Factors Affecting Money Demand with the Presence of the Variables of Foreign Assets of the Central Bank and Government Debts and Investigating its Stability in Iran

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ABSTRACT

Awareness of the correct form of the money-demand function of a country is necessary to adopt monetary policies in each country's economy. Also, recognition of the stability of money demand plays a key role in economic decision making. This study has addressed the factors affecting money-demand in Iran during 1978-2016 using ARDL method and investigated its stability using CUSUM method. Most studies conducted in our country have used the variables of interest rate, national production, exchange rate and inflation rate as factors affecting money demand. The present study has used the variables of foreign assets of the central bank and government debts in addition to four variables mentioned in order to create a distinction with other similar studies, according to the results of the study carried out by Jindal (2016) and Opuku (2017). According to the results of the ARDL method, the variables of the government debts, national production, inflation, foreign reserves of the central bank and the exchange rate (which is based on the Opoku's scientific theory (2017) and known as the wealth effect[1]) have a positive and significant effect on the money demand in Iran, and the interest rate has a negative and significant effect on money demand in Iran. According to the results of the CUSUM method, the money demand function in Iran is stable.

[1]The *wealth effect* is a behavioral economic theory suggesting that people spend more as the value of their assets rise. The idea is that consumers feel more financially secure and confident about their *wealth* when their homes or investment portfolios increase in value.

1. Introduction

Awareness of the money-demand function[2] parameters plays a key role in the formation of monetary policies[3]. There is a need for stable money demand as a tool for the inflation planning correctly, creating an appropriate money-demand function is of utmost importance, because the monetary policy is used as the main tool for implementation of inflation targeting[4] and the stability of money demand depends on its determining factors (Opoku, 2017). In order to implement monetary policy, a specific money-demand function is very important. An important structure in macroeconomic theories and an important component in implementation of monetary policy is the relationship between money demand and its main factors. Therefore, money demand is considered as one of the important issues that has attracted the most attention in the literature of developed and developing countries (Kjosevski, 2013).

Money demand is of utmost importance from two experimental and policy making aspects. The money demand function has always attracted much attention of economists as a debatable topic which is considered as a key component in many macroeconomic theories. An important basis in the transfer mechanism of monetary policy to the real sector is money demand function therefore it should have a good stability. Money demand reflects the relationship between monetary policy with the rest of the economy and when money demand function is stable, it will be possible to provide an accurate prediction of the effects of changes in the supply of money on other macroeconomic variables such as prices and interest rates. Each country should adopt a special plan within the economic policies framework considering the economic and political situation in order to achieve its economic goals. It is necessary to investigate the major factors affecting money demand considering the importance of money demand in Iran and the different attitudes about the determining factors of money demand, so that macroeconomic policies can be made based on it.

Most studies conducted in our country have used the variables of interest rate, national production, exchange rate

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[2] In monetary economics, the demand for money is the desired holding of financial assets in the form of money: that is, cash or bank deposits rather than investments.

[3] Monetary policy is the macroeconomic policy laid down by the central bank. It involves management of money supply and interest rate and is the demand side economic policy used by the government of a country to achieve macroeconomic objectives like inflation, consumption, growth and liquidity.

[4] Inflation targeting is a monetary policy regime in which a central bank has an explicit target inflation rate for the medium term and announces this inflation target to the public. The assumption is that the best that monetary policy can do to support long-term growth of the economy is to maintain price stability.

and inflation as factors affecting money demand. The present study has used the variables of foreign assets of the central bank and government debts in addition to four variables mentioned in order to create a distinction with other similar studies, according to the results of the study carried out by Jindal (2016) and Opoku (2017). This study was carried out aimed to estimate the parameters of the money demand function for Iran using the time series econometrics method. The present study has examined the factors affecting the money demand function in Iran during 1978-2016 using the ARDL method.

This study is organized as follows: Theoretical foundations are addressed in the section 2 (after introduction), the internal and external background are discussed in the section 3, and the section 4 has addressed the methodology, the methodological results are presented in the section 5 and the section 6 has discussed the conclusion.

