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Assessing the Stability of Money Demand Function in Saudi Arabia

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Abstract

This paper aims to investigate the stability of money demand function for Saudi Arabian economy over the period of 2007:Q1-2018:Q4 by applying various structural break tests. The obtained results from the utilized tests reveal the stability of money demand function. The estimated money demand function also shows the impact of income on money demand is consistent with theory expectations in addition to the positive impact of exchange rate and interest rate on the demand for money. Moreover, the estimated error correction model indicates that money demand needs about 5 quarters to adjust to its equilibrium path in case it deviates from the steady state condition.

Keywords: Money demand; Stability; Cointegration; Saudi Arabia.

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 function is crucial because it enables monetary policymakers in some countries[1] to fight inflationary pressures and to stimulate the economy through targeting money growth. Likewise, maintaining a stable level of money demand is essential for other countries adopting fixed exchange rate regime like Saudi Arabia to sustain a stable nominal exchange rate. As a result, there has been an 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 empirical studies conclude the stability of money demand, whereas others do not.

Hence, in order to avoid contradictory 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. These sources of instability might be due to financial innovations (Arrau and Gregorio, 1993), shifts in exchange rate regime (Boughton, 1981), currency substitution (Girton and Roper, 1981), and output uncertainty (Choi and Oh, 2003). Furthermore, some economists point out to some econometric issues leading to the existence of instable money demand function. For instance, Cheong (2003) indicates that a misspecified money demand function is a key factor contributing to the instability of money demand. Additional factor playing an 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 function in Saudi Arabia. Additional motivation for this study is the 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. Hence, the main objective of this research paper is to investigate the relationship between money demand and its determinants in Saudi Arabia on one hand, and to assess whether this relationship is stable or not over both the long and short runs on the other hand.

[1] 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.

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The outline of the paper is as follows: section 2 presents the framework of money demand function, while section 3 overviews the existing literature that is relevant to Saudi Arabian economy. 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 is based on the Keynesian Theory, which can be specified as follows:

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

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 (Bahmani, 2008; Bahmani-Oskooee and Shabsigh, 1996) incorporate the exchange rate as an additional determinant capturing the behavior of money demand. Likewise, it is essential to bear in mind that Mundell (1963) was among the pioneer economists 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 showing the effect of exchange rate on the demand for money. 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 increases, it is considered as an increase of wealth leading to the possibility of higher demand for money. Bahmani-Oskooee and Pourheydarian (1990), also provide an alternative explanation in this regard. 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 money demand. The opposite scenario is expected to occur if the public expects the appreciation of foreign currency relative to their domestic currency.

Therefore, by following Bahmani-Oskooee and Shabsigh (1996) and Bahmani (2008), we augmented the money demand function with the exchange rate variable. It is also important to note that our motivation to embed the money demand function with exchange rate variable come from the fact of Saudi Arabia pegging its currency to the US dollar at fixed exchange rate since 1986. This in turn indicates that any fluctuations of the US dollar may influence the currency of Saudi Arabia.

Bearing this in mind, the augmented money demand function with nominal effective exchange rate can be formulated as follows:

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

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,Y_t, I_t, NE_t, and ε_t denote the demand for money (real money balance), real output measured by real non-oil GDP, nominal interest rate, nominal effective exchange rate, and error term at time t respectively. Based on economic theory[2], we expect a positive 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 δ may have either positive or negative impacts on the demand for money as suggested by Bahmani-Oskooee and Shabsigh (1996).

3. Literature Review

There is a rich literature on money demand 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 (Bahmani-Oskooee and Chomsisengphet, 2002), Asian countries (Bahmani-Oskooee and Rehman, 2005), European countries (Coenen and Vega, 2001), African countries (Bahmani-Oskooee and Gelan, 2009), and Middle Eastern countries (Bahmani, 2008). Sriram (2001) 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-Towaijari (1999) who employ quarterly data starting from 1977-1997 to examine the long run relationship between money demand and its determinants in

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

Saudi Arabia. Their evidence reveals that over long run inflation and interest rates affect the demand 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[3] (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 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) focuses 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.

By surveying the existing literature on Saudi Arabia, we note that most empirical studies interpret the existence of cointegration relationship as a sign of stability. Likewise, some of the research papers (Bahmani, 2008; Masih and Algahtani, 2008) tend to rely on old stability tests rather than implementing most recent developed tests.

4. Utilized Dataset

The data used in this paper to outline the determinants of money demand function for Saudi Arabia include real non-oil gross domestic product "GDP" (Y) measuring income, broad money supply (M3), the consumer price index (P), nominal effective exchange rate (ER), and the 3-month Saudi Arabian Interest Bank Offered Rate (R). The sampling period starts from 2007:Q1 to 2018:Q2, with 49 observations. The interest rate and money supply data obtained from various issues of Saudi Arabian Monetary Authority (SAMA) monthly statistics bulletin, while the data for real non-oil GDP are also extracted from the SAMA annual statistics. The data for Saudi nominal effective exchange rate and consumer price index are sourced from the International Financial Statistics of the International Monetary Fund. It is also essential to note that since quarterly data for non-oil GDP are not available for the whole series, therefore, we interpolate annual data into quarterly frequencies by applying the statistical interpolation technique. To this end, it is important to note that all variables, with exception to the interest rate, are transformed into the natural logarithm form.

