

## A critical Discussion about Demand for Money Studies in the Iranian Economy (1989-2000)

Sayyed Mahdi Mostafavi\*

&

Kazam Yavari\*\*

### Abstract

This paper provides a critical review of the demand for money estimation. In doing so, first we explain the main effective factors on the demand for money on the light of monetarists, which those are: transaction demand for money and opportunity cost of holding money. Then I have done a short report about the existing studies on the demand for money in the Iranian economy and have a special attention to their defects and problems. Some of them are as follow:

Including the wrong factors on the demand for money model which in turn it leads to double calculating the budget deficit, making mistake to compute the data regarding to data conversion, including a stationary variable on the co-integration regression, and as a result obtaining wrong magnitudes for some coefficients in the model and finally the lack of offering interpretation for money income elasticity.

**Keywords:** demand for money, inflation real money rate of interest exchange rate co-integration, estimation, GDP, M1 and M2.

### 1- Introduction

This paper's objective is to provide a critical review of literature concerning demand for money in the Iranian economy. In the simplest terms, demand for money is the amount of money, which people wish to hold, a factor, which is effectively determined by wealth constraints, which have a positive effect, and by the opportunity cost of holding money<sup>1</sup>, where the effect is negative, (Friedman, 1959).

---

\*- Academic staff, Faculty of Economics, University of Ferdowsi, Mashhad, Iran.

\*\* - Corresponding Author-Associate Professor of Economics, TMU, and Vice President, Research, ITSIR

1- The value of money that which must be given up to acquire or achieve the liquid assets.

Demand for money has attracted the attention of monetary economists since the mid-eighteenth century or even earlier, because it relates to the main macroeconomic issues of inflation, unemployment, levels of income, interest rates, financial markets and the banking system. Basically, demand for money theories can be analysed under two major headings:

**A. The transactions demand for money:** this type of demand for money happens when there is a distance of time between income and expenditures. The transaction motive of demand for money can usually be explained via real wealth, permanent income or current income (depending on the theory).

**B. Opportunity cost of holding money:** this type of demand for money occurs when an individual makes a comparison between the rate of return on money and its proxies (bonds, equities, and durable goods). The opportunity cost of holding money is related to the role of money as a store of value. The rate of interest, the rate of inflation or the rate of change in the price of durable goods<sup>1</sup>, are relevant factors here.

According to Friedman (1956) and Goldfeld (1973), the theoretical specification for the money demand function is given by:

$$M = f(Y, i, P) \quad (1)$$

Where M, Y, i, and P stand respectively for nominal money stock, income, nominal interest rate and price level. This function could be stated as real terms for all variables except interest rate:

$$m = f(i, Y / P) \quad (2)$$

where: m is real money stock, and has been obtained by deflating nominal money stock by consumption price index and Y/P is real income. Obviously in the equilibrium circumstance where money demand is equal to money supply ( $m^d = m^s$ ), m should be equal to  $m^d$ . Hence (2) is equivalent to

$$M^d = f(i, Y / P) \quad (3)$$

---

1- For example some studies applied foreign exchange in their work. (See: Nazemzade (1983), Amirsharafi (1991), Nowferesti (1995), and Emadzade (1990) in this paper.

In order to derive easily interpreted formulations of (3), so as to display a direct estimation of the factors, and to state the elasticity of the demand for money in relation to variations each in separate factor, the variables may be defined in logarithmic form as follows:

$$M^d - p = c + \alpha (y-p) + \beta i \quad (4)$$

Where,  $y$  stands for income. According to the demand for money theory  $\alpha$  is positive and  $\beta$  is negative. Since data for aggregate income is not accessible, a conventional proxy called GDP is used in its place. The opportunity cost of holding money may involve factors like the rate of money interest, the inflation rate and the rate of return of foreign exchange. In choosing the relevant factors in the money demand function, a good understanding of the economic situation in the subject country is needed.

An important point in conventional models of money demand is to find the most appropriate variable for denoting the opportunity cost of holding money<sup>1</sup>. In developing countries like Iran where there is not an efficient financial market, the rate of interest cannot explain the demand for money, and so researchers use inflation rates, rates of return on durable goods, investment over GDP or investment over non-oil GDP instead. But some studies tend to use the price of goods rather than their rate of return. Yet when people wish to demand money, the factor that can demonstrate their amount of demand, is first differences of goods prices. This represents a considerable shortcoming in the demand for money.

The paper consists of four sections. Section 2 reviews a short report of the previous studies related to the demand for money in Iranian economy and a critical discussion about them. Section 3 consists seven main points related to the existing studies on the demand for money in Iranian economy. Section 4 is concluding remarks.

---

1- The income or benefit foregone as the result of not putting the money in bank or buying share or any other using money.

## 2- Existing studies on the Iranian Economy

The determinants of the demand for money have been the subject of a long debate among Iranian economists over the last two decades and it has attracted the attention of many writers. We therefore examine in detail some of the most important models derived from empirical sources, which are closest to a preferred model. Hence this paper could help us to design an appropriate model for the Iranian economy.

A summary of the Iranian studies is presented in the following Table.

