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Estimation of Money Demand Function in Iran Including Households Religious Costs: A NARDL Approach

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ABSTRACT

Money demand determinants vary in every economy. There are many studies about Iran money demand function, which employed different variables and estimation methods. In this study, broad money (M2) is dependent variable and GDP, interest rate, exchange rate and household religious costs are descriptive variables. Household religious costs (urban and rural) are included in Iran money demand function as a religious factor because of Iran Islamic-based economy. We used NARDL method with quarterly data between 1376 and 1396, to determine if household religious costs have symmetric or asymmetric effects on Iran money demand. Bound testing approach shows a cointegration between variables, hence, we can interpret the long-run coefficients. Results show that all explanatory variables are statistically significant. Estimated coefficients of GDP, interest rate and exchange rate are 0.82, 0.01 and -0.17, respectively. Household religious costs show asymmetric effects, where estimated coefficients of negative and positive changes in household religious costs are -0.37 and 0.31, respectively.

Keywords:

Money Demand, Household Religious Cost, Non-linear ARDL

1. Introduction

Money is one of the most important issues in economics, because of its main role, and therefore, money demand is important too. Theoretically, money demand literature is mainly based on Pigou (1917), Fisher (1930), Keynes (1930, 1937), Baumol (1952), Friedman (1953) and Tobin (1958) studies. But there are a lot of studies about money demand function and its features, considering different variables and estimation methods, for instance, Blejer (1978), Arango and Nadiri (1981), Bahmani-Oskooee and Rhee (1994), Bahmani-Oskooee (1996), Arize and Shwiff (1998), Bahmani-Oskooee et al (1998), Arize et al. (1999), Hueng (2000), Bahmani-Oskooee and Chomsisengphet (2002), Bahmani-Oskooee and Ng (2002), Nezhad and Askari (2006), and Bahmani-Oskooee and Bahmani (2015).

In this study, we consider money demand function in Iran. There are two new aspects in this research. First, we consider household religious costs as a descriptive variable to determine money demand in an Islamic-based economy. According to Islamic laws, we can divide household religious costs into two parts: Fard (or Faridah or Wajib) and Mustahabb. Fard religious costs are a duty for Muslims. There are different fard costs include Khums and Zakat. And also, there are a lot of mustahabb religious costs, for example, Sadaghah or Waqf. Second, we use non-linear autoregressive distributed-lag (NARDL) method to determine if household religious costs have asymmetric effects on money demand. So, we generate partial elements of negative and positive change of household religious costs and estimate the model by bound testing approach.

A brief literature review is presented in section 2. In section 3, we introduced the econometrics methodology of this study. Then, empirical results are explained in section 4. And finally, a conclusion is presented in section 5.

2. Literature Review

A brief review of literature is provided. Money demand concept is a functional form of demanded money in an economy and its major determinants like income, interest rate and etc.

Quantity theory of money, by Fisher (1930), is written as:

$$MV = PT \qquad (1)$$

where M is the quantity of money in circulation, V is transactions velocity of circulation, P is average price, and T is the total number of transactions.

Keynes (1930, 1937) propounded Liquidity preference theory, explaining three motivates for money demand. First, the transactions motive, the need for money for current transactions. Second, the precautionary motive, holding money for unforeseen contingencies. And third, the speculative motive, holding money in liquid form to take advantage of market movements regarding to rate of interest.
Friedman (1953) explains money demand function as:

$$\frac{M_d}{P} = f\ (y, r_1, r_2, ..., r_i) \qquad (2)$$

where M_d is nominal demand for money, P is price level, y is income and r_i is rate of return asset i.

Bahmani-Oskooee and Bahmani (2015) explain that in the most recent studies, exchange rate is included in money demand function, in addition to income and interest rate, mainly based on Robert Mundell study in 1963. Based on contrasting results in effects of exchange rate in Iran money demand function, they put exchange rate as an asymmetric variable. Their results show that currency variable affect the money demand in an asymmetric way.