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 and Fuller (1981) and Phillips and Perron (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 developed by Kwiatkowski *et al.* (1992) and Elliot *et al.* (1996) to ensure the stationarity of the economic variables. The results of all implemented tests, as shown in tables 1 and 2, confirm the nonstationarity of the economic variables in their levels; however, the variables become stationary when we take the first difference.

[3] The GCC countries consist of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

Table-1. Augmented Dickey and Fuller (1981) and Phillips and 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
m^d	2.88	-0.43	-1.99	-2.71	-3.73	-3.25	-2.34	-0.83	-6.03	-6.49
Y	0.26	-1.56	-1.71	-1.54	-3.92	-1.96	-4.61	0.26	-1.41	-2.34
NE	0.54	-2.99	-1.34	-5.09	-5.19	-5.13	-0.94	-2.53	-4.24	-4.24
I	-2.29	-2.65	-3.19	-6.73	-8.34	-6.81	-2.82	-1.94	-4.91	-5.50

Note: The ADF 5% critical values are for None=-1.95, Trend= -3.50, and Drift=-2.93. The PP 5% critical values for constant=-2.92 and Trend= -3.50. ** denotes that it is significant at 10%.

Table-2. Kwiatkowski *et al.* (1992) and Elliot *et al.* (1996) Unit Root Tests

	KPSS Test						ERS Test	
	Level Data		First Difference		Level Data		First Difference	
	Trend	Constant	Trend	Constant	Constant	Trend	Constant	Trend
m^d	0.18	1.21	0.10	0.41	-0.12	-1.28	-0.95	-2.43
Y	0.30	1.20	0.10	0.93	-0.39	-0.98	0.14	-1.91
NE	0.23	0.85	0.07	0.16	-0.47	-1.00	-2.34	-3.03
I	0.26	0.39	0.08	0.53	-0.64	-0.67	-3.03	-3.32

Note: The KPSS 5% critical values for constant = 0.463, and for trend= 0.146. For the ERS the 5% critical values for constant =3.11, and for trend= 5.64.

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 Trace and Maximum Eigenvalue tests of Johansen and Juselius (1990) for multiple cointegration relationships. The result of both tests as shown in table 3 confirm the existence of at least one cointegration relationship among the variables under investigation. This in turn implies that all variable co-move together in the same direction meaning that the estimated cointegration relationship with the variables in their levels is not spurious, so it is valid for analysis.

Table-3. Johansen and Juselius (1990) Cointegration Tests

Trace Test				
H_0	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
Test statistics	67.56*	33.96**	14.89	4.62
Eigenvalue Test				
H_0	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
Test statistics	33.61*	19.07	10.26	4.62

(*) (**) denote 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 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 the Lc stability test originated by Hansen (1992). The null hypothesis of this test is the parameter stability. Furthermore, the Lc test is useful if we are interested in assessing the ability of the model in capturing a stable relationship. The test's result is presented in table (4) revealing the stability of parameter estimates over long run at 5% significance level. In addition, this test can be viewed as cointegration test as noted by Hansen (1992) Hansen (1992), in which the null hypothesis is the presence of cointegration against the alternative of no cointegration. This in turn verifies the previous cointegration results, as reported in table (3), 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 and 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.

$$\Delta m^t_d = \alpha + \sum^k_{i=1} \beta_{i1} \Delta m^d_{t\_i} + \sum^k_{i=1} \gamma_{i1} \Delta y_{t-i} + \sum^k_{i=1} \delta_{i1} \Delta NE_{t-I} + \sum^k_{i=1} \theta_{i1} \Delta I_{t-i} + \phi ECT_{t-1} + \varepsilon_t \qquad (4)$$

Where m_t^d represents the real money demand $[\frac{m_3}{P}]$, while yt, NEt, It, and εt denote real output, 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 it is calculated as follows:

$$ECT_{t-1} = m_t^d{}_{-1} - \alpha - \beta Y_{-1t} - \delta NE_{t-1} \gamma I_{t-1} \quad (5)$$

Table 5 presents the corresponding structural break tests with its asymptotic p-values computed by Hansen (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 behind this contradiction. One possible explanation to the different results might be the money demand specification. In other words, Banafea (2014) specifies the demand for money as function of output and interest rate, whereas our specification of money demand includes an 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 real non-oil GDP and the broad definition for money supply (M3) unlike Banafea (2014) who uses the narrow definition for money supply (M1) alongside the overall GDP. These factors may explain the differences between our results and Banafea's.

