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The Impact of Exchange Rate on Demand for Money in Iran

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Abstract:

Central banks have long been interested in obtaining precise estimations of money demand given the fact that the evolution of money demand plays a key role over several monetary variables. One implication of currency substitution is that the exchange rate could serve as another determinant of the demand for money. Due to the recent currency crisis in Iran, it would be important to investigate the phenomenon of currency substitution. By using quarterly data from Iran during 1990Q2 to 2013Q1 and the Generalized Method of Moments approach, we show that exchange rate in addition to real GDP, Inflation, lagged monetary aggregate has effect on the demand for real m2 in Iran. We found that income and lagged monetary aggregate elasticities are positive while the exchange rate elasticity and inflation coefficient are negative. This indicates that inflation and depreciation of domestic currency decreases the demand for money.

Key Words: Money Demand, Exchange Rate, GMM, Iran

JEL Classification: E41, F31, C22.

1. Introduction

Money demand models represent a natural benchmark against which monetary developments can be assessed. The importance of money demand has become a prominent research topic in economics in recent years due to its role in monetary policy formulation. There can be seen a wide array of literature on the demand for money, however, the focus of them is varied in accordance with time span, choice of variables and motives of money demand.

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The majority has emphasized that wealth and permanent income affect for money demand[1],[2],[3]. Contrary to the view[4], they have argued that current income affects for money demand rather than permanent income, as people demand money mostly for transaction purpose.

However, in addition to those fundamental determinants, new findings on the determinants of money demand have appeared in recent literature. According to them, exchange rate, inflation rate and interest rate spread are also can have a considerable impact on the demand for money[5],[6],[7] .

In this paper, we concentrate about the effect of exchange rate on monetary demand. Robert Mundell[8] (1963) suggested the idea that the exchange rate is another important determinant of money demand because it plays a critical role. He added the exchange rate in addition to income and the interest rate. Empirical studies tried to acknowledge the link between exchange rate and the demand for money because Mundell had not risen this important step. These studies all emphasize that the demand for money depends not only on the interest rate and income, but also on the exchange rate.

The importance of exchange rates is also stressed by Orlowski[9] (2004) for Hungary, Poland and the Czech Republic as well as by Komarék and Melecký [10](2001) for the Czech Republic. Izadi and Dehmarde[11] (2012), Sameti and yazdani[12] (2011) and Dehmarde and Izadi[13] (2009) confirm this effect in Iran, too.

Forasmuch as, having a stable money demand is very important, the existence of a well-specified and stable relationship between money and other macroeconomic variables, like prices, GDP and exchange rate can be perceived as a prerequisite for the use of monetary aggregates in the conduct of monetary policy.

The main contribution of this paper is to demonstrate that whether exchange rate could make the wealth effect or expectation effect

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1 . Chow,(1966).
2. Thornton, (1982).
3 . Friedman, (1959).
4 . Lieberman, (1979).
5. Brunner, K., A. H. Meltze, (1963).
6. Bahmani, S., (2011).
7. Narayan, ,et al ,(2009).
8 .Mundell (1963).
9.Orlowski, (2004).
10.Komárek andMelecký, (2001).
11 . Izadi and Dehmardeh (2012).
12 . Sameti and yazdani, (2011).
13. Dehmardeh, & Izadi,(2009).

uncertain, it could have a positive or negative impact on money demand, and should, therefore, be considered as another determinant to be included in the money demand function due to the vital role it plays.

With these objectives in mind the outline of this paper can be stated as follows. Section 2 briefly reviews a few relevant empirical works. In Section 3 the model and method which employed will be described. Section 4 will notice to Data and empirical methodology. In section 5 empirical results for time series unit root and cointegration tests and estimation of GMM equations are presented. Summary and Conclusion are in Section 6.

2. Review of Studies

A considerable body of literature has investigated the demand for money in developing countries (Wong, 1977, Arize 1989, Gupta and Moazzami, 1989, Arrau, 1991, Bahmani-Oskooee and Malixi, 1991, Simmons, 1992, and Sriram, 2000)[1]. For example, Arize[2] (1989) estimates estimates the demand for money in four Asian economies: Pakistan, the Philippines, South Korea, and Thailand. His results show that foreign interest rates, exchange rate depreciation and technological change are important determinants of the Asian money demand functions.