Nezhad and Askari (2006), investigate for impact of interest rate in Muslim societies. For this, two groups of Muslim and non-Muslim countries with comparable economic conditions were selected. The results show that people in selected Muslim countries are totally inelastic to the interest rates, while interest rates play an essential role in investment and demand for money in non-Muslim countries. The results also imply that in Muslim countries, the transactional motive is dominant and income plays the main role

By using the Johansen-Juselius cointegration analysis and exclusion test, Bahmani-Oskooee (1996) shows that in a country where there is a black market for foreign currencies, it is the black market exchange rate and not the official rate that should enter into the formulation of the demand for money.

Based on the different studies on the concept of money demand function, and also, empirical studies for Iran, we found a necessity to include household religious costs into Iran money demand function, due to the main religious of Iranian people (Islam) and the

Islamic bases of Iran economy. Household religious costs include all the religious-based costs expended by households. By doing this, we can investigate to see how the household religious costs affect the Iran money demand.

3. Methodology

Different econometrics methods are established to determine a cointegration relation between variables, mainly Engle and Granjer (1987) and Johansen (1991). In this study, we applied bound testing approach ARDL model, proposed by Pesaran and Shin (1998) and Pesaran et al (2001), to determine cointegration between variables. Then, considering Shin et al (2014), we applied asymmetric effects of household religious costs to the model. Using an NARDL model in empirical studies can be referred to Bahmani-Oskooee and Bahmani (2015) and Bahmani-Oskooee and Mohammadian (2016).

We considered Iran money demand function as below:

$$LnM_t = \alpha_0 + \alpha_1 LnY_t + \alpha_2 R_t + \alpha_3 LnEX_t + \alpha_4 LnRC_t + \varepsilon_t \quad (3)$$

Where M_t is real broad money (M2), Y is real GDP as a measure of income, R is real interest rate, EX is real exchange rate, RC is real household religious costs, ε_t is error term, Ln is the natural logarithm, and t denotes time periods. The equation (3) is a long-run approach of ARDL model for estimating a linear money demand function. We can interpret the coefficients in long-run term, if we establish a cointegration relation between the variables.

Following Shin et al. (2014), for applying asymmetric effects of RC on Iran money demand, we can divide household religious costs movements into negative and positive elements as below:

$$LnRC = LnRC_0 + LnRC_t^- + LnRC_t^+ \quad (4)$$

Then we will compute partial sum processes of negative and positive changes in RC by:

$$LnRC_t^- = \sum_{j=1}^{t} \Delta LnRC_t^- = \sum_{j=1}^{t} \min(\Delta LnRC_j, 0) \quad (5)$$

$$LnRC_t^+ = \sum_{j=1}^{t} \Delta LnRC_t^+ = \sum_{j=1}^{t} \max(\Delta LnRC_j, 0) \quad (6)$$

Where $LnRC^-$ and $LnRC^+$ are partial negative and positive changes in natural logarithms of household religious costs. By substituting equations (5) and (6) in equation (3), we can represent a long-run money demand model considering asymmetric effects of household religious costs as below:

$$LnM_t = \beta_0 + \beta_1 LnY_t + \beta_2 R_t + \beta_3 LnEX_t + \beta_4 LnRC_t^- + \beta_5 LnRC_t^+ + \varepsilon_t \quad (7)$$

We can interpret the coefficients of equation (7), only if there is cointegration between the variables. To test for cointegration, we use F-statistic based on bound testing approach, proposed by Pesaran et al (2001). The critical values of this F-statistic are different from normal F-statistic, so, critical values are provided by them. There are two critical values, I(0) and I(1), which are for cases that all variables are purely I(0) or I(1). If calculated F-statistic is higher than I(1) critical bound value, we can reject the null hypothesis of no cointegration. In contrast, if calculated F-statistic is lower than I(0) critical bound value, then we accept the null hypothesis of no cointegration. Also, there is another condition that calculated F-statistic is between I(0) and I(1) bound values, which implies that the bound testing is inconclusive.