**Table 1: A summary of empirical studies in the Iranian economy**

Author	Date of study	Frequency	Period of study	Dependent variable(s)	Determinants	Range of elasticity	Method of Estimation	Functional form
Hajean	1989	A	1968-85	M1, M2, M3	GDP, $E\pi$ , $Ei$	-0.63, 0.03	ML	SL
Emadzade	1990	A	1959-1986	M2	BD/GB, P, GDP	-0.87, 0.07,	ML	DL
Jalae	1991	A	1959-1988	M1/P, M2/P	GDP/P, $\pi$ , $i$ , D(1979)	-25.56, 0.001	OLS, ML	L, DL
Amirsharafi	1991	A	1967-87	M1, M2	$f_i$ , $E_x$	-0.6, 0.3	ML	DL
Khashadorian	1992	A	1959-1980	RM1, RM2	RGDP, $\pi$	-1.72, 0.27	ML	DL
Falihi	1994	A	1970-1990	M1, M2	$E\pi$ , $B_i$ , $Eb_i$ , GDP, D (1978)	-1.6, 0.08	ML	DL
Nowferesti	1995	A	1959-1992	M1	GDP, $x$ , $\pi$ , D(1979)	-8.17, 0.07	OLS	L
Bahmani-Oskooee	1996	A	1959-1990	M1/P, M2/P	$B_x$ , $\pi$ , GDP/p	-1.39, 0.25	ML	DL
Esmaeelnia	1996	Q	1980-95	M1	$B_x$ , GDP, $E\pi$	-0.25, 0.002	ML	DL
Tavakkoli	1996	Q	1972-1990	M1	GDP/p, $\pi$	-5.67, 0.10	ML	DL
Pesaran	1998	A, Q	1961-97 1974-94	PCM2, M2/p	PCGDP, $\pi$ GDP/p, $\pi$	-4.0, 0.51	ML	DL
Moradi	2000	A	1959-1996	RPCM2, RPCMB	RPCGDP, $E\pi$	-4.31, 2.09	ML	DL

Where: M3 stands for quasi money,  
 BD for budget deficit, GB for government budget,  
 R for real, M/P for real money stock (deflated by CPI),  
 $i$  for interest rate,  $\pi$  for inflation,  
 $B$  for black market rate or parallel rate,  $f$  for foreign,  
 PC for per capita,  $E$  for expected,  
 DL for double log, SL for semi-log, L for linear,  
 A for annual, Q for quarterly, M for monthly,  
 D for dummy variable in Iranian revolution,  
 ML is maximum likelihood and OLS is ordinary least squares.

As the range of parameters show, these figures are the range of elasticities when functional form is double log, and it is the range of elasticities at the mean when the functional form is semi-log, and finally it does not show the elasticity when the functional form is linear. The existing studies are reviewed in a chronological order:

**Hajejan (1989)** estimates demand for money stock using annual data for the years 1968 through 1985. One of the novel approaches of this study is to try M1, M2, along with M3, M1 being narrow money, M2 private sector liquidity and M3 quasi money<sup>1</sup>. The set of explanatory variables in this work includes nominal income, the expected rate of inflation and the expected rate of interest. These two expected rates are calculated by using the adaptive expectations mechanism, using a semi-logarithmic<sup>2</sup> model for money demand. Since Hajejan (1989) uses data from pre and post revolutionary period, it uses the maximum rate of nominal interest in saving deposits for the old banking system, and the long-term interest rate for saving deposits in the post revolutionary period.

Hajejan regressed broad money on income, expected<sup>3</sup> rate of inflation, expected rate of money interest, and lagged dependent variable in a semi-logarithmic form function. The income elasticity<sup>4</sup> equals to 0.36, the corresponding elasticity for the expected rate of inflation is to be -0.03, the corresponding elasticity for the expected rate of money interest is to be -0.63,  $M2_{t-1}$  elasticity equals to 0.67. As Durbin Watson statistic ( $DW = 1.26$ ) shows, there exists autocorrelation problems among error terms. Hence Hajejan added dummy variables  $D_1$  and  $D_2$  for revolution and war respectively, and reestimated the model. In this circumstance autocorrelation problem is removed, ( $DW$  changed from 1.28 to 1.98), and corresponding coefficients have been slightly changed. The estimated parameter signs are consistent with the theory but the value of inflation is low. In other words the absolute value of the coefficient of the expected rate of inflation is low (0.03), whereas the coefficient of expected rate of interest is not low (-0.63). These values are unexpected, because it seems that the official interest rate in Iran cannot denote the opportunity cost of holding

---

1- M3 has calculated in Central Bank of Iran as  $M2 - M1$ .

2- i.e log of dependent variable, but linear on the right hand side.

3- by applying adaptive expectations mechanism

4- these elasticities are calculated at the mean

money. Hence it might be mis-specification in functional form, which is semi-logarithmic, rather than double log.

**Emadzade (1990)** investigates the demand for money during the period 1959-1986, based on annual data. The difference between his model and the others is the inclusion of the ratio of the budget deficit (BD) to the government budget (GB) as a variable to denote opportunity cost of holding money. He argues that if the government finances its BD by issuing bonds, the interest rate will increase and so the demand for money will come down. Also, he mentioned that the BD incurred by increasing income levels could change the demand for money. As a result, he concluded that there was a positive relationship between MD and BD and his suggested model is as follows:

$$(M2/p)_t = a_0 + a_1 y_t + a_2 CPI_t + a_3 (M2/p)_{t-1} + a_4 (BD/GB)_t + U_t \quad (5)$$

Where: M2/p is real broad money stock; y is GNP at constant prices (1974), CPI is the consumer price index; BD/GB is the ratio of budget deficit over the budget government; and all factors are in natural logarithms.

