:Q1 to 2016:Q4. The employed dataset consists of nominal gross domestic product deflated by CPI, Saudi consumer price index (CPI), nominal monetary aggregate M2 deflated by CPI, USA discount rate as a proxy for domestic interest rate, Japan discount rate as a proxy for foreign interest rate, and real effective exchange rate for Saudi riyal against other currencies. All the data are obtained from the International Financial Statistics database of the International Monetary Fund (IFS-IMF) except of the GDP which is obtained from the World Bank website[3].

5. Empirical results

5.1. Unit root tests results

[3] The data of GDP is transformed from annual frequency to quarterly frequency using E-VIEWS 9.5 due to the limitation of the quarterly data of GDP.

The ARDL bounds testing methodology of Pesaran et al. (2001) can be used with a mixture of I(0) and I(1) series, therefore, there is no need to preform unit root tests, however, we apply two of the unit root tests to ensure that none of the series are integrated of order two, I(2), since the series that integrated of I(2) will invalidate the methodology.

The initial step in our empirical analysis is to check the integration properties of our time series to ensure that none of the series are integrated of order two I(2). This is very important in empirical research to ensure the avoidance of spurious regressions, in which the parameter estimates have biased standard errors leading to misleading interpretation of these estimates. Thus, the Kwiatkowski-Phillips-Schmidt-Shin (1992) and Elliott-Rothenberg-Stock (1996) unit root testing procedures were implemented to verify the stationarity. All the implemented testing procedures suggest that all variables are integrated of order one $I(1)$, at the 5% level of significance. The detailed results are available from the authors upon request.

5.2. Stability of the money demand function in the long run

Since the existence of structural breaks may lead to misleading results of estimating money demand function, Hansen (1992) test for parameter instability is applied, and the results are presented in Table (2). The test statistic of Lc indicates that the null hypothesis of cointegration for M2 money demand is not rejected. Therefore, the result provides evidence of stability of the money demand function, M2, in the long run in Saudi Arabia.

Table 2: Hansen instability test results

Monetary aggregate	Lc
M2	0.648 (0.180)

Note: numbers in parentheses are p-values.

Moreover, the results of the bounds test are presented in Table (3), and the calculated F-statistic for the model is 4.76, which is greater than the upper bound critical value of 3.49 at the 5 percent significant level. This result suggests that the null hypothesis of no cointegration is rejected. Consequently, the results of bound test are consistent with the results of Hansen parameter instability test, which indicate that there exists a long run relationship between money demand and its determinants in Saudi Arabia.

Table 3: Bounds Test results

Test Statistic	value	Significant level	I(0): Lower bound	I(1): Upper bound
F-Statistic	4.76	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Note: Akaike Information Criterion (AIC) is used to choose the lag length, k is the number of regressors, and the critical values are obtained from Pesaran et al. (2001) page (300) in Table CI(ii) case II: restricted intercept and no trend.

5.3. Long run elasticities

Since the results of bounds test indicates that there is a long run relationship between money demand and its determinants in Saudi Arabia, therefore, the long run elasticities are estimated based on the ARDL (c, j, l, h, m) specifications, equation (3). The results are presented in Table (4) and suggest that real income has a positive and statistically significant effect on real money demand. For instance, the results indicate that a 1 percent increase in real income induces an increase in money demand by 1.9 percent. The income elasticity is greater than 1 percent, which is not consistent with the quantity theory but consistent with the

recent studies (Al Rasasi, 2016; Alyousef, 2014; Banafea, 2014)[4]. Fujiki (2014) indicates that the structure of population in a society may impact the income elasticity. Fujiki shows that an increase of the age of the Japanese society led to a decrease in the income elasticity. Alyousef (2014) indicates that the increase of the income elasticity in Saudi Arabia could be related to the growth of the youth population since the age of more than 0.60 percent of Saudi population is less than 30 years. In addition, Banafea (2014) indicates that Saudi economy is becoming more monetized therefore the income elasticity is higher than 1.