2. Theoretical foundations

One of the most important issues of economic schools is money and its importance in economic activities. According to the Cambridge School and from the perspective of Marshall, the most important determining factors of money demand are income and assets of individuals. According to the Cambridge equation[5], money demand is a function of income. According to the Cambridge equation, there is a direct relationship between money trading demand and revenues and the general level of prices in order to make cash balancing between receipts and payments. According to Keynes's theory, three components of money demand include: trading demand, precautionary and speculation[6]. According to Keynes's theory, the first two components are the direct function of national income and the third component is the reverse function of interest rate. Friedman believes that finding a money demand function means finding a mix of money and other assets that provides the maximum benefit for the individual.

According to this framework, holding money depends on the return on other assets, such as bond[7], stocks, and so on. Friedman believes that the individual's demand for real balances is a function of his/her permanent income, mix of wealth, the rate of return on financial assets to in money, the expected inflation rate and individual taste.

On the other hand, the variables of exchange rate, government debt, and oversees assets of the central bank can be considered as factors affecting money demand according to the empirical theoretical foundations and the structure of

the money market (Jindal, 2016). The effect of the exchange rate on the money demand depends on the process of two effects of succession and wealth and no definitive comments can be made about the expected sign and its significant effect on money demand (Opoku, 2017). Therefore, as mentioned earlier about theoretical foundations on money demand, the money demand function can be explained as follows:

$$M_2 = f(GS, EX, GDP, FA, R, INF)$$

Where, M2: Money (broad definition of money) as a dependent variable and explanatory variables[8] include:

GS (government debt), EX (exchange rate), GDP (Gross domestic product[9]), FA (Foreign Assets of Central Bank), R (interest rate) and INF (Inflation Rate).

Theoretically, it is expected that Gross Domestic Product (GDP)[10], inflation, government debt and foreign assets of the central bank are positive, the coefficient of exchange rate is unknown and the coefficient of interest rate is negative.

The exchange rate and relevant changes can have two effects on the amount of money demand, both of which are: "the effect of wealth and succession". According to the effect of wealth, wealthy owners evaluate their portfolio based on domestic currency, so that In this case, the value of foreign assets held by them will increase in terms of domestic currency by domestic devaluation, and thus, they will return a part of their foreign assets to the country in order to achieve a fixed share of the wealth invested in domestic assets and convert into national currency, which finally the demand for domestic currency will increase. As well, the countries heavily dependent on imports more need for domestic currency to purchase imported goods in the event of national devaluation and an increase in the prices of imported goods, therefore in this case, there is a direct relationship between money demand and decreased domestic currency which is known as the effect of wealth (Arango and Nadiri, 1981; Opoku, 2017; Kjosevski and Petkovski, 2017; Kejowski, 2013; El-Rasheed and et al, 2017).

According to the effect of succession, with domestic currency devaluation, if the reduction rate is lower than the expected rate, economic agents try to increase the share of foreign assets in their portfolio of assets in order to prevent a further decline in purchasing power, because a national

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[5] The Cambridge equation formally represents the Cambridge cash-balance theory, an alternative approach to the classical quantity theory of money. Both quantity theories, Cambridge and classical, attempt to express a relationship among the amount of goods produced, the price level, amounts of money, and how money moves.

[6] Speculation is the purchase of an asset (a commodity, goods, or real estate) with the hope that it will become more valuable in the near future. In finance, speculation is also the practice of engaging in risky financial transactions in an attempt to profit from *short term fluctuations* in the market value of a tradable financial instrument—rather than attempting to profit from the underlying financial attributes embodied in the instrument such as capital gains, dividends, or interest.

[7] In finance, a bond is an instrument of indebtedness of the bond issuer to the holders. The most common types of bonds include municipal bonds and corporate bonds.

[8] An explanatory variable is a type of independentvariable. The two terms are often used interchangeably. But there is a subtle difference between the two. When a variable is independent, it is not affected at all by any other variables. When avariable isn't independent for certain, it's anexplanatory variable.