Bahmani-Oskooee and Malixi[3] (1991) estimate the demand for money in 13 developing countries as a function of inflation, real income and the real effective exchange rate. They conclude that, depreciation in real effective exchange rate falls down the demand for domestic currency.

Simmons[4] (1992) employs an error-correction model to estimate the demand for money in five African economies. This study emphasizes on the opportunity cost variables: domestic interest rate and expected exchange rate depreciation. The results indicate that the domestic interest rate is an important determinant of the demand for money functions for three of the five countries, whereas external opportunity cost variables are significant for only one of the others. He also finds that in four out of five cases inflation plays an extremely important role in determining the demand for money.

1 . Valadkhani, (2008).
2.Arize, (1989).
3. Bahmani-Oskooeeand Malixi, (1991).
4 . Simmons,(1992).

Agenor and Khan[1] **(1996)** estimate a dynamic currency substitution model incorporating forward-looking rational expectations for a group of ten developing countries. They also allude to the view that the foreign rate of interest and the expected rate of depreciation of the parallel market exchange rate play a crucial role in the choice between holding domestic money and switching to foreign currency deposit held abroad.

Buch[2] **(2001)** has specified money demand functions for Hungary and Poland by monthly data from 1991 to 1998. Her money demand function includes an income variable, domestic and foreign interest rates and changes of exchange rate expectations as well as inflations rates. The results indicate that inflation rates reduce demand for money in Hungary and the stability of demand for money is affected by exchange rate policy.

Dreger *et al*.[3] **(2006),** the money demand analysis in the new Member States of the European Union (EU) is conducted using panel cointegration methods over the period 1995 Q1-2004 Q2. A well-behaved long-run money demand relationship can be identified only if the nominal exchange rate is included to standard macroeconomic variables such as broad money, real GDP, consumer price index and three-month money market interest rate. In the long-run cointegrating vector the income elasticity exceeds unity (1.7), while the interest rate elasticity is negative and relatively small and the exchange rate elasticity is also negative as expected.

Tang[4] **(2007)** estimated the long-run relationship between M2 balances and its determinant components such as real GDP, exchange rate, and inflation rate in ASEAN economies from 1960 to 2005. Individually, M2 balances in Malaysia, the Philippines and Singapore appeared to be cointegrated with real GDP, exchange rate and inflation. However, the other two countries showed no cointegration.

Valadkhani[5] **(2008)** investigated the long-run and the short-run relationship between money demand and its determinant variables among six Asian-Pacific countries during 1975-2002. The demand for money in the long-run positively responds to real income and inversely to the interest rate spread, inflation, the real effective exchange rate, and the US real interest rate and the long-run income elasticity is greater than unity.

1. Agenor and Khan, (1996).
2. Buch, (2001).
3. Dreger, Reimers and Roffia, (2006).
4. Tang, (2007).
5. Valadkhani, (2008).

However, in the short-run, the ECM test showed that only income, inflation and interest rate have significant effects on the change in M2 suggesting that currency substitution and capital mobility are only valid in the long-run period.

Jarko[1] **(2009)** a set of six countries is used to estimate money demand with panel cointegration methods over the recent disinflation period. Money demand is found to have been significantly determined by the euro area interest rates and the exchange rate against the euro, which indicates possible instability of money demand functions in the CEECs. The coefficient estimated for the interest rate in the euro Area (-0.06) is much larger than the coefficient of domestic interest rates (-0.002). The exchange rate is revealed to have negative effects on money demand, but the estimated elasticity is low (-0.03). This indicates that currency substitution does not play an important role in the CEECs. The Industrial production elasticity is 0.2 and significant.

Narayan, S and MishraIn[2] **(2009)** estimate a money demand function for a panel of five South Asian countries. They find that the money demand (M2) and its determinants, namely real income, real exchange rate, short-term domestic and foreign interest rates are cointegrated both for individual countries as well as for the panel. The estimated coefficient of real income, interest rate and exchange rate respectively are 1.23, -0.23 and 0.26. The test for panel Granger causality suggests short-run causality running from all variables, except foreign interest rate to money demand.