Not surprising that the signs of both short term interest rates (domestic and foreign interest rates) are consistent with the theoretical expectations but statistically not significant since most of the Saudi society is considered to be more conservative toward dealing with interest rates due to the Islamic laws, which prohibit dealing with interests. Both AlYousef (2014) and Banafea (2014) indicate that there is a small effect but statistically significant of domestic interest rate 0.03 and 0.02, respectively, on money demand in Saudi Arabia, however, these studies did not include the foreign interest rate to the model as one of the determinants of money demand as suggested by the cash in advance model. Therefore, the results of the current paper contradict the previous studies. In fact, inappropriately excluding important variables from the model may lead to misleading results and incorrect decisions.

Moreover, the impact of the real effective exchange rates (reer) on real money demand is negative and statistically significant. We find that the reer elasticity is -0.59, indicating that the depreciation of the Saudi currency would lead to Saudis to prefer holding foreign currency instead of the domestic currency, which indicates that the existence of substitution effect.

[4] Income elasticities as reported in the recent studies (Al Rasasi, 2016; Alyousef, 2014; Banafea, 2014) are 2.47, 1.49, and 1.64 percent, respectively.

Table (4): Long run elasticities

Variables	Coefficients	t-statistics (standard errors)
constant	-37.698 ***	-8.9297 (4.2217)
$\ln y_t$	1.9386 ***	12.0759 (0.1605)
$\ln id_t$	-0.0171	-0.7610 (0.0225)
$\ln if_t$	0.0456	1.4359 (0.0318)
$\ln reer_t$	-0.5871**	-2.6585 (0.2208)

, * denote statistical significance at 5 percent and 1 percent level, respectively.

With respect to the speed of adjustment of money demand to its long run level, the ARDL (6, 4, 0, 0, 6)[5] error correction model is estimated, and the result shows that the estimated coefficient α_6 in equation (4) is -0.23 and statistically significant at 5 percent level, which implies that the money demand takes about 0.23 percent each quarter to adjust to its long run equilibrium when money demand deviates from its steady state.

Moreover, the stability of the ARDL (6, 4, 0, 0, 6) error correction model is investigated using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUM of Squares) tests proposed by Brown et al. (1975). Figures 1 and 2 of CUSUM and CUSUMSQ test statistics indicate that the model is stable in the short run since the test statistics fall inside the critical bounds of 5 percent significance. In addition, the model is tested for serial correlation using Breusch-Godfrey serial correlation LM test, and the results suggest not rejecting the null hypothesis, which states no serial correlation at up to 6 lags since the F statistic is 1.441 with p-value 0.226.

[5] The choice of the lag length is based on AIC.

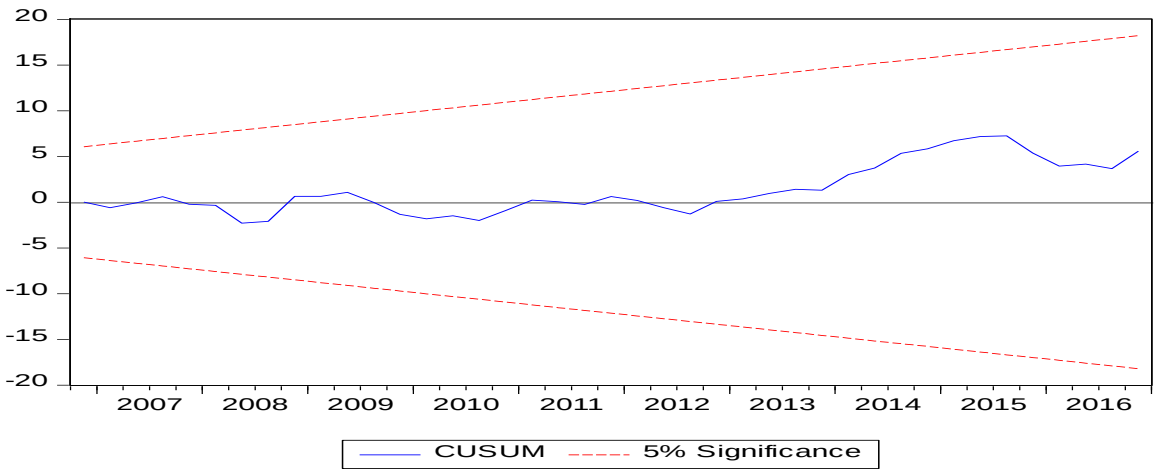

Figure 1: The cumulative sum (CUSUM)