[9] Gross domestic product (GDP) is a monetary measure of the market value of all the final goods and services produced in a specific time period, often annually. GDP (nominal) per capita does not, however, reflect differences in the cost of living and the inflation rates of the countries; therefore using a basis of GDP per capita at purchasing power parity (PPP) is arguably more useful when comparing differences in living standards between nations.

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devaluation is considered as a higher opportunity cost to keep domestic money, but given that it is impossible to access foreign assets in most foreign countries or is less possible, investors in the **black-markets** for **currency** will convert the national currency into foreign currency, which leads to decrease the domestic currency demand. In this case, there is a negative relationship between domestic devaluation and domestic money demand which is known as the effect of succession (Agenor, 1992; Opoku, 2017; Kjosevski and Petkovski, 2017; Kejowski, 2013, Rashid et al., 2017).

The interest rate, or the opportunity cost of holding money, reflects the difference between the rate of return on money and the alternative assets for money. According to evidences, the interest rate has a negative and significant effect on money demand (Opoku, 2017; Petkovski, 2013; Al-Rashid et al., 2017). As prices increase, more money is needed to meet the needs of an individual, so the purchasing power of money is effective on money demand. According to evidences, inflation has a significant effect on the money demand (Opoku, 2017; Kjosevski, 2013; and Al-Rashid et al., 2017). Often the level of income is considered as a successor to the volume of trades in the economy, therefore it plays a key role in the empirical studies related to money trading demand theories. Increased income has a positive and significant effect on money demand (Opoku, 2017; Kjosevski and Petkovski, 2017; Kjosevski, 2013; and Al-Rashid et al., 2017).

The money demand is affected by government debt and foreign assets of the Central Bank through monetary impact (Jindal, 2016).

3. Research background

Fallahi and Negahdari (2005), during a study entitled "Investigating Factors Affecting Money Demand in Iranian Economy with Emphasis on Exchange Rate" (Application of the ARDL Model)", have estimated the Iranian money demand function using the ARDL method during 1338-1338 was Annual and 1988-2002. According to the results, that there is a positive relationship between positive income elasticity of money demand[11] and there is a negative relationship between exchange rate and money demand (the effect of succession).

Also, there is a negative relationship between inflation and its substitutes, such as the house price index[12] with money demand.

Dahalan et al (2005), during a study investigated the Malaysian money demand function using the Divisia index. According to the results, the variables of inflation, interest rate, financial wealth and income have a significant effect on

the money demand, and the Divisia index should be used when setting monetary policy.

Shahrastani and Sharifi Renani (2007), during a study entitled "Estimation of money demand function and investigating its stability in Iran ", estimated the Iranian money demand function for 1985-2005 seasonally using the ARDL method. According to the results, inflation has a negative effect on the money demand and the national income and exchange rate variables have a positive effect on the demand for money, as well as the results of the CUSUM method showed that the money demand in Iran is stable.

Azim et al (2010), during a study estimated the money demand function in Pakistan. They concluded that income and inflation have a positive effect on money demand if the exchange rate has a negative effect on the money demand.

Shahadudheen (2011), during a study investigated the effect of the exchange rate on the Indian money demand for 2009-1998, and used the Johansen method[13]. According to the results, the exchange rate has a positive effect on the money demand.

Erfani et al (2012), during a study entitled "Estimation of the money demand in Iran using the Divisia index", estimated the demand function in Iran during 1991-2009 seasonally using Divisia indices and simple sum. According to the results, the modulation rate and stability of Divisia's monetary demand functions are greater than the simple sum.

Adibpour and Elhami (2014), during a study entitled "The Effect of Exchange Rate Uncertainty on Money Demand in Iran," have investigated the effect of exchange rate uncertainty on the money demand in Iran for 1988-2008 seasonally by using the VEC method. According to the results, exchange rate uncertainty, real exchange rate and inflation have a negative effect on the money demand and income has a positive effect on the money demand.

