«تحقیقات مالی»
سال چهارم - شماره ۱۳ و ۱۴ - بهار و تابستان ۱۳۷۸
ص ص ۱۷۸ - ۱۹۴

Testing Monetary Approach to Foreign Exchange Rate (Rial - Dollar)

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In late 1970s, in response to the increased flexibility of exchange rate after 1973 and growth of academic interest in determination of exchange rate, monetary approach to exchange rate determination, was developed.(1)

In this paper, our aim is to test this approach for Rial-Dollar exchange rate in black market in Iran. First we survey the literature for works done in this area by other economists and use models used by them for testing monetary approach to Rial - Dollar exchange rate. Our hypothesis is that in Iran, money supply in USA and Iran affect the Rial - Dollar Exchange rate.

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Models Used for Testing Monetary Approach

In the first model, we have the following assumptions:

a - Money wages are flexible, therefore, we always have full employment, and real income and product are at their full employment level.

b- There is no restriction on capital movement and holder of monetary assets are risk neutral.

Thus, the uncovered interest parity in spot markets i.e. $r=r^{*}=e$ is satisfied. We assume that e is constant.

c- Goods prices in home and foreign countries are related to each other according to purchasing power parity equation, i.e. $P= \bar{\nu}eP^{*}$.

P is home country price, p^{*} is foreign country price, e is exchange rate and v is a parameter, and country's price index is: $P\doteq \alpha P+(1-\alpha)eP^{*}$

α is weight given to home country's goods and services.

Using the equilibrium condition for home country money market, and solving the equation for exchange rate, we get the following equation:

$$e= \Phi \left[\frac{M}{M^{*}} \right]$$

M is home country money supply and M^{*} is foreign country's money supply.(2)

In second model, it is assumed that balance of payment is equal to difference between money supply and money demand. Income and interest rate are endogenous variables. Exchange rate is endogenous and is determined in foreign exchange market. Foreign exchange supply and demand are affected by: interest rates, relative prices, expansion of domestic credits, government expenditure and current account balance. Thus we have:

$$o = b\Delta W + C\Delta Q + e\Delta P - f\Delta r - PSBR - \Delta BLP + \Delta PLG$$

Above equation shows the basic assumption of the model. In the equation, W is wealth, Q is GNP, P, price level, r, rate of interest, PSBR, public sector borrowing requirement, BLP, commercial banks loan, PLG, private sector loans to government and non - bank private sector. Since balance of official settlement account affects the foreign exchange rate, therefore exchange rate is affected by variables affecting (o) in above equation. (3)

In the third model, supply of money is assumed to be constant. and purchasing power parity condition holds. Thus rate of change of foreign exchange is a function of difference between rate of change of money supply, growth of national product and interest rates in two countries:

$$e = (m - m^*) + \Phi (y - y^*) + \lambda (\iota - \iota^*)$$

m, m^* and y, y^* are respectively logarithm of money supply and national products and ι and ι^* are interest rates in two countries. If we take inflation rates as proxy for interest rates, $(\iota - \iota^*)$ will be substituted by $(P-P^*)$. (4) In fourth model, in addition to money supply and GNP for two countries, it is assumed that spot foreign exchange rate is also a function of forward market discount and premium, thus we have:

$e= (m - m^*)+n (y - y^*) +b\sigma$

σ is forward market discount or premium and m,m^*+,y,y^* are log of money supply and GNP in two countries. (5)

The first model is tested for Dutch Mark - Dollar rate using monthly data for the period of 1980-88. Estimated equations are:

$e= 0.681 + 0.56 (m - m^*)$

$e= 0.681 - 0.553 (m - m^*)$

m and m^* respectively are log of German and American money supply and e is log of D. M.

Dollar exchange rate. Standard errors are acceptable and R-squared for both equation is approximately 0. 96. In second equation, there is one month lag between e and- $(m-m^*)$(6).

Second model is tested for Dollar and other currencies exchange rate using data related to periods before and after 1978. Results obtained are not satisfactory. Third model is tested by

A. sofi and A. Kazemi for Rial - Dollar exchange rate in Iran. Sofi reports that although the series are stationary but are not cointegrated, so use of OLS, does not render reliable results. (8)

A. Kazemi's results with regard to effect of log of difference of money supply on log of Rial.

Dollar exchange rate, are not reliable .(9)

Fourth model is tested for different currencies and different periods.