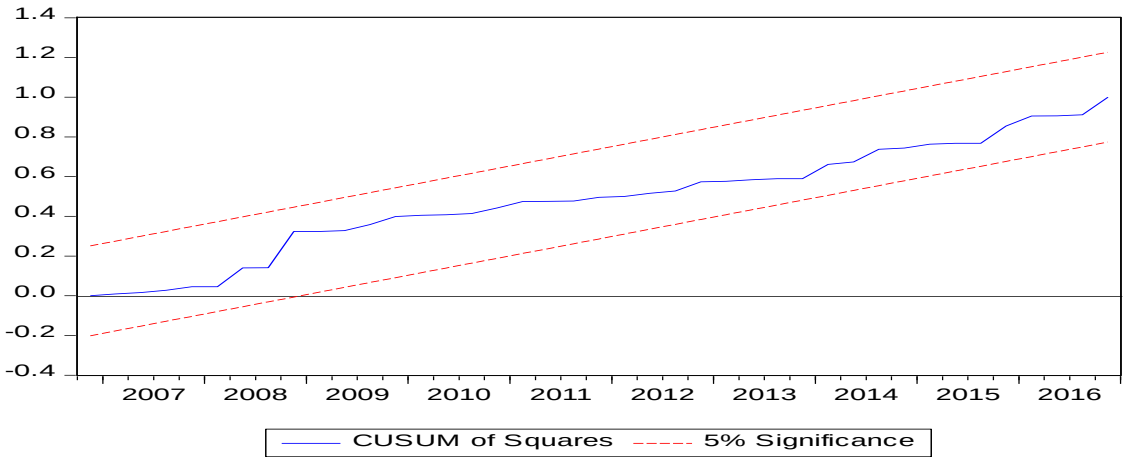

Figure 2: The Cumulative Sum of Squares (CUSUM of Squares)

6. Conclusion and discussion

This paper aims to examine the stability of the money demand function in both long and short run in Saudi Arabia using both parameter instability tests and cointegration techniques for the period 2000Q1-2016Q4. The result of Hansen (1992) suggests that the money demand function is stable in the long run in Saudi Arabia, which is confirmed by bounds test. Moreover, the results indicate that the income elasticity is greater than one (1.9) which is consistent with the recent studies and that could be related to the growth of the youth population since the

age of more than 0.60 percent of Saudi population is less than 30 years beside that Saudi economy is becoming more monetized.

With respect to the interest rates, the results indicate that there is no significant effect of both short term domestic and foreign interest rates on the Saudi domestic money demand although they have the expected signs, and this could be related to the Islamic laws, which prohibit dealing with interests. In fact, most of the recent studies indicate that there is a small effect of interest rates (domestic interest rates) -0.03 and 0.02 respectively on Saudi money demand but statistically significant. However, these studies did not include the foreign interest rate to the model as one of the determinants of money demand as suggested by the cash in advance model. Consequently, the results of the current paper contradicts the previous studies. In fact, inappropriately excluding important variables from the model may lead to misleading results and incorrect decisions.

This study provides evidence of substitution effect since the results indicate that there is a negative and statistically significant impact of real effective exchange rate on domestic money demand. The depreciation of the Saudi currency would lead Saudis to prefer holding foreign currency instead of domestic currency. The result of this study may also help policymakers in Saudi Arabia to formulate an appropriate monetary policy since money demand function is stable in both the long and short run. Thus, understanding the behavior of money demand would be useful for monetary policy makers in Saudi Arabia in order to take the required actions, if needed, to stabilize the economy.

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