The author has estimated this model and the result is as follows:

$$(M2/p)_t = -8.3 + 0.873 y_t + 0.076 CPI_t + 0.268 (M2/p)_{t-1} + 0.213 (BD/GB)_t + U_t \quad (6)$$

(-7.6) (15.2) (0.95) (3.9) (6.1)

Where the t statistic is in brackets. In this model the coefficient of CPI is not significant and DW shows that there is a positive autocorrelation between error terms. Emadzade then tried two other conventional methods: Cochrane-Orcutt and Hildreth-Lu. The results of these are respectively as follows:

$$(M2/p)_t = -7.51 + 0.659 y_t - 0.18 CPI_t + 0.614 (M2/p)_{t-1} + 0.119 (BD/GB)_t + U_t \quad (7)$$

(-10.04) (12.2) (-2.6) (8.15) (4.4)

$$R^2=0.996 \quad DW=1.98 \quad F=1582$$

$$(M2/p)_t = -7.39 + 0.656 y_t - 0.175 CPI_t + 0.616 (M2/p)_{t-1} + 0.115 (BD/GB)_t + U_t \quad (8)$$

(-9.65) (11.75) (-2.53) (8) (4.19)

$$R^2=0.996 \quad DW=1.98 \quad F=1577$$

All of the signs are consistent with the theory. The values indicate that the null hypothesis can be rejected for all of the variables. The coefficient of determination is very high<sup>1</sup> (0.996), and the F calculated value shows that the whole equation in the two procedures is significant. Finally the DW statistic in both equations makes it seem that there is no autocorrelation in the model. The latter two methods have been accepted in the study and although the method of Cochrane-Orcutt is invalid according to the modern time series, but it has been followed in this study.

Emadzade has applied conventional techniques in his work, and it needs the economic analysis of time series and co-integration. Moreover using BD /GB in the demand for money function is unusual. Since the major part of budget deficit has been financed through borrowing from the central bank, money stock contains budget deficit. Hence using this variable in demand for money function leads to the problem of recalculating the budget deficit. Once it is a part of GDP, and a second time it is a determinant explicitly.

**Jalae (1991)** presented an estimate of the demand for real money by using annual series from 1959-1988. One of the objectives of this study is to investigate whether monetary policy in the Iranian economy is independent of fiscal policy or dependent on it. The other target of Jalae's work is the effect of the revolution (1979) and eight years of war (1980-1988) on the demand for money. The function of demand for money used in this work has three features: a simple model (containing real GDP inflation and a dummy variable for the revolution), a partial adjustment model, and a model of expected income for money demand, while the range of independent variable elasticities for M1 is between 0.04 and 34.04 and for M2 is between 0.001 and 25.56.

In each case Jalae considered two functional forms: linear and double log. He analysed M1 and M2 in his study. Regarding the simple model, Jalae concluded that demand for money determinants for real M2 is more reasonable than for real M1. He further concluded that since the interest rate is determined by the government according to the last period information, it is not a real rate, and as a result it has no significant coefficient in either real M1 or M2 functions. Moreover, the inflation coefficient in real M1 model has a positive coefficient,

---

1- this figure is not reliable, because the author applied conventional technique.

which is unusual. He then excluded these two determinants and re-estimated the model, with the conclusion that real income coefficient is equal to 0.22, inflation coefficient is equal to 22.64, and dummy coefficient is equal to 25.56. He then moved to the double log functional form (i.e. logarithms of real M2, real GDP, inflation, but without a dummy variable). The real income, inflation and dummy elasticities are: 0.52, -0.001, and 0.14 respectively. The inflation elasticity in this equation is statistically insignificant, perhaps because of incorrect values for the variable (logarithm of inflation rather than inflation<sup>1</sup>).

Jalaei came to the following conclusions: (1): Income coefficient in all cases is significant and in the linear case for real M1 it is equal to 1.07, which indicates that income elasticity for money is more than one, whereas it is less than one for other cases. (2): The lag dependant variable in all cases is statistically non-zero, which indicates that the role of expectations is important in money demand function. (3): The interest rate coefficient is insignificant in all cases, which indicates that it has no real magnitude.

The inflation rate coefficient in all cases is significant but has a very low magnitude (around 0.01), which indicates inflation does not affect the demand for money. It seems that inflation should be effective on demand for money, but the reason for its low value coefficient is the use of its logarithm rather than its original value.

**Amirsharafi (1991)** presented two demand for money models by using annual data for the period 1969-1986. He placed considerable emphasis on interest rates and pointed out that an important issue in developing countries is how the interest rate in these countries may be determined citing that the disequilibrium in the money market leads to fluctuations in interest rates. He also considered the effect of world factors such as foreign interest rates and expected rates of foreign exchange on the domestic rate of interest. He then proposed two models for money demand.

In the first model the demand for money depends on GDP, money stock in the previous period, the expected rate of inflation, and  $IFE_{t-1}$ , which IFE is the world interest rate plus the rate of return in foreign exchange. The income elasticity for money demand is equal to 0.3, and the inflation elasticity for

---

1- See Thomas (1997).



money demand is equal to 0.6, and the interest rate elasticity is equal to 0.05. These coefficient values are low although they have consistent signs with theory.

In the second model, Amirsharafi uses a partial adjustment mechanism. He obtains the foreign interest rate by three methods: It uses the interest rates in America, Japan, Britain, Germany and France, but also uses the official interest rates in the Iranian economy, and was therefore unable to achieve the rich desired results.