Abdullah ***et al***[3]**. (2010)** re-examine the demand for money in ASEAN-5 countries using the Autoregressive Distributed lag (ARDL) approach to cointegration analysis. They found that the income elasticity and the exchange rate coefficient are positive while the inflation elasticity is negative. This indicates that depreciation of domestic currency increases the demand for money, supporting the wealth effect argument and people prefer to substitute physical assets for money balances that support our theoretical expectation.

Saten ***et al*.**[4] **(2010)** used panel data estimation methods to estimate cointegrating equations for demand of money (M1) for a panel of 11 OECD countries during the 1975Q1-2008Q4. The estimation provides the

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1 . Jarko, (2009).
2. Narayan, and Mishra, (2009).
3. Abdullah, Ali and Matahir, (2010).
4 . Saten , Chowdhury and Rao, (2010).

estimated panel group cointegrating parameters for the random effects models with the Pedroni FMOLS method. According to estimation, the income elasticity, the coefficient of interest rate and the cost of holding money- exchange rate- are respectively 0.825, -0.012 and -0.03 but the rate of inflation is insignificant.

Dobnik[1] (2011) examines the long-run money demand function for 11 OECD countries from 1983Q1 to 2006Q4 using panel data and including real GDP, nominal three-month interbank rate, real effective exchange rate and real stock prices as wealth. By using dynamic ordinary least squares (DOLS) estimator, it is found that the impact of income and real effective exchange rate on money demand are positive respectively 1.64 and 0.14, while it is negative for the interest rate (-0.03) and stock prices (-0.15). The estimated (semi-) elasticities of money are larger for the common factors than for the original variables, except the income elasticity.

Imandoust and Ghasemie[2] (2011) avoid a prejudgment on the effective factors of Iran's money demand, Bayesian Model Averaging is utilized. As it is common, this approach is based on the estimation of a regression model for many times and estimation of coefficients with Bayesian Model Averaging. Data period is between 1976 -2007. Results show that GNP, CPI, formal exchange rate, ratio of budget deficit on GNP, lagged dependent variable and CPI with lagged have significant effects on demand of money.

Adam *et al*.[3] (2011) develop an econometric model of the demand for M2 in Tanzania, using quarterly data from 1998 to 2011. Portfolio behavior also responds to expected inflation and exchange rate depreciation, with weaker effects from interest rates. The long run effects of real gross national expenditure and monetary intensity of economic activity are 1.11 and 0.06 respectively but The spread between the T-bill rate and the rate on time deposits, inflation rate and the rate of nominal depreciation have negative effects as -0.27, -0.78 and -0.24. The components of M2 respond to opportunity costs as expected, with currency more sensitive to expected inflation and deposits more sensitive to the interest rate on government securities.

Bahmani and Bahmani-Oskooee[4] (2012) by using annual data from post revolutionary Iran (1979 to 2007) and the bounds testing approach to

1. Dobnik,(2011).
2. .Bafandeh Imandoust and Ghasemi (2011).
3. . Adam, Kessyb, Nyellac and O'Connelld, (2011).
4. .Bahmani, and Bahmani – Oskooee, (2012).

cointegration, discover another determinant of the demand for money, exchange rate volatility. Their results reveal that indeed, exchange rate volatility has both short-run as well as long-run negative effects on the demand for real M2 monetary aggregate in Iran. The results clearly indicates that the other three variables: income, inflation rate and the exchange rate do in fact have short-run effects and these short-run effects translate into the long run on the demand for money in Iran. Inflation rate carries its expected negative and highly significant coefficient as does the exchange rate. The long-run income elasticity is 1.0086 and highly significant.

Dharmadasa and Makoto[1] (2013) investigate the long run money demand function for Sri Lanka from 1978 to 2010 by using error correction version of autoregressive distributed lag (ARDL) approach while giving special attention to the effect of international financial crisis on money demand. Findings of the paper emphasized that M1 money demand in Sri Lanka is highly co-integrated with the real income; real exchange rate and short term domestic and foreign interest rates. Real income and financial crisis have positive effect but real exchange rate, domestic and foreign interest rates have negative impact on money demand.