Lashkari et al (2016), during a study entitled "Investigating the Factors Affecting Money Demand by Friedman Money Demand Approach (Case Study: Selected Developing and Developed Countries)", have investigated the Factors Affecting the Money Demand in Developing and Developing Countries using the data panel method for 1993-2013. According to the results, the house price index has the highest impact on money demand and for developed countries, the share price index has more returns compared to other forms of asset holdings.

Jindal (2016), during a study, estimated the Indian money demand function. According to the results, the variables of government debt, national production and foreign assets of the central bank have a positive effect on the money demand and the exchange rate variable has a negative effect on the money demand.

Opoku (2017), during a study estimated the money demand function in Ghana using the ARDL method. According to the results, the variables of national production, inflation and exchange rate variables have a positive effect on

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[11] In economics, income elasticity of demand measures the responsiveness of the quantity demanded for a good or service to a change in income. It is calculated as the ratio of the percentage change in quantity demanded to the percentage change in income. For example, if in response to a 10% increase in income, the quantity demanded for a good increased by 20%, the income elasticity of demand would be 20%/10% = 2.0.

[12] A house price index (HPI) measures the price changes of residential housing as a percentage change from some specific start date (which has HPI of 100). Methodologies commonly used to calculate a HPI are the hedonic regression (HR), simple moving average (SMA) and repeat-sales regression (RSR).

[13] In statistics, the Johansen test, named after Søren Johansen, is a procedure for testing cointegration of several, say k, I(1) time series. This test permits more than one cointegrating relationship so is more generally applicable than the Engle–Granger test which is based on the Dickey–Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) cointegrating relationship.

money demand and the variables of financial innovation and interest rate have a negative effect on the money demand.

Al-Rashid et al (2017), during a study investigated money demand function in Nigeria using the ARDL method and its stability by using CUSSUM and CUSSUMSQ for 1980-2018. According to the results, the variables of interest rate and inflation rate have a negative effect on national production and exchange rate has a positive effect on money demand and also money demand function is stable.

There are significant differences between this study and similar domestic studies as follows:

The variables of interest rate, national production, exchange rate and inflation have been used as effective factors on money demand in most domestic studies. The present study has used the variables of central bank's foreign assets and government debts in addition to the four variables mentioned to make a distinction with other similar domestic research using the results of the studies conducted by Jindal (2016) and Opoku (2017).

4. Methodology
4.1. Auto regressive Distributed Lag Model (ARDL)

Some methods do not have necessary credibility, such as the Engle and Granger approach which don't consider short-term reactions between variables. Therefore, patterns with short-run dynamics which lead to estimate more accurate coefficients from the model are able to attracted more attention of researchers. In general, a dynamic pattern refers to a pattern in which the lag of variables is entered as follows:

$$Y_t = \alpha X_t + \beta X_{t-1} + \delta Y_{t-1} + u_t$$

In order to reduce bias related to estimating pattern coefficients in small samples, it is better to use a model that considers many numbers of lag for variables.

$$\varphi(L, P)Y_t = \sum_{i=1}^{k} b_i (L, q_i) X_{it} + c'w_t + u_t$$

The above model is called an Auto regressive Distributed Lag Model (ARDL), where,

$$\varphi(L, P) = 1 - \phi_1 L - \phi_2 L^2 - \cdots - \alpha_P L^P$$

$$b_i(L, q_i) = b_{i0} + b_{i1}L + b_{i2}L^2 + \cdots + b_{iq}L^q$$

Where, L is the lag operator, W is a vector of fixed variables, such as the width of the origin, the virtual variables, the time process, or the exogenous variables with the fixed lags. The m is the maximum lag which can be determined by the researcher and k is the number of explanatory variables.