**Khashadoorian (1992)** presents the estimates of the demand for real money by using annual data for 1959 through 1980. The effective determinants in this study are real GDP and the expected rate of inflation. The former shows transaction demand for money and the latter shows the opportunity cost of holding money. This study uses the partial adjustment mechanism, with the adjustment coefficient value equals to 0.16<sup>1</sup>. It shows that the adjustment process in the Iranian economy is very slow (i.e adjustment over a six year period), demonstrating that the money market is in long-run equilibrium situation. All of student-t probability values for parameters are less than 2%, so the parameters at least on 98% level of confidence are significant. The study concludes that moving to an advanced model for adjustment is needed. In the long-run, the income elasticity equals to 1.72, significantly more than unity, which is usual for developing countries. The inflation coefficient is equal to -0.27. This figure is very low and it might be that the financial structure of the Iranian economy is inefficient and people's options for using their money in their portfolio are insufficient, or misspecification of the model.

**Falihi (1994)** estimated the demand for money for the years 1970-1990. The set of explanatory variables includes: the expected rate of inflation, ( $\pi^e$ ), the unofficial<sup>2</sup> expected rate of interest ( $fi^e$ ), the unofficial rate of interest ( $fi$ ), GDP, the revolution is represented by a dummy variable ( $D: 1978$ ), the rate of interest, and the black market exchange rate. The partial adjustment mechanism has been used in calculating the rate of expectations. His money demand function is as:

$$M2 = \alpha_0 + \alpha_1 GDP + \alpha_2 \pi^e + \alpha_3 fi^e + \alpha_4 i^e + \alpha_5 D(1978) + \alpha_6 RM2_{t-1} + e_t \quad (9)$$

---

1- Khashadoorian, 1992: 249.

2- Falihi calculated unofficial rate of interest through the free market in private sector.

where  $\alpha_6 = 1-\lambda$ , and  $\lambda$  is speed of adjustment. He concluded that the expected rate of inflation, the unofficial expected rate of interest and the unofficial rate of interest have an inverse effect on the demand for money. Additionally, GDP and the revolution are significant in the model with a positive coefficient.

Falihi estimated narrow money and broad money, and in each case he tried the expected rate of inflation and the expected unofficial interest rate separately. In the short run the income elasticity for money demand equals to 0.83. Moreover the expected inflation rate elasticities equal to  $-0.31$  and  $-0.44$  for M1 and M2 models respectively, whereas the expected unofficial interest rate elasticities are  $-0.08$  and  $-0.11$  for M1 and M2 models respectively. Falihi further estimated money demand in the long run. He concluded that income elasticities for M1 and M2 are 1.33 and 1.6 respectively. Moreover, the expected rate of inflation elasticities for two definitions of money are  $-0.44$  and  $-0.69$  respectively, whereas the expected unofficial interest rate elasticities are  $-0.1$  and  $-0.19$  respectively. The other point in his research is the speed of adjustment. According to the Table 15 of his thesis, the range of correspondent figures for this statistic is between 0.55 and 0.75 in alternative models. This range indicates that in every period a considerable gap between desirable and real values for money demand removes.

**Nowferesti (1995)** investigates the relationships among demand for money, GDP, the exchange rate and the rate of inflation. His empirical study represents estimation for money demand in Iran using annual data for the period 1959-1992. He concludes that the signs for the coefficients of both the exchange and the inflation rates are negative, and are statistically significant. In examining the structural change in the post-revolutionary period, he divides the period covered by his study into two parts: before and after the revolution of 1979. He estimates the model for these two periods and applied the Chow test. He concludes that the null-hypothesis of no structural change could be rejected, and that demand for money underwent a structural change at the time of the revolution due to the special political-economic conditions, which caused people to what their portfolio of assets. He then estimates a model using the OLS method and includes a dummy variable for the revolution. The result is as follows:

$$\begin{aligned}
 RM_t = & -124.91 + 0.075GNP - 8.05P_t - 2.64r_t - 0.26Ex + 0.64RM_{t-1} + 830.04D(1979) + u_t \\
 & (-1.49) \quad (5.51) \quad (-2.02) \quad (-0.16) \quad (-3.86) \quad (8.74) \quad (5.51) \\
 R^2 = & 0.993 \quad \quad \quad DW = 1.62 \quad \quad \quad F = 719.4 \quad \quad \quad (10)
 \end{aligned}$$

Where: RM is the real narrow money stock, P is the inflation rate, r is the rate of interest for time deposit, Ex is the exchange rate, and D (1979) is the dummy variable for the time of the revolution, which is equal to zero for the period up to 1979 and is equal to 1 for the post revolutionary period. The figures in brackets are the t ratios.

These figures show that the coefficient of the interest rate for time deposits was statistically insignificant. A possible reason for this was the inefficiency of the financial markets. Since after the revolution, the Economy Council on Money and Credit determined the rate of interest, on the basis of the economic conditions of the previous year. Yet the real interest rate during the post-revolutionary period was almost always increasing and was significantly higher than the official rate. As the coefficient of the interest rate is insignificant, the author has excluded this factor and re-estimated the equation. The result is as follows:

$$\begin{aligned}
 RM_t = & -134.26 + 0.074GNP - 8.176P_t - 0.265Ex + 0.646RM_{t-1} + 821.3D(1979) \quad (11) \\
 & (-2.35) \quad (7.53) \quad (-2.13) \quad (-4.44) \quad (9.87) \quad (5.98) \\
 R^2 = & 0.993 \quad \quad \quad DW = 1.63 \quad \quad \quad F = 895.65
 \end{aligned}$$

This equation shows that the sign of the coefficient for GNP is positive, which is consistent with the theory. The sign of the coefficient for the exchange rate is negative, because when the rate of hard currency increases, people prefer to hold their assets in dollars<sup>1</sup> rather than in domestic currency. And the sign of the coefficient for the rate of inflation is negative, which is also consistent with the theory. When the price of goods is increasing, people do not want to lose the value of their assets and therefore prefer to hold as little money as possible.