Following Pesaran and Shin (1998), we can represent equation (7) NARDL model into an error correction (EC) form:

$$\begin{aligned}\Delta LnM_t = {} & \varphi_1 + \sum_{i=1}^{n1} \varphi_2 \Delta LnM_{t-i} + \sum_{i=0}^{n2} \varphi_3 \Delta LnY_{t-i} + \sum_{i=0}^{n3} \varphi_4 \Delta R_{t-i} + \sum_{i=0}^{n4} \varphi_5 \Delta LnEX_{t-i} \\ & + \sum_{i=0}^{n5} \varphi_6 \Delta LnRC_{t-i}^- + \sum_{i=0}^{n6} \varphi_7 \Delta LnRC_{t-i}^+ \\ & + \theta_1 LnM_{t-1} + \theta_2 LnY_{t-1} + \theta_3 R_{t-1} + \theta_4 LnEX_{t-1} + \theta_5 LnRC_{t-1}^- + \theta_6 LnRC_{t-1}^5 + \varepsilon_t \end{aligned} \quad (8)$$

Equation (8) is a non-linear autoregressive distributed-lag (NARDL) model that can be used to estimate asymmetric effects of RC on money demand in both long and short-run (Bahmani-Oskooee and Bahmani, 2015). After estimation the parameters of equation (7), a cointegration test must be applied to check the null hypothesis of no cointegration, $H_0 : \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = 0$.

Estimated coefficients of first-differenced variables in equation (8) are short-run coefficients. Furthermore, dividing θ_2 to θ_6 by θ_1, yields long-run coefficients, presented in equation (7), named β_1 to

β_5. In fact, first we have to estimate equation (8), and then, by using diagnostic tests we can check for autocorrelation, heteroscedasticity, residual normality, model specification and stability. Afterwards, by standardizing the coefficients, we have equation (7) long-run coefficients.

4. Results

Quarterly data between 1376 and 1396 is collected from Statistical Center of Iran and Central Bank of the Islamic Republic of Iran. Some variables are transformed to quarterly data, while they were monthly or annually. By using CPI[1], all variables have changed to real ones instead of nominal. Moreover, Fisher equation is used to produce real interest rate, by employing nominal interest rate and inflation rate.

By using NARDL model, we are indifferent with presence both I(0) and I(1) variables. Although most of the economic variables are stationary in level or first difference, to make sure that none of the variables are I(2), we employed ADF[2] unit root test to determine stationarity. Results of the unit root tests show that all variables are I(0) or I(1).

We calculated partial negative and positive changes of household religious costs, named LnRC_NEG and LnRC_POS, in order to equations (5) and (6). Considering M2 (real broad money) as dependent variable and Y (real GDP), R (real interest rate), EX (real exchange rate), LnRC_NEG (partial negative changes of real household religious costs), and LnRC_POS (partial positive changes of real household religious costs) as explanatory variables.

First, we have to estimate equation (8) by OLS method to identify best lag orders for variables. We used AIC[3], SC[4], HQ[5] selection criteria to choose best lag orders. After applying different maximum lags for variables and comparing the outputs selected by the selection criteria, we did some trial and tests to explore for some other different lags. Finally, a model with (1, 0, 0, 0, 3, 2) lag orders is selected, offered by HQ selection criterion. Short-run coefficients are shown in table 1.

We used diagnostic tests to check for serial correlation, heteroscedasticity, residuals normality, Ramsey RESET Test, CUSUM and CUSUMSQ stability tests. In Table 2, R-squared and adjusted R-squared show a high explanation by regression.

Table 1. Short-run Estimated Coefficients

Lag order	0	1	2
D(LnM2)	-	-0.303 (-4.255)	
D(LnY)	0.250 (4.230)		
D(R)	0.002 (2.796)		
D(LnEX)	-0.050 (-1.916)		
D(LnRC_NEG)	0.763 (3.244)	-0.215 (-0.744)	0.590 (2.466)
D(LnRC_POS)	0.449 (2.030)	-0.566 (-2.582)	

Note: The numbers in parentheses below the estimated coefficients are the t-statistic values.
Source: Research findings

Table 2. Diagnostic Tests

R-squared	Adj. R-squared	LM[6]	BPG[7]	RESET[8]	Normality
0.997	0.997	0.899 (0.412)	0.929 (0.518)	1.481 (0.143)	0.928 (0.629)

Note: The numbers in parentheses below the criteria values are t-statistic values.
Source: Research findings