In the next step, one of the equations is chosen using one of the Akaike, Schwarz Bayesian (SBC) or Hannan - Quinn (HQC) criteria. The Schwartz-Bayesian criterion is used to avoid the loss of degree of freedom for the number of samples less than 100. The same dynamic model is used to calculate the long-run coefficients of the model. Long-term coefficients for the x variables are calculated using the following equation (Nkoro and Kelvin Uko, 2016):

$$\theta_i = \frac{\hat{b}_i(1, q_i)}{1 - \hat{\varphi}(1, P)} = \frac{\hat{b}_{i0} + \hat{b}_{i1} + \hat{b}_{i2} + \cdots + \hat{b}_{iq}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \hat{\alpha}_3 - \cdots - \hat{\alpha}_P}$$

There are two methods to check that the long term relationship of this method is not false:

In the first method, the following hypothesis is tested:

$$H_0: \sum_{i=1}^{P} \phi_i - 1 \geq 0$$

$$H_a: \sum_{i=1}^{P} \phi_i - 1 < 0$$

H0: There is no cointegration[14] or a long-term relationship, because if the sum of the coefficients is less than one, then the short-term dynamic relationship tends towards long-term equilibrium. In order to perform the desired test, the number one must be deducted from the sum of the coefficients with the dependent variable lag and divided by the sum of the standard deviations of the coefficients.

$$t = \frac{\sum_{i=1}^{P} \hat{\phi}_i - 1}{\sum_{i=1}^{P} S_{\hat{\phi}i}}$$

If the absolute value of t obtained is greater than the absolute value of the critical values given by Benerjee, Dolado, and Mestre, H0 is rejected and the existence of a long-term relationship is accepted.

The second method is to use the bounds testing.

4.1.1. Bounds testing

Assuming that βi and μ are long-term coefficients, H0, H0: μ = β1= β2=..........= βi= 0 (there is no long-term relationship) is investigated versus the H1, μ ≠ β1≠ β2≠...... βi ≠ 0 (there is long-term relationship). Bounds testing, refers to a hybrid method to investigate long-term relationships between variables. This relatively new method has many advantages compared to other methods. Firstly, it is used regardless of whether the desired series is I (0) or I (1); secondly, the vector error correction model (VECM) can be generated using the ARDL bounds testing using a simple linear transformation; thirdly, this model shows short- and long-term dynamics; fourthly, according to experimental results, this approach provides better results for small samples (Belloumi, 2013).

The present study has used the second method, the bounds testing in order to investigate the existence of a long-term relationship.

4.1.2. Error Correction Method (ECM)

In 1957, Philips used the Error Correction Method (ECM) for the first time and then it was used to correct imbalances using the Engle and Granger approach. According to Philip, the error correction model is considered as a policy tools

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[14]Cointegration is a statistical property of a collection (X_1, X_2, ..., X_k) of time series variables. First, all of the series must be integrated of order *d* (see Order of integration). Next, if a linear combination of this collection is integrated of order less than d, then the collection is said to be co-integrated. Formally, if (*X,Y,Z*) are each integrated of order *d*, and there exist coefficients *a,b,c* such that $aX + bY + cZ$ is integrated of order less than d, then *X*, *Y*, and *Z* are cointegrated. Cointegration has become an important property in contemporary time series analysis. Time series often have trends—either deterministic or stochastic. In an influential paper, Charles Nelson and Charles Plosser (1982) provided statistical evidence that many US macroeconomic time series (like GNP, wages, employment, etc.) have stochastic trends—these are also called unit root processes, or processes integrated of order They also showed that unit root processes have non-standard statistical properties, so that conventional econometric theory methods do not apply to them.

adjustment method in order to make closer the target variable to its optimal value. Cointegration between a set of economic variables is considered as the main reason for using error correction patterns (Tashkini, 2005).

Cointegration between a set of economic variables provides a statistical basis for using error correction models (ECMs). These models are widely used in experimental works and have a growing reputation. The main reason for this is that it is able to make relationship between short-term fluctuations of the variables and their long-term values. In fact, these models are considered as a type of partial adjustment models in which, effective forces in the short run and the speed of approaching the long-term equilibrium value can be measured by entering the Mana residue from a long-term relationship.

In other words, according to the error correction model, the dependent variable changes are a function of the deviation of the long-term equilibrium equation (which is expressed by the error correction component) and the changes of the other explanatory variables (Tashkini, 2005).