---

1- Please see section 2.5.1 in the light of Dollarisation for more explanation.

**Bahmani-Oskooee (1996)** uses a model to estimate demand for money. His study has at least two advantages over the most of the others. First, it chooses a black market exchange rate, whereas most researchers either did not apply this factor or employed the official rate along with it. In fact, the actual rate for hard currency effective in demand for money is its rate in the free-market, as the dollar is available to everybody in this market. The second advantage of this study is that it pays attention to the question of stationarity. Since the factors involved in the demand for money model, (which are on the levels), are not usually stationary, and the differences on variables should be applied in the model. Bahmani-Oskooee suggested demand for money model as follows:

$$RM_t = a + bY_t + c Inf_t + d EX_t + e_t \quad (12)$$

Where: M is the demand for real cash balances; Y is the real GDP, Inf is inflation, and EX is the exchange rate defined as the number of Iranian Rials per US dollar. In this model, the order of integration for the entire involved factor should be determined. The common method for determining the order of integration is the ADF test. Bahmani-Oskooee argues however that graphs for the factors involved in his model show the presence of a structural break, (due to the revolution), in each series around 1978, except in the case of the official exchange rate, which is almost constant during most of the period. Hence Bahmani-Oskooee has applied the ADF test for the OES and has also applied a modified version by Perron (1989) who incorporated a structural break for other factors in the model. The results for all variables involved in the model are I (1). Thus, by using the first difference for all variables, the author can obtain the stationary factors.

In order to determine the long-run relationship among variables, Bahmani-Oskooee has then applied the Johansen & Juselius (1990) procedure. He has examined it, using two likelihood ratio tests, known as trace tests. The results of these tests for different groups of factors, shows that, when the official exchange rate (OEX) was included in the demand for money model (either M1 or M2), there is one co-integrating vector, but, when the black market exchange rate (BEX) is included, there are two co-integrating vectors in the M1 equation, and three vectors in the M2 equation.

An important question is whether all of the factors involved in the model in each case really belong to the co-integration space. To determine which variable(s) should be excluded from the co-integration space, the author applies the likelihood ratio (LR) test for the exclusion of each variable. The author uses Johansen (1988:237) to show that this test is based on the estimated eigenvalues of unrestricted and restricted co-integration space according to a specific equation. The results are reported in table 3.5. As table 3.5 shows, all possible co-integrating vectors in each case are reported, and the author normalises all models on the monetary aggregate M1 or M2 by setting their parameters at “-1”. Moreover the null hypothesis for the coefficient of OEX in the first case for M1, and in the third case for M2, cannot be rejected.

**Table 2: Estimated Coefficients of alternative money stock equations**

ase	M1	M2	Y	Inf	OEX	BEX
1	-1.00(8.8)a	_____	1.04(8.5)	0.12(0.1)	1.8(1.8)	_____
2	-1.00(12.4)b	_____	1.12(11.4)	-1.89(4.4)	_____	0.35(12.5)
3	_____	-1.00(8.8)a	1.16(6.5)	0.25(0.10)	0.59(0.5)	_____
4	_____	-1.00(17.1)c	1.39(14.9)	-1.37(11.7)	_____	0.25(13.1)

Notes: Numbers inside the brackets are the  $\chi^2$  statistics.

- a. The  $\chi^2$  statistics in this case have one degree of freedom. The critical value of  $\chi^2(1) = 3.84$ , at the 5% level of significance
- b. The  $\chi^2$  statistics in this case have two degrees of freedom. The critical value of  $\chi^2(2)=5.99$ , at the 5% level of significance
- c. The  $\chi^2$  statistics in this case have three degrees of freedom. The critical value of  $\chi^2(3)=7.81$ , at the 5% level of significance

However, the null hypothesis of the coefficient of BEX can be rejected in cases 2 and 4 where BEX has entered into the narrow and broad money functions. Only in case 4 are all the employed factors significant. It follows that, in Iran, the most appropriate formulation for money demand will be one that includes M2, real income, inflation rate and BEX. Furthermore, in the last case, all coefficients carry their expected signs, except the inflation rate in the third

vector. The positive sign of the BEX coefficient could be justified by the wealth effect in the literature. Thus in the long-run this equation holds:

$$M2_t = 1.39Y_t - 1.37 \text{Inf}_t + 0.25 \text{BEX}_t + u_t \quad (13)$$

The major defect of this study is its use of the exchange rate rather than the rate of return of foreign exchange. Inflation is rate of change in the consumption price index, which has been applied in my study.

**Esmaeelnia's (1996)** model has three determinants: GDP, the expected rate of inflation; and the black market exchange rate. The first determinant is a scale variable and two others denote opportunity cost of holding money. He argued that the most appropriate theory for money demand was Friedman's theory. He justified the fact that GDP was the best factor for measuring wealth, pointing out that human wealth includes the present value of income through current and future work.

Esmaeelnia suggests the following model:

$$(M1/p)_t = a_0 + \alpha_1 (M1/P)_{t-1} + a_2 \text{GDP}_t + a_3 \text{Ext}_t + \alpha_4 \text{Inf}^*_t \quad (14)$$

where: M1/p is real narrow money demand, GDP is gross domestic product, Ext is exchange rate, Inf\* is desired inflation, and all factors are in logarithm. As the inflation variable in the above equation is the desired value for inflation, which is not observable. In order to transform desired inflation to real inflation, Esmaeelnia suggested two models namely adaptive expectations and autoregressive process. The expected rate of inflation has been obtained through an adaptive expectation model. According to this model speed of adjustment for inflation equals to 0.745. Esmaeelnia then calculated the expected rate of inflation and did put in demand for money function.