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 the non-oil GDP is about 95.5 percent in 2018 for Saudi Arabia. This reflects the velocity of money in the economy and it seems reasonable compared to other oil-exporting and emerging market economies4. 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 events. In particular, the Saudi Arabian Monetary Authority succeeded during 1993 and 1998 in stabilizing the Saudi nominal exchange rate5; this in turn also increases foreign investors' credibility in investing in a stabilized economy such as Saudi Arabia. In addition, the financial sector exposure is limited in Saudi Arabia6, which indicates the availability of liquidity to maintain the demand for money. All these factors are reasonable indicators reflecting the stability of money demand in Saudi Arabia over time.

Table-4. Hansen (1992) Stability Tests

	Test statistics	**P-value**
Lc	0.60	0.11

Table-5. Andrews (1993) and Andrews & Ploberger (1994) Structural Break Tests

	Estimated Break Date	**Ave F**	**Exp F**	**Sup F**
Test statistics	2015:Q4	6.01	5.98	18.04
P-value		(0.43)	(0.10)	(0.10)

5.4. Interpretation the 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 (6) summarizes the parameter estimates of the long run money demand function. Evidently, the parameter estimates of money demand function, as given by equation (3), are in line with theory expectation suggesting the positive and significant relationship between output and the demand for money. Against theoretical expectation, we find a positive relationship between money demand and interest rate although the impact of interest rate is insignificant. What is this mean is that a rise in income by one percent would increase the demand for money by 0.97 percent. Similarly, higher interest rate tends to increase the demand for money; the possible explanation of the positive impact of interest rate on the demand for money is consistent with the findings of Hasanov *et al.* (2017) indicating that higher interest rate would lead to rise the demand for money via the demand for deposits. For further illustration, deposits rates are expected to be higher due to their close link with lending rates implying that higher loan rates would encourage banks to raise deposit rates to attract economic agent to increase their deposits into banks, which in turn would lead to higher money aggregates M3 which includes demand deposits. Concerning the impacts of exchange rate on the demand for money, the estimated coefficient is positive; in other words, the appreciation of exchange rate by one percent would increase the demand for money (domestic currency) by 0.44 percent. This finding is in line with the argument provided by Arango and Nadiri (1981) and Bahmani-Oskooee and Pourheydarian (1990) presented in section 2.

[4] In 2017, the ratios for Algeria 80.5%, India 75.7%, Mexico 38.8%, Oman 57.5%, Turkey 54.3%; these statistics are obtained from the World Bank website; https://data.worldbank.org/indicator/FM.LBL.BMNY.GD.ZS?end=2017&start=2011&view=chart

[5] For further discussion of SAMA interventions, see Al- Hamidy and Banafe (2005).

[6] For further information, see the financial stability report published on SAMA website.

Table-6. The Estimates of Long Run Relationship

	β	γ	δ
Parameter estimates	0.97*	0.0002	0.47**
t-statistics	(7.53)	(0.01)	(1.92)
(*) (**) denote the 5% and 10% significance levels respectively. The estimated model: $m_t^d = \alpha + \beta Y_t + \gamma I_t + \delta NE_t + \varepsilon_t$			

After the interpretation of the long run coefficients of money demand, it would insightful to interpret how money demand behaves over the short run. To do so, the estimated coefficients of the error correction model, as presented in equation (4), are summarized in table (7). The estimated parameter of the error correction term (ϕ) is negative and statistically significant at 5 percent significance level; this in turn means that the demand for money, if deviates from its steady state condition, would return to its long run path within five quarters. Furthermore, the negative sign and statistical significance of the error correction term suggests that not only the stability of the cointegration relationship, but also the capability of the explanatory variables in predicting the money demand movements.

Furthermore, the empirical results of the ECM show that in the short run money demand with two lags, interest rate with two lags, and nominal effective exchange rate with one lag have positive and significant impacts on the demand for money, while output does not have significant impact on money demand over the short run.

Table-7. The Estimated Parameter of the Error Correction Model

Variable	Parameter estimates	t-statistics
Constant	-0.001	-0.281
Δm_t^d-1	0.033	0.419
Δm^d_{t-2}	0.364*	2.676
Δy_{t-1}	-0.331	-0.282
Δy_{t-2}	0.943	1.040
ΔI_{t-1}	-0.002	-1.072
ΔI_{t-2}	0.006*	2.821
ΔNE_{t-1}	0.145*	3.645
ΔNE_{t-2}	0.023	0.261
ECT_{t-1}	-0.184*	-6.013

6. Conclusion

The main objective of this paper is to examine the relationship between the demand for money and its determinants on one hand, and to evaluate whether this relationship is stable or not on the other hand. To reach such objective, this paper employs quarterly data starting from 1993:Q1 to 2018:Q4 for money supply M3 deflated by consumer price index, nominal effective exchange rate, real non-oil GDP, and the US Libro interest rate. By relying on most common econometric techniques, 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 real output by one percent leads to higher money demand by 0.97 percent. Likewise, when the nominal exchange rate or interest rate increases by one percent, we find the demand for money increases by 0.44 percent and falls by 0.001 percent respectively.

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

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