3. The Model and the Method

According to Harb[2] (2003) money demand is formulated as following:

$$(M2R)_t = f(S_t, O_t)\,;\, fS > 0\,,\, fO < 0 \qquad (1)$$

Where $(M2R)_t$ is the quantity demanded of money, S_t is a scale variable and O_t is the opportunity cost of holding money. The variables used for the estimation of the money-demand function depend on the theoretical function of money. We estimate a money demand function (stock of real aggregate money) for the high-inflation country of Iran, by including real GDP (as a proxy to capture transactions and precautionary demand for money), inflation rate, which is measured by D(Log (CPI)) where CPI denotes the Consumer Price Index, the nominal market exchange rate, denoted by ER and the lagged liquidity.

$$M_2R = f(GDP, Inflation\ rate, Market\ exchange\ rate, M_2R(-1))$$

1. Dharmadasa & Makoto (2013).
2. Harb, (2003).

Usually, real GDP represents the real income and, therefore, the transactions volume in the economy. Economic theory suggests that income should have a positive effect on money holdings[1].

In developing countries, due to lack of well developed financial markets, rather than using the interest rate as the opportunity cost of holding money, researchers have often proxied it with the rate of inflation[2] in a high inflation country like Iran. For several reasons, the inflation rate is appropriate for measuring opportunity cost. First, financial markets are not well developed. Second, the interest rate has usually been set by the Iranian Central Bank and the government and remained fixed for extended time periods, which justifies why, in the case of Iran, the inflation rate is used as a proxy for the opportunity cost of holding money. Finally, in Iran real assets are considered more attractive than financial assets. This is because historically real asset prices have often increased at a much more rapid rate than the rate of return on financial assets. So, Due to lack of well developed stock market, most Iranians speculate in land or housing markets rather than in financial markets.[3]

Given the history of this country which, during periods of high inflation, have been experiencing a partial replacement of domestic by foreign currencies, we also include in the money demand equation − in addition to standard macroeconomic variables such as lagged money, real GDP and inflation− the exchange rate variable. The results from the empirical analysis show that a well-behaved money demand relationship can be identified only if the exchange rate − as part of the opportunity cost – is included. Therefore, the exchange rate is likely to be an important factor explaining money demand behavior in this country. As regards, there is a black market for foreign exchange, the black market exchange rate and not the official exchange rate included in the money demand function. Following these arguments, the open-economy version of money demand can be summarized as follows,

$$Ln\,(M2R)t = \gamma_0 + \gamma_1 \mathrm{Ln}\,(GDP)t + \gamma_2\, D(\mathrm{Ln}(CPI)t) + \gamma_3\, Ln(ER)t + \gamma_4 \mathrm{Ln}(M2/P(-1)) + \varepsilon\, t$$

Where *(M2R)t* is the real monetary aggregate. In our study, we used board money (M2) as monetary aggregate. The expected sign and magnitude of the coefficient for *real GDP* is as follows: if $\gamma_1 = 1$, the quantity theory applies; if γ_1=0.5, the Baumol-Tobin inventory-theoretic approach is

[1]. Foresti and Oreste,(2012).
[2] . Dreger and Wolters (2006).
[3] . Bahmani-oskooee, (1996).

applicable; and if γ_1>1, money can be considered a luxury or it might also be interpreted as an indication of neglected wealth effects. Ball[1] (2001) showed an income elasticity of less than unity has a number of implications for monetary policy. For instance, one may conclude that the Friedman rule is not optimal in this case and the supply of money should grow more sluggishly than output to achieve the goal of price stability.

It is also expected that the coefficient signs for inflation and exchange rate to be negative (*i.e.*γ_2 and γ_3<0).The rate of inflation is considered as a proxy to measure the return on holdings of goods, and its coefficient should be negative, *i.e.* γ_2 <0, as goods (*e.g.* real estate and shares etc.) are an alternative to holding domestic currency. The expected signs for this exchange rate is negative (or γ_3<0), supporting the currency substitution and capital mobility hypotheses. This basically means that the currency depreciation and a rise in the inflation rate can lead to a higher propensity to substitute away from domestic currency.

Finally, the estimation of γ_4 is expected to be positive. It means the liquidity in the previews period has a positive effect on money demand.

In this study, a money demand analysis in Iran is conducted using Generalized Method of Moments (GMM) which will be referring more detail in the following.