### A- Adaptive Expectations Model (AE)

The result of the estimation by applying this model is as follows:

$$(M1/p)_t = 0.517 + 0.17 \text{GNP}_t - 0.008 \text{Inf}^*_t - 0.02 \text{Ext}_t + 0.74(M1/p)_{t-1} + U_t \quad (15)$$

$$(-1.9) \quad (4.5) \quad (-6.6) \quad (-2.4) \quad (12.4)$$

$$R^2 = 0.81$$

All of the factors involved in the model are significant and their parameter signs are reasonable, but inflation and black market exchange rate are very low. Esmaeelnia also calculated long run coefficient for expected rate of inflation, which is equal to - 0.03. The coefficient of GDP shows the income elasticity for money. It means that if GDP increases by 100%, the demand for money will increase 17%.

The other important parameter estimated in this procedure, is the adjustment coefficient for money demand. Its value is 0.26. It means that in three months about 26% of the gap between desired and actual demand for money will close.

## B- Autoregressive Process Model

According to Esmaeelnia, the model of demand for money is as follows:

$$(M1/p)_t = -0.82 + 0.25GDP_t - 0.002 Inf^*_t - 0.03Ext_t + 0.64(M1/p)_{t-1} + U_t \quad (16)$$

(-2.6) (5.8) (-2.2) (-3.9) (11.1)

The value of the coefficients in this model is a little different to that for the adaptive expectations hypothesis, but the signs are the same. Here the adjustment coefficient of demand for money is 36%. This means that the speed of adjustment from actual demand for money to desired demand for money is faster than with the adaptive expectations hypothesis.

**Tavakkoli (1996)** estimates the narrow real money demand function using quarterly data from 1972:1-1990:1. The set of explanatory variables includes real GDP and the inflation rate. Since quarterly data for GDP is not available, Tavakkoli converts annual data to quarterly through Lisman and Sandee's method.

He uses time series and co-integration. Unit root tests indicate that narrow money and real GDP are integrated at frequency one I(1), and that the inflation rate is stationary. The results from co-integration analysis through the Johansen (1988) maximum likelihood method show that only one co-integrating vector exists between the money demand and its determinants. The long-run GDP elasticity of narrow money demand is 0.106. The estimated coefficient for the

inflation rate is equal to  $-5.67$ . Although these two figures have the correct signs, the former has a low value while the latter's value is high.

There are three problems with Tavakkoli's work relating to data conversion from annual to quarterly, to co-integration regression and to data analysis:

Regarding the problem of data conversion, Tavakkoli has applied the procedure of Lisman & Sandee (1964)<sup>1</sup>. Yet as Bruggeman (1995) argues, this procedure is highly arbitrary. Tavakkoli has not used GDP components information. And quarterly data for GDP components like oil, agriculture, industry and services are available. Moreover, Tavakkoli has mistakenly computed the data with the effect that the quarterly data is four times greater than the correct data. Because he confused lower case  $x$  with capital  $X$ , while  $x = \frac{1}{4} X$  in the paper. (see: Lisman & Sandee, 1964:88). As an example, the figures of GDP for the four seasons in 1971 are Rls billion 6931.6, 7157.4, 7440.4, and 7780.6 respectively, while the actual data for GDP in 1971 is Rls billion 29310, one fourth the sum of these figures<sup>2</sup>. It is worth noting although Tavakkoli has mistakenly computed the quarterly data, this does not lead to a great difference in the magnitude of the estimated coefficients since his functional form is double log<sup>3</sup>.

The second defect in Tavakkoli's study is a major problem in the use of the co-integration test. Since he takes inflation to be a stationary variable, he should not include this variable in the co-integration regression, although he has done so.<sup>4</sup>

The third defect is in the money demand coefficients. Since in Tavakkoli's computing the annual data for GDP is four times more than quarterly data for GDP, consequently this problem affects estimated GDP and inflation coefficient values<sup>5</sup>. As mentioned, the coefficient value of GDP in Tavakkoli's thesis is 0.106. (See page 170). Hence, he did not offer any interpretation for money

---

1- see Tavakkoli, 1996:124.

2- see Tavakkoli, 1996:176.

3- Note that  $\ln(4Y) = \ln 4 + \ln Y$  which it is nearly equals to  $\ln Y$  (when  $Y$  is a large figure).

4- See pages 170, 176 and Table 16 and also page 257.

5- Because in the model:  $Y_i = \alpha_1 + \alpha_2 X_i + u_i$ , if we estimate coefficient of  $X_i$  through OLS, estimated value of  $\alpha_2$  equals to  $\frac{\sum(x_i y_i)}{\sum x_i^2}$ , where  $x_i$  and  $y_i$  stand for deviation of mean for  $X$  and  $Y$  respectively.



income elasticity. The same problem holds for the inflation coefficient value, which is equal to 5.679. As the data is incorrect, this figure is not real.