In the first step, a long-term relationship is estimated and make sure it is not false. Therefore, the Cointegration equation should be estimated as follows:

$$Y_t = \beta_0 + \sum_{j=1}^{n} \beta_j X_{jt} + \varepsilon_t$$

Then, the error of the following equation as the equilibrium error is estimated:

$$\varepsilon_t = Y_t - \beta_0 - \sum_{j=1}^{n} \beta_j X_{jt}$$

In the second step, the residue lag of the long-run relationship is considered as an error correction factor which is used to make relationship between the short-run behavior of Y_t with its long-run equilibrium value, and the following equation is estimated:

$$\Delta Y_t = \alpha + \sum_{i=1}^{m} \beta_{i0} \Delta Y_{t-1} + \sum_{i=1}^{n} \beta_{i1} \Delta X_{1t} + \cdots + \sum_{i=1}^{r} \beta_{in} \Delta X_{nt-i} + \lambda \varepsilon_{t-i} + \nu_t$$

$$-1 < \lambda < 0$$

In the above equation, ε_{t-1} represents the error of regression estimation in a long-term relationship with a time lag. In this equation, λ is the short-term adjustment coefficient. This coefficient shows that in a short-term period, how many percent of the deviation from the long-term relationship is corrected. When X_t and Y_t, are two first order Cointegration equations, ε_t is related to the Zero-order Co-integration equation I (0), ie Mana. Given that, ΔX_t and ΔY_t are also Mana, the error correction model variables (ECM) are all I (0). Therefore, this model can be estimated without need to obtain false regression using OLS method, and using t and F statistics in the model test (Tashkini, 2005).

4.2. Stability testing

Stability testing of the "money demand function" refers usually to testing approximation compatibility of the regression coefficients over time. The stability testing introduced by Braun, Durbin and Evans (1975) was used in this study, which is based on the remaining turning components. In the turning models, the correlation of the error components is zero during a period and the stability test is based on the accumulated summary of the CUSUM turning remaining component. One of the most important advantages of this test is that it can be used even when there is uncertainty about structural changes. On the other hand, it is perfectly suitable for time series data. According to the H0 in this test, the vector of coefficients in each period is the same and another hypothesis expresses other modes.

Brown et al (1975) suggest the CUSUM test as follows:

$$W_r = 1/\sigma + \sum_{k+1}^{r} (W_j)$$

The stability hypothesis is accepted if Wr is between boundaries, and it can be said that the estimated coefficients are stable, otherwise the stability hypothesis is rejected and we conclude that the estimated coefficients are unstable (Al-Rashid et al, 2017).

4.3. Specifying the model

The money demand function in Iran can be presented the framework of a general model as follows using theoretical foundations and the results of studies conducted by Jindal (2016) and Opoku (2017),:

$$LNM_2 = f(LNGS, LNEX, LNGDP, LNFA, R, INF)$$
$$LNM_2 = B_1 LNGS + B_2 LNEX + B_3 LNGDP + B_4 LNFA + B_5 R + B_6 INF + e_i$$

Ln M2: Natural logarithm of money (broad definition of money)
LNGS: Natural Logarithm of Government Debt
LNEX: The natural logarithm of the exchange rate
LNGDP: Natural Logarithm of GDP
LNFA: The natural logarithm of the Central Bank's foreign assets
R: Bank interest rate
INF: Inflation rate (Consumer Price Index)
e_i: Error

This study considered the period of 1978 to 2016 annually. Data were collected from the central bank.

5. Results of the method

5.1. Investigating the reliability of model variables

The Dickey Fuller test[15] was used to test the reliability of the variables.

Table 1. The results of the Dickey Fuller test.