4. Data and methodology

4.1 . Data

We shall use quarterly data for Iran for the period 1990Q2-2013 Q1. The data period are selected because there are no gaps in the data on the variables and therefore our data set is balanced. The data used are as follows: *Ln (M2R)* = logarithm value for real money balances (M2); Ln (*GDP_SA*) = logarithm value for real GDP (1995=100) by seasonal adjusted; *Ln(ER)* = logarithm value for market Exchange rate, *D(Ln(CPI))*=D(logarithm consumer price index); Ln(*M2/P(-1))* = logarithm value for lagged real money balances and εt represent the disturbance term. The data is obtained from Central Bank of Iran (CBI).

4.2 . Methodology

GMM is one of the parameters estimation methods in time series data. GMM estimation was formalized by Hansen (1982), and since has become one of the most widely used methods of estimation for models in

[1] . Ball,(2001).

economics. GMM is a robust estimator in that, unlike maximum likelihood estimation (MLE), it does not require information of the exact distribution of the disturbances. Only specified moments derived from an underlying model are needed for GMM estimation. In some cases in which the distribution of the data is known, MLE can be computationally very burdensome whereas GMM can be computationally very easy.

In models for which there are more moment conditions than model parameters, GMM estimation provides a straightforward way to test the specification of the proposed model. This is an important feature that is unique to GMM estimation.[1]

This method considers the effect of dynamic adjustment of dependent variable. If lagged dependent variable used in the model, there would be a correlation between explanatory variables and error terms. So, usage of OLS will show biased and inconsistent results. GMM method can solve this problem by using instrument variables.[2] For algebraic and mathematical expression of GMM consider the following:

$$y_t = z_t\delta_o + \varepsilon_t,\ t = 1, \dots, n \qquad (2)$$

Where z_t is a vector of explanatory variables, δ_c is a vector of unknown coefficients, y_t is dependent variable and ε_t is a random error term. The model (2) allows for the possibility that some or all of the elements of z_t may be correlated with the error term ε_t, i.e., $E[z_{tk}\varepsilon_t] \neq 0$ for some k. If $E[z_{tk}\varepsilon_t] \neq 0$ then z_{tk} is called *an endogenous variable*. It is well known that if z_t contains endogenous variables then the least squares estimator of δ_o is biased and inconsistent.

Associated with the model (2), it is assumed that there exists a K ×1 vector of *instrumental variables* x_t which may contain some or all of the elements of z_t. Let w_t represent the vector of unique and non-constant elements of $\{y_t, z_t, x_t\}$. It is assumed that $\{w_t\}$ is a stationary and stochastic process.

The instrumental variables x_t satisfy the set of K orthogonal conditions.

$$E[g_t(w_t, C)] = E[x_t\varepsilon_t] = E[x_t(y_t - z_t\delta_o)] = 0 \qquad (3)$$

Where $g_t(w_t, \delta_o) = x_t\varepsilon_t = x_t(y_t - z_t\delta_o)] = 0$. Expandindg (3) gives the relation

$$\sum xy = \sum xz\,\delta_o$$

[1].Richards (2013).

[2].Asgharpur, Salmani, Feshari, and Dehghani, (2011).

Where $\sum xy = E[x_t y_t]$ and $\sum xz = E[x_t z_t]$. For identification of δ_o, it is required that the K×L matrix $E[x_t z_t]=\sum xz$ be of full rank L. This *rank condition* ensures that δ_o is the unique solution to (3). Note, if K = L, then $\sum xz$ is invertible and δ_o may be determined using

$$\delta_o = \sum\nolimits_{xz}^{-1} \sum\nolimits_{xy}.$$

A necessary condition for the identification of δ_o is the *order condition*

$$K \geq L \qquad (4)$$

Which simply states that the number of instrumental variables must be greater than or equal to the number of explanatory variables in (2)? If K = L, then δ_o is said to be (apparently) just identified; if K > L, then δ_o is said to be (apparently) over-identified; if K < L, then $\delta_o$is not identified.