Equation estimated in beginning of 1970s for Dutch Mark - Sterling exchange rate is as follows:

$$e= 4.454+0.42m-0.9\, lm^{*} -0.17y^{*} -0.2y +0.00015\sigma$$

Results are not acceptable. (10)

Testing Models for Iranian Economy

To test the first model, first we used data for the period of 1966 - 1996. The result obtained are as follows:

$$\log e = 4.86+ 0.99 \qquad \log\frac{MIR}{MUSA}$$

R-squared=0.84 d=0.178 t= (39.17) (12.73)

Above results are not reliable, because the Durbin - Watson statistic is very low. This shows high autocorrelation in regression. In order to eliminate the autocorrelation, we used the Durbin's two step procedure. (11)

We estimated the following equation:

$$\log e = 23.17+0.51 \qquad \log\frac{MIR}{MUSA}$$

R-squared=0.97 d=1.48 t= (0.07) (1.01)

It is necessary to point out that after using above procedure, the R-squared is related to Durbin's equation and not to our regression.

Since the t- statistics are not acceptable, the equation estimated is not satisfactory. To find out whether there is any reliable relation between variables of the model or not, we printed the scatter diagram. Figure (1) shows that because before 1980, the exchange rate is controlled, the correlation between variables are stronger after 1980. Therefore, we used the data for the period of 1980 - 1996.

Using Durbin's two step procedure for elimination of autocorrelation, the estimated equation is·

$$\log e = 5.51 + 0.83 \log\frac{MIR}{MUSA}$$

R- squared=0.98 d= 1.72 t= (20.5) (7.68)

According to Newbold - Granger suggestion, due to trend of time series, the estimated regression may suffers from spurious regression. (12) In order to make sure that results obtained are reliable, we used Augmented Dicky - Fuller (13), correlogram, Box and pierce Q statistic and Ljung - Box statistic for testing time series stationarity. The ADF results are summarized in below table. The correlogram (14), (BP) Q and (LB) statistics are shown in figure 2.