**Pesaran (1998)** estimates per capita broad money demand for the years 1961-1997 using annual data, applying autoregressive distributed lagged models (ADL). The determinants in this study are per capita real income at constant 1982 market prices, and inflation. The lag order in this model is equal to unity. The results indicate that in the long run all the estimated coefficients have signs consistent with the theory, and are statistically significant. Income elasticity is equal to 1.85, and the corresponding elasticity for inflation is  $-1.71$ . Pesaran then estimated the model for the post revolutionary period (1979-1997), and compared the results of the two periods. The first finding was a structural break in the demand for money. The second one was the low value of the long-run income elasticity of the demand for money during the post revolutionary period. This issue led to the undesirable consequences for the country's growth potential and for the ability of monetary authorities to harness inflationary pressures through money supply controls. The findings also indicate that the effect of inflation on demand for money seems to have decreased after the revolution, thus showing that similar rates of expansion in liquidity are likely to have had more inflationary effect after the revolution than before.

**Moradi (2000)** studies per capita demand for money for the period 1959 to 1996 using annual data. He estimates both the long run and the short-run demand for real money. He applied a cash-in-advance framework to design a micro foundation model of demand for money. The dependent variables in this study are per capita real M2, and per capita monetary base, and the set of explanatory variables includes per capita real GDP in 1990 prices, dummy variable for revolution, (D1978), and the expected inflation rate, the functional form being double log<sup>1</sup>.

Moradi used time series and co-integration in his work. He applied augmented Dickey-Fuller tests and Perron tests for detecting unit root of the series, and, he concluded similar results for both procedures. The per capita real M2, per capita monetary base, per capita real GDP in 1990 prices, are I(1) and the expected inflation rate is stationary. Moradi used the Johansen and Juselius

---

1- All variables are in log except inflation.

procedure. He concluded that there exists only one co-integrating vector between per capita real broad money, inflation and per capita real income when one break in 1978 is accounted for.

The estimated long-run real income elasticities of monetary base and broad money are 2.37 and 2.09 respectively, while the correspondent estimated long-run elasticities for the expected rate of inflation are  $-4.31$  and  $-3.40$  respectively. Moradi has also employed ADL method for co-integration tests. He concluded that the long run elasticities for income are 2.64 and 2.33, while the correspondent figures for inflation are 4.64 and 3.26 respectively. In the short-run the change of inflation elasticities ranges from  $-0.56$  for monetary base to  $-0.46$  for real M2. All the inflation elasticities and error correction terms are significant except dummy variable for broad money model. Although the error correction terms coefficients are quite low, ( $-0.12$  and  $-0.14$  respectively) but they are statistically significant. Based on Granger causality test Moradi concluded that there is a bi-directional causality between per capita real balances and income for both measure of money.

Moradi has also included foreign exchange rate in both official and parallel rates to his models and concluded insignificant values for exchange rate coefficients.

There are some points in this study, which worth mentioning here:

1. Regarding to the co-integration test, since Moradi takes expected rate of inflation to be a stationary variable, he should not include this variable in the co-integration regression, although he has done so<sup>1</sup>.

2. Regarding to the error correction models although real per capita GDP is an explanatory variable but he excluded this variable from his model<sup>2</sup>. All of the relevant coefficients' magnitude and sign are significant and consistent with theory for both per capita real broad money and per capita money base functions.

Other researchers have used combinations of the above determinants in their works along with a similar functional form or similar method of estimation. Hence we may mention a short report of their work here.

---

1- See Moradi, 2000: 114 and 120, Table 5.7.

2- see Moradi, 2000, Table 5.8.

Briefly we can see that Tabatabaee-Yazdi (1991) uses the expected rate of inflation as an explanatory variable, while using the adaptive expectation mechanism for calculating it. Kermani (1992) pays attention to political changes after the revolution while he enters as a dummy variable, concluding that this dummy variable is empirically significant in the Iranian economy.

### **3- Some main points in this section**

This section has provided a detailed picture of the empirical investigations into demand for money in Iran. Some common features of these empirical studies are:

- 1- In spite of the studies made in the developed countries, which use the interest rate as an instance for opportunity cost of holding money, with respect to the studies made of the Iranian economy, the rate of inflation is used as an appropriate instance for opportunity cost of holding money. Hence we can see that only **Jalae (1991)** has used the interest rate but he did not get a significant coefficient. This is the main finding of the previous studies made of the demand for money.
- 2- All of the researchers used a single equation.
- 3- Most of the researchers included lagged dependent variables in their models in order to explain the present value of demand for money. The model building techniques most frequently used are conventional long-run log linear models.
- 4- The data set stretch up to 1996. The annual time series data are most frequently applied, while a few studies used quarterly data.
- 5- Ordinary least square is the dominant estimation method. Few of the mentioned researchers used the unit root test for the factors involved in their models, even though macroeconomic variables in the Iranian economy usually have a unit-root,<sup>1</sup> signifying the importance of co-integration tests.

---

1- As has been shown in chapter 4 and in Bahmani-Oskooe's work the unit root test is necessary before estimating the equation's parameters by OLS.

- 6- Almost all the studies used Durbin Watson or Cochrane-Orcutt to detect the autocorrelation problem of error terms, but they did not use the DW for testing co-integration<sup>1</sup>.
- 7- Only one study (Nazemzade, 1983) attempted to test the stability of its estimated function.