The word “apparently” in parentheses is used to remind the reader that the rank condition

$$Rank\ (\textstyle\sum xz) = L \qquad (5)$$

must also be satisfied for identification.[1]

After estimating the coefficients, it's necessary to use Sargan Test for evaluating the validity of defined instrumental variables in the model and for over identifying restrictions of equation which are satisfied. Moreover, if there are more moment conditions than parameters, then GMM proceeds in a fashion familiar from IV estimation. It makes a linear combination chosen to minimize the asymptotic variance of the estimator – and ensure zero sample correlation between this linear combination and the residual (Gallant 1987; Newey and West 1987b). We refer to the use of it as *"J test"*. This test ties naturally to criterion function – based tests of parametric hypotheses.[2] Sargan test (1985) is asymptotically chi- square which is defined as follows:

$$J = \hat{\varepsilon}\, z\Big(\sum z' H z\Big)^{-1} z' \hat{\varepsilon} \sim \chi^2(K-L)$$

In this criterion function, $\hat{\varepsilon} = Y - Z\hat{\delta}$ which $\hat{\delta}$ is GMM estimator and also it is a $K \times 1$ matrix of estimated parameters, x is matrix of instrumental variable and H is a square matrix which it's dimensions is $(T-q-1)$. T and q denote number of observation and number of explanatory variables respectively. In this test, if the null hypothesis does not reject, instrumental variables will be valid in the model and the model does not need to define

[1]. Richards, (2013).
[2].Hansen and Kenneth,(2002).

additional instrumental variables. However, if the null hypothesis is rejected, instrumental variable will be insufficient and should define more appropriate instrument variables in the model.[1]

5. Empirical Results

This section presents the results of a small-scale survey of monetary demand in terms of the GMM technique.

To estimate the model by GMM, it's necessary to specify the instrument variables which used. For this purpose, the lag of the dependent variable and the lag of independent variables such as EX(-1), GDP_SA(-1) in additional to oil price and the lag of long run interest rate were applied as instruments variables. Anderson and Hsiao (1981[2], 1982[3]) observed that lags of the data are valid instruments, so IV estimation of equation is appropriate.

Since there are instruments equivalent to right-hand-side variables, the estimated regression was identified. To assess the validity of the different specifications, we computed the Sargan (1964) test for identifying restrictions, which amounts to a test of the exogeneity of the explanatory variables.

The money demand relationship is specified here in the standard way, with a scale variable and a proxy to capture the opportunity costs of holding money (see Laidler[4] (1993) for a comprehensive survey on money demand issues).

The first step of the empirical analysis investigates the properties of our time series data. Hence, before testing the model, unit root tests were conducted to check the presence of unit root in variables. From these tests, it can be concluded that there is a clear evidence for stationary or non-stationary of variables. The results of the ADF[5] and KPSS[6] unit root test are presented in Table 1. It should be noted that the null hypotheses are different in these two unit root tests. The null hypothesis of ADF mentions that there is a unit root. KPSS proposed a test of the null hypothesis that an observable series is trend stationary (stationary around a deterministic trend). The series is expressed as the sum of deterministic trend, random walk, and stationary error, and the test is the Lagrange multiplier test of

[1]. Asgharpur, SalmaniFeshari and Dehghani, (2011).
[2]. Anderson and Hasio, (1981).
[3]. Anderson and Hasio, (1982).
[4]. Laidler, (1993).
[5].Augmented Dickey – Fuller, (1979)
[6]. Kwiatkowski – Phillips – Schmidt – Shin, (1992)

the hypothesis that the random walk has zero variance. KPSS type tests are intended to complement unit root tests, such as the Dickey–Fuller tests.[1]

Table 1: Results of Unit Root Test

Variables	ADF		KPSS	
	Level	1st Difference	Level	1st Difference
lm2r	-0.693	$-2.959^{**,*}$	1.183	$0.236^{***,**,*}$
dlcpi	-2.311	$-11.067^{***,**,*}$	0.160	$0.112^{***,**,*}$
lgdp_sa	-2.051	$-10.517^{***,**,*}$	1.217	$0.303^{***,**,*}$
lex	0.052	$-9.409^{***,**,*}$	1.134	$0.112^{***,**,*}$

Source: Computed based on the data from CBI
*, **, *** shows significant at 10%, 5% and 1% significant level respectively (ADF= -2/894, KPSS= 0/463)

As indicated in Table 1 all of the variables used in this research are first order integrated or I (1). Since by difference, we lose valuable information on levels of variables, for avoiding a spurious regression and also evaluating the stationary of the model we can use co-integration tests to estimate the long run relationship between M2R and the independent variables. So, in this paper, we propose robust procedures for a residual-based test of co-integration when the data are generated by a unit root process.[2] If I(1) variables are co-integrated, this means that although they are individually non-stationary, they are moving together so that there is some long run relationship between them. Cointegration can thus be seen as the existence of a long run relationship between variables and economic theory leads us to expect that cointegration should exist. Cointegration is a long run property of variables. In the short-run, the variables can be moving in different ways, driven by different dynamic processes. However, cointegration ties the variables together in the long run.