Variable	Probability	H0	Result
LNM2	0.19	Non-stationary	Non-stationary
LNGS	0.15	Non-stationary	Non-stationary
LNEX	0.38	Non-stationary	Non-stationary
LNGDP	0.67	Non-stationary	Non-stationary
LNFA	0.20	Non-stationary	Non-stationary
R	0.06	Non-stationary	Stationary at 10 % level
INF	0.00	Non-stationary	Stationary
DLNM2	0.00	Non-stationary	Stationary
DLNGS	0.00	Non-stationary	Stationary
DLNEX	0.00	Non-stationary	Stationary
DLNGDP	0.00	Non-stationary	Stationary
DLNFA	0.00	Non-stationary	Stationary

Source: Results of the research

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[15] In statistics, the ***Dickey–Fuller*** test tests the null hypothesis that a unit root is present in an autoregressive model. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity.

As shown in Table 1, the variables used in this study are I (0) and I (1), and none of the variables used in this study are I (2), therefore the ARDL method can be used.

5.2. Investigating the hypothesis of long-term relationship for broad money demand (bounds testing)

According to this test, if the F-statistic value is greater than the IO Bound and I1 Bound statistics, H0, There is no long-term relationship", is rejected, and H1 is confirmed. According to the results, this statistic with a value of 24.68 is higher than the I1 Bound and I0 Bound statistics at all probability levels, therefore, H0 is rejected and H is confirmed, thus there is necessary condition for the use of the ARDL test.

Table 2. The results of bounds test.

Test Statistic	Value	k
F-statistic	24.68	6
Significance	I0 Bound	I1 Bound
10%	1.75	2.87
5 %	2.04	3.24
2.5%	2.32	3.59
1%	2.66	4.05

Source: Results of the research

5.3. Investigating the classical assumptions for broad money demand

Breusch–Pagan test was used in order to investigate the serial correlation hypothesis, the Arch-test has been used to investigate the heterogeneity variance hypothesis and the coding test has been used for specifying the model correctly.

Table 3. The results of classical assumptions for broad money demand

Test type	Probability
Serial auto-correlation	0.21
Variance Heterogeneity	0.14
Specifying the model correctly	0.27

Source: Results of the research

According to the results, H0, there is no serial auto-correlation, the variance Heterogeneity, and specifying of the model correctly, is not rejected.

5.4. Long-term coefficients using ARDL method for broad money demand

Table 4.Long term Coefficients using ARDL Method For broad money demand

Variable	Coefficient	Standard deviation	T student	Probability
LNGS	.279929	.057730	4.848933	.0029
LNEX	.726912	.064663	11.241536	.0000
LNGDP	.128592	.023973	5.364046	.0017
LNFA	.241598	.045106	5.356255	.0017
R	-.230544	.041341	-5.576699	.0014
INF	.049770	.011235	4.429847	.0044

Source- Results of the research

According to the results, the government debt ratio is positive and significant. The positive government debt ratio indicates that if the government's debt increases by one unit, the money demand will change by 0.28 units in the same direction. In fact, monetary base will increase with increasing government debt and finally the money demand will be increased, which is proportional to economic theories. The positive exchange rate coefficient indicates that if the exchange rate increases by one unit, the money demand changes by 0.73 units in the same direction, which is proportional to economic theories.

Devaluation can lead to increase the value of foreign assets of individuals in our country, and then increase monetary base, and finally lead to increase money demand through reducing interest rates. Furthermore, the countries heavily dependent on imports (such as Iran), in the event of national currency devaluation, public and private sectors need more money to import consumer, capital and intermediate goods[16]. Thus, there is a direct relationship between money demand and the domestic currency devaluation, which is known as the effect of wealth. The positive national production coefficient indicates that if the national production changes by a unit, the money demand changes by 0.13 unit in the same direction. This is the long-term income elasticity of the money demand, which positive income elasticity of the money demand is proportional to economic theories. If the central bank's foreign assets coefficient is positive, that is if the central bank's foreign assets change by a unit, the money demand will change by 0.24 units in the same direction, so that an increase in foreign assets of the central bank will increase the monetary base and, as a result, money demand, which is proportional to economic theories.