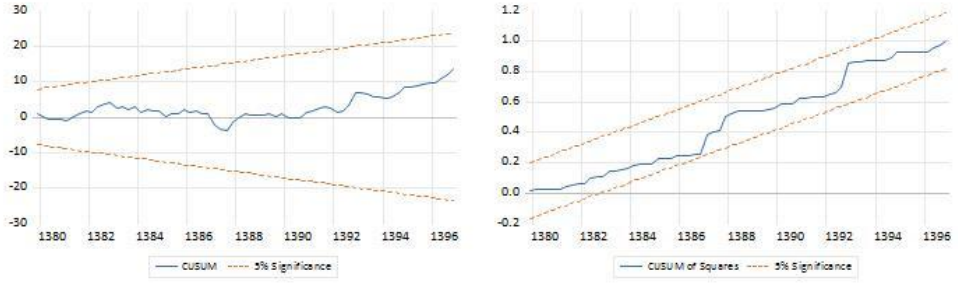

Figure 1. CUSUM and CUSUMSQ
Source: Research findings

As presented in table 2, LM test shows no serial correlation, BPG test shows homoscedasticity, Ramsey RESET test doesn't reveal model misspecification, and finally, residuals are normally distributed. Also, CUSUM and CUSUMSQ in figure 1, show the stability of the selected model.

To check for existence of cointegration that will lead to a long-run relation between variables, we perform a bound testing. The calculated F-statistic and its critical values at different significance levels are shown in table 3. Calculated F-statistic is meaningfully higher than critical upper bounds at all significance levels, which means we can reject the null hypothesis of no cointegration that implies a cointegration or long-run relation between variables.

Table 3 Bounds Testing

F-statistic	8.701	
Significance Level	Lower Bound	Upper Bound
10%	1.81	2.93
5%	2.14	3.34
1%	2.82	4.21

Source: Research findings

Estimated long-run coefficients mentioned in equation (7) is represented at table 4. As shown, all estimated coefficients are statistically significant.

Table 4 Long-run Estimated Coefficients

Variable	Coefficient	t-statistic	Prob.
LnY	0.825	19.580	0.000
R	0.007	3.154	0.002
LnEX	-0.166	-2.089	0.040
LnRC_NEG	-0.371	-6.776	0.000
LnRC_POS	0.308	2.904	0.005

Source: Research findings

Therefore, according to existence of cointegration and results of diagnostic tests, we may interpret the long-run estimated coefficients. Both real GDP and real interest rate estimated coefficients are positive, equal to 0.82 and 0.01, respectively. Exchange rate estimated coefficient is -0.17. It should be noted that interest rate and exchange rate show both positive and negative effects on Iran money demand function, based on different studies. Finally, estimated coefficients of LnRC_NEG and LnRC_POS are -0.37 and 0.31, respectively, show asymmetric effects of RC variable. That means RC affects money demand but the attitude is different in respect to increase or decrease in RC.

5. Discussion and Conclusions

The importance of money in economics is so high that make it a necessity to study money demand and its determinants. Therefore, there are a lot of studies about money demand function that vary on explanatory variables and estimation methods. In this study, we applied a money demand function with real broad money (M2) as dependent variable and real GDP, real interest rate, real exchange rate and partial negative and positive changes of real household religious costs as explanatory variables. There are two new aspects in this study in contrast of the others. First, regarding to Islamic bases of Iran economy, we have included household religious costs as an explanatory variable in estimation of money demand function. Second, we have employed a non-linear autoregressive distributed-lag (NARDL) model to determine asymmetric effects of household religious costs on Iran money demand function.

Bound testing approach established the existence of a long-run relationship between variables. According to long-run results, all estimated coefficients are statistically significant. Estimated coefficients for GDP and interest rate is 0.82 and 0.01, respectively. In other hand, estimated coefficient for exchange rate is -0.16. For partial negative and positive changes of household religious costs, estimated coefficients are -0.37 and 0.31, respectively, lead to an asymmetric effect on money demand.

According to importance of religious costs in the expenditures of a household in an Islamic economy, understanding the difference between asymmetric effects of RC would be very helpful to determine and predict the money demand. Therefore, monetary policymakers may take advantages of this study to achieve their monetary goals.

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Notes

[1] Consumer Price Index
[2] Augmented Dickey-Fuller
[3] Akaike information criterion
[4] Schwarz criterion
[5] Hannan-Quinn criterion
[6] Breusch-Godfrey Serial Correlation LM Test
[7] Breusch-Pagan-Godfrey Heteroscedasticity Test
[8] Ramsey RESET Test