If a set of variables are co-integrated, then the residuals from a static regression of any variables will be stationary. If not, then the residuals will be integrated.

The results of Co-integration test has shown in the next table. Augmented Dickey-Fuller and KPSS tests on the GMM residuals from a static regression provide a way of testing cointegration.

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[1]. Mahadeva and Robinson, (2004).
[2]. Hjalmarsson and Österholm, (2007).

Table2: The result of co-integration tests

Test for Unit root in Level and Intercept included in test equation			
Residuals		ADF	KPSS
Test statistic		-5.0940	0.3907
Critical values	1%	-3.5074	0.7390
	5%	-2.8951	0.4630

Source: Computed based on the data from CBI

According to last results, the residuals are I(0), so the series are cointegrated. It shows that our model has empirically meaningful relations.

Table 3 shows the results of the benchmark regression in detail. The variables employed in this study are given in the first column of Table 3. Column two contains a short description of the variables.

Table 3: Result of Model Estimation by GMM

variables	Description	Coefficients	Std.Error	t-statistic	Prob.
c	Intercept	-1.60	0.90	-1.76	0.081
d(l(CPI))	Differential of log of CPI	-0.69	0.22	-3.18	0.0021
LGDP_SA	Log of real GDP- seasonally adjusted	0.25	0.14	1.80	0.0765
L(m2R(-1))	Log of real money M2(-1)	0.89	0.07	13.0	0.0000
LEX	Log of market exchange rate	-0.02	0.01	-2.17	0.0326
AR(2)	-	0.45	0.08	5.87	0.0000
R^2= 0.99		D.W= 2.159			
J- Statistic =0.0287					

Sources: Computed based on the data from CBI

In view of the theoretical and empirical evidence, we estimate the demand for real money, i.e. price homogeneity has been imposed. In general, the results of money demand studies seem to be quite robust with respect to the specific choice of the deflator. Here the general consumer price index has been chosen as a deflator for money variable.

Although there are a variety of theoretically acceptable specifications of a demand for money function, especially regarding the opportunity costs of money, we have picked for a simple model. This allows the analysis to proceed with a relatively large number of degrees of freedom, leaves enough observations for out-of-sample analyses, and avoids the danger of over-fitting the equations to the specific samples at hand.

Since there are rigidities in the real world, the inflation rate may help to explain money growth. In addition, inflation may be a proxy for the yield of real assets and if real assets play an important role in investor's portfolios, it will influence the decision to hold money. These considerations are supported by our empirical result that inflation is significant as a regressor in the transaction-dominated money growth equation.

In particular, the coefficient of our inflation is negative and significant at a 1% level. Given the log-linear setup, this implies that a 1 percent increase in the inflation is associated with a 0.69 percent reduction in the money demand. This result suggests that the demand for money has also implications for portfolio decisions in Iran. On the other side, an increase in the rate of inflation immediately encourages agents to diversify their portfolios by reserving real assets amongst other things.

In this study, the negative coefficient of market exchange rate is also consistent with the argument of which emphasized that depreciation of the domestic currency has derived the expectation of further depreciation and resulted in less holding of domestic currency and more holding of the reserve currency, the dollar. It is significant at the 1% level. The LEX coefficient suggests that 1 percent increase in exchange rate lead to 0.02 percent decrease in monetary demand.

Under these circumstances individuals may either diversify their portfolios in the economy by substituting other currencies ($US, Euros, etc) for domestic currency in their financial portfolio or can acquire other financial and/or real assets (say shares, gold and real estate property).

In the specific case at hand, during periods of high inflation, Iran experienced a partial replacement of domestic by foreign currencies, either as a store of value or a medium of exchange.

In the following, the real GDP elasticity (0.25) shows positive and smaller than unity coefficient. The effect of GDP is accordance with the macroeconomic theories but insignificant at the 5% level although it is significant at the 10% level.