The negative interest rate coefficient indicates that if the interest rate changes by a unit, the money demand will change by 0.23 units in the reverse direction. That is, with an increase in the interest rate, the opportunity cost for money holding increases and money demand decreases, which is proportional to the economic theories. The positive inflation coefficient indicates that if the inflation changes by a unit, the money demand will change by 0.05 units in the same direction, and in fact, as prices increase, the individual will have to demand more money to meet his needs. So, money purchasing power has a significant effect on money demand, which is proportional to economic considerations.

5.5. Error correction factor for broad money demand

Table 5. Error correction factor for broad money demand

Variable	Coefficient	Standard deviation	T student	Probability
ECM (-1)	-. 985178	.109113	-9.028947	.0001

Source: **Results of the research**

According to the results, the ECM (-1) coefficient is -0.98, given that it has a negative sign and its absolute value is smaller than unit, it confirms that there is a long-run relationship between the model variables. This coefficient indicates that about 98% of the dependent variable non-equilibrium is adjusted in each period.

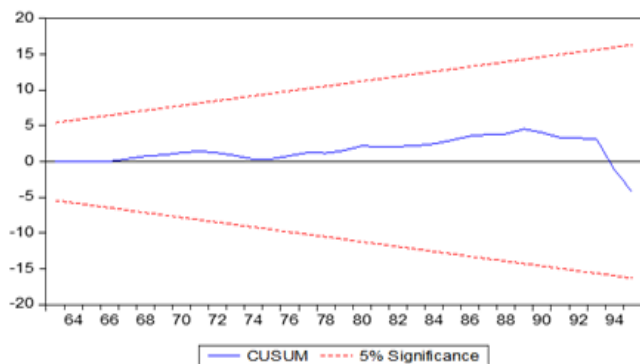## 5.6. Investigating the stability of the broad money demand function

Stability testing of the "money demand function" refers usually to testing approximation compatibility of the regression coefficients over time. The stability testing introduced by Braun, Durbin and Evans (1975) was used in this study, which is based on the remaining turning components. In the turning models, the correlation of the error components is zero during a period and the stability test is based on the accumulated summary of the CUSUM

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[16] Intermediate goods, producer goods or semi-finished products are goods, such as partly finished goods, used as inputs in the production of other goods including final goods. A firm may make and then use intermediate goods, or make and then sell, or buy then use them. In the production process, intermediate goods either become part of the final product, or are changed beyond recognition in the process. This means intermediate goods are resold among industries.

turning remaining component. One of the most important advantages of this test is that it can be used even when there is uncertainty about structural changes.

On the other hand, it is perfectly suitable for time series data. According to the H0 in this test, the vector of coefficients in each period is the same and another hypothesis expresses other modes. The CUSUM test on the implementation of the remainder of the estimated model can be used to investigate the stability of the money demand function. If the movement path of the test statistic is located between the direct lines, it can be concluded that the money demand function is stable.

Figure 1. Investigating the stability of the broad money demand function.

If the movement path of the test statistic is located between the direct lines, it can be concluded that the money demand function is stable.

6. Conclusions and recommendations

Money demand is of utmost importance from two experimental and policy making aspects. The money demand function has always attracted much attention of economists as a debatable topic which is considered as a key component in many macroeconomic theories. According to the results of studies conducted by different countries, money demand depends on the exchange rate, government debt and foreign reserves of the central bank, in addition to inflation, interest rates and income. The present study has estimated the money demand function in Iran during 1978-2016 using the ARDL method and its stability was investigated using CUSUM method. According to the results of the ARDL method, the variables of the government debt, national production, inflation, foreign reserves of the central bank and the exchange rate (which is in line with the Opoku's scientific theory in 2017 and known as the effect of wealth) have a positive and significant effect on the money demand in Iran, and the interest rate has a negative and significant effect on money demand in Iran. According to the results of the CUSUM method, the money demand function in Iran is stable.

In order to implement monetary policy, a specific money-demand function is very important. An important structure in macroeconomic theories and an important component in implementation of monetary policy is the relationship between money demand and its main factors and is an important component of monetary policy implementation. Therefore, it is recommended to pay serious attention to the effective variables on the money demand.

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