#### **4- Concluding Remarks**

Regarding to the Iranian economy there are some shortcomings. Points worth mentioning are:

- 1- None of the researchers use the rate of return on durable goods<sup>2</sup> in the money demand model, a major deficiency.
- 2- Most of the studies carry the implicit assumption that the data involved are stationary, and traditional econometric methods to estimate their models are applied. Yet most recent studies on economic factors have concluded that the mentioned factors are no stationary in their levels. Therefore the time series and co-integration for the Iranian economy must be taken into account, except those who have applied these techniques in their studies.
- 3- When the financial markets are inefficient, monetary assets are not effective in the money market as an opportunity cost of holding money yet some researchers like Emadzade ignored this issue. The interest rate is an example of this. Some researchers even used the official rate rather than parallel rate in their models.
- 4- All of the researchers except Bahmani-Oskooee (1996) and Esmaeelnia (1996) failed to include the foreign exchange rate as an explanatory variable in their models, yet while Iran has an open economy and the government meets its needs with goods imported from abroad, the foreign exchange rate is a crucial factor in the monetary economy.
- 5- In spite of many positive points in the existing studies in the Iranian economy, there are some defects, which have mentioned in this paper. Those are as follow: wrong factor in the model (see: Emadzade 1990, and Bahmani-Oskooee 1996), a lack of appropriate technique (see: Jalae 1991), wrong

---

1- CIDW test, for more explanation see Banerjee et al (1993).

2- Like gold, car and building.

data computation (see: Tavakkoli 1996), wrong co-integration model (see: Tavakkoli 1996, and Moradi 2000), a finally wrong analysis in the estimated parameters, (see: Tavakkoli 1996).

## References

- 1- Amirsharafi, H., (1991) "A estimation of Demand for Money in Iran and Interest Rate problems 1967-1986", Shahid Beheshti University, Iran, MS Dissertation (in Persian).
- 2- Bahmani-Oskooee, M. (1996) "The Black Market Exchange Rate and Demand for Money in Iran" *Journal of Macroeconomics*, 18(1): 171-176.
- 3- Banerjee, A., Dolado, J., Galbraith, J.W., and Hendry, D.F. (1993) "Co-integration, Error Correction, and the Econometric Analysis of Non-Stationary data", New York, Oxford University Press
- 4- Bruggeman, A. (1995) "Disaggregating annual real GDP data into quarterly figures" Report 95/331, NOB. 1995, universitaire faculteiten St-Ignatias ,Prinsstraat 13-13 2000 Antwerpen.
- 5- Emadzade, M. (1990) "The optimum Model of Money demand for Iranian Economy in relation with monetary policies" Tehran, Ph.D. Thesis (in Persian).
- 6- Esmaeelnia, A., (1996) "The Estimation of Money Printing Through Employing of Demand for Money Estimation in the Iranian Economy", University of Tehran, Iran, MA Dissertation (in Persian).
- 7- Falihi, N., (1994) "Partial Adjustment Hypothesis tests and Demand for Money Function in Iran 1959-1991" Shiraz University, Iran, MS Dissertation (in Persian).
- 8- Friedman, M. (1959) "The Demand for Money: Some Theoretical and Empirical Results", *Journal of Political economy*, 67/6: 327-351.
- 9- Goldfeld, S. M. (1973) "The demand for money revisited" *Brooking Papers on Economic Activity*, 3: 577-638.
- 10- Hajean, M. R., (1989) "A study for the nature of Monetary Policy in Iran 1968-1985", Tehran University, Iran, MS Dissertation, (in Persian).
- 11- Harris, R.I.D. (2003) "Using Co-integration Analysis in Econometric Modeling", UK, Hall/Harvester Wheatsheaf.

- 12- Jalaee-Esfandabadi, A. (1991) "Estimation of Money Demand Function and money Supply Analysis in the Iranian Economy 1959-1988", Isfahan University, Iran, MA Dissertation, (in Persian)
- 13- Johansen, S. & Juselius, K. (1990) "Maximum likelihood estimation and inference on co-integration with application to the demand for money", *Oxford Bulletin of Economics and Statistics*, 52: 169-210.
- 14- Johansen, S. (1988) "Statistical Analysis of Co-integration Vectors", *Journal of Economic Dynamic and Control*, 12: 231-254.
- 15- Kermani, M.S. (1992) "The role of inflation in Money Demand Function: A Case Study of an Oil-Exporting Country". Paper (Unpublished), presented in Seminar.
- 16- Khashdoorian, A., (1992) "Estimation of money Demand and Money Supply simultaneously 1959-1990", Shahid Beheshti University, Iran, MS Dissertation (in Persian).
- 17- Lismon, J. H. C., and Sandec, J., (1964) "Derivation of Quarterly Figures from Annual Data" *Applied Statistics*, XIII, 2: 87-90.
- 18- Moradi, M. A. (2000) "Dynamic Modeling of Inflation in a small open Country: The case of Iran", The University of Liverpool, Ph.D. Thesis.
- 19- Nazemzade, A. (1983) "Demand for money in developing countries cases of Iran, Nigeria and Venezuela" The Florida State Univ. Ph.D. Thesis.
- 20- Nowferesti M. (1995) "The Relationship among Money Demand, Exchange Rate and the Rate of Inflation" *plan and development* 11:1-14 (in Persian).
- 21- Perron, P., (1989) "The Great Crash, The Oil price shock, And the Unit root Hypothesis", *Econometrica* 57(6): 1361-1401.
- 22- Pesaran, H., (1998) *Economic Trend and Macroeconomic Policies in Post-Revolutionary Iran*, DAE Working Paper, No. 9818.
- 23- Tabatabaee-Yazdi, R. (1991) "Consideration of Inflation in Iran: Simultaneous Method with an Emphasis on Expectation of Inflation", Tehran University, Iran, MS Dissertation (in Persian).
- 24- Tavakkoli, A. (1996) "Causes of Inflation in the Iranian Economy 1972-1990" University of Nottingham, Ph.D. Thesis.
- 25- Thomas, R.L., (1997) "Modern Econometrics an Introduction", Addison Wesley Longman.