The coefficient for lagged real money implies a speed of adjustment of about 089 percent per quarterly of the difference between actual and long-run equilibrium. The t-statistic implies that this variable is statistically significant at one percent confident level.

It is necessary to explain that the presence of AR(2) variable in the model implies that there was second order autocorrelation in error term.

For this reason, by placing AR(2) we resolve this problem. Durbin Watson statistic is 2.159 which shows there is not autocorrelation between errors in our model.

The R-square of 0.99 is reasonably high suggesting that about 99 percent of the variations in money demand are explained by the variation in real GDP, lagged M2, market exchange rate and inflation rate.

Sargan test results indicate that we cannot reject the null hypothesis and defined instrumental variables are valid. J-statistic is 0.0287 which is smaller than critical value of χ^2distribution. The small J-statistic indicates a correctly specified model.

On the basis of the above estimates, we may conclude that for the whole sample period estimates of GDP elasticity are slightly lower than unity and money demand is responsive to changes in the cost of holding money.

6. Summary and Conclusion

Estimation of money demand function gathered considerable interest because of its implication to policymakers and researches when planning monetary policy. The prime objective of this paper was to examine the money demand function in Iran while emphasizing the influence of exchange rate crisis on it. In this regards, we believe that in 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 money demand equation. This paper has used GMM technique to estimate the demand for money (M2) in Iran for the entire sample period of 1990Q2 to 2013Q1. The Generalized Method of Moments (GMM) approach is employed as the main estimation technique to test the presence of relations among variables which are assumed to be the determinants of money demand in Iran. According to empirical literature and the main emphasis of paper, we involve real GDP, inflation rate, lagged real M2 and market Exchange rate in addition to instrumental variables. This paper extends the proposition of including exchange rate as an additional determinant to money demand function.

The ADF (1979) and KPSS (1992) test for unit roots support the view that all the variables appearing on a standard money demand function are I(1).The Engle-Granger two-step procedure has then been employed to test for cointegration. The results of cointegration test clearly indicate that in the long-run there is a cointegrating vector, which links the real demand for M2 with explanatory variables. In the other words, the residuals of GMM regression are I(0) or stationary.

The findings are consistence with previous findings related to Iran and also they are consistence with macroeconomic theories. The results show a significant positive relationship between real money balances (M2) and the real income, using the Gross Domestic Product (GDP) as a proxy. This implies that the increase in real GDP (income) could make money available for transaction purposes, which would be absorbed in the economic activities.

The relationship between money demand and inflation is significant and negative as expected. This is in line with previous studies and support the theory that an increase in the general price level would reduce the value of real money balance, and hence, the demand for money. So, there is a strong incentive for Iranian to switch out of money and into real assets when there are strong inflationary expectations.

The coefficient of market exchange rate in money demand function is significant and negative which indicates substitution effect between domestic currency and foreign currency. It shows when exchange rate increases (depreciation of domestic currency), people increase demand for foreign currency and reduce the demand for domestic currency in order to avoid reduction in their purchasing power. However, if the depreciation of domestic currency induces the expectation of further depreciation, the opposite effect would take place with the public deciding to hold more foreign currency and less domestic currency.

Since the paper gave a special attention to the exchange rate crisis, the results of the estimation confirm that exchange rate crisis can have an influence on money demand in Iran. This condition could be more important for monetary policy makers to control the supply of money during an exchange rate crisis to avoid systemic banking crises and the volatility in the money market. In addition, market exchange rate variable provide a clue for monetary authority and the government that external factors should be taken into account when formulating future monetary policies in the country.

The lagged M2 impact is highly significant and positive suggesting that money demand is basically determined by last year monetary aggregate in Iran. Given the higher inflation elasticity of money demand, it can be concluded that the monetary policy in Iran must target inflation rate and simultaneously monitor the impacts of changes in the commodity prices, monetary aggregates and growth on inflation rate.

For future empirical work, a choice of other opportunity cost variable, instead of inflation rate and using volatility of exchange rate could be considered for demand estimation. There is also a need for future empirical work to examine in detail the relationship between money demand and inflation rate in order to shape policy efforts by the authorities. Future research need to take note of the type of model and data they use and bear in mind the impact that arise from different observations and models when comparing results.

We hope that our paper will provide incentives for further work to improve time series data estimation methods.

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