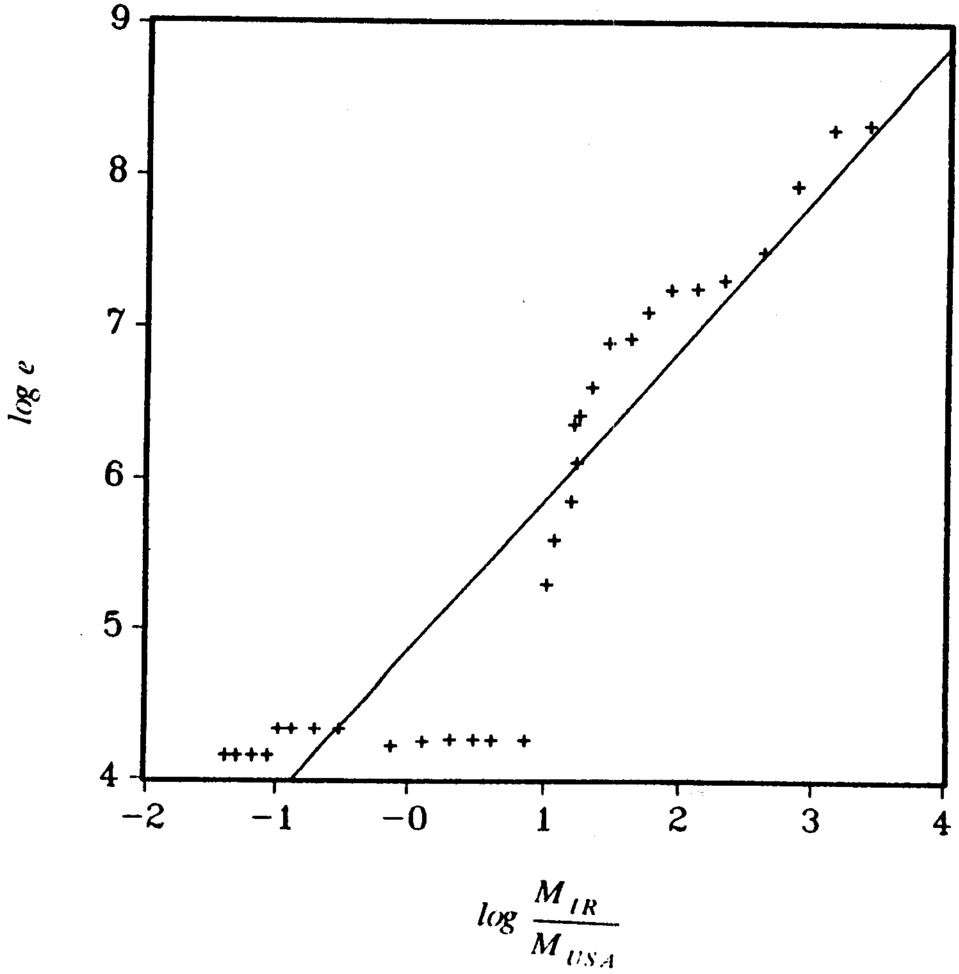

Figure 1

Series : $\log e$

```
==========================================================================
      Autocorrelations          Partial Autocorrelations          ac      pac
==========================================================================
|          .    |**********   |       .      |**********  |  1   0.782   0.782
|          .    |*******      |       .    **|     .      |  2   0.558  -0.136
|          .    |*****.       |       .      |     .      |  3   0.378  -0.029
|          .    |***    .     |       .      |     .      |  4   0.253   0.007
|          .    |**     .     |       .      |     .      |  5   0.158  -0.025
|          .    |*      .     |       .    **|     .      |  6   0.049  -0.117
|          .   *|       .     |       .     *|     .      |  7  -0.060  -0.092
|          .  **|       .     |       .      |     .      |  8  -0.138  -0.029
|          . ***|       .     |       .    **|     .      |  9  -0.216  -0.121
|          .****|       .     |       .     *|     .      | 10  -0.286  -0.098
==========================================================================
 Box-Pierce Q-Stat    22.25    Prob   0.0139    SE of Correlations   0.243
 Ljung-Box  Q-Stat    31.16    Prob   0.0006
==========================================================================
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Figure 2

Series : $\log \frac{M_{IR}}{M_{USA}}$

```
==========================================================================
      Autocorrelations          Partial Autocorrelations        ac      pac
==========================================================================
|        .     |************ |          .     |************ |  1  0.889   0.889
|        .     |**********   |          .    *|     .       |  2  0.778  -0.058
|        .     |*********    |          .    *|     .       |  3  0.670  -0.047
|        .     |*******      |          .    *|     .       |  4  0.565  -0.050
|        .     |******       |          .    *|     .       |  5  0.466  -0.041
|        .     |*****        |          .    *|     .       |  6  0.370  -0.054
|        .     |****.        |          .    *|     .       |  7  0.280  -0.039
|        .     |***  .       |          .     |     .       |  8  0.197  -0.036
|        .     |**   .       |          .     |     .       |  9  0.128  -0.001
|        .     |*    .       |          .     |     .       | 10  0.070  -0.014
==========================================================================
 Box-Pierce Q-Stat   82.32    Prob   0.0000     SE of Correlations  0.180
 Ljung-Box  Q-Stat   96.98    Prob   0.0000
==========================================================================
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Figure 2

Augmented Dicky-Fuller: log e			
-6.2919			Dicky-Fullert-statistic
-4.6193	1%		Mackinnon critical values:
-3.7119	5%		
-3.2964		10%	
Augmented Dicky-Fuller: log MIR/MUSA			
-1.8418			Dicky-Fuller t-statistic
-4.6193	1%		Mackinnon critical values:
-3.7119	5%		
-3.2964		10%	

All the above tests indicate that loge is stationary and $\log \frac{MIR}{MUSA}$ is nonstationary. To make the second series stationary, we used the first difference and again tested the new Series for stationarity. We found out that the first-differenced $\log \frac{MIR}{MUSA}$ is still non stationary.

Using the second difference data, $\log \frac{MIR}{MUSA}$ became stationary.

So, $\log \frac{MIR}{MUSA}$ is integrated of order two [I(2)] and log e is integrated of order zero [1(0)].

Thus, in the first model time series can not be cointgrated. Therefore, the regression estimated for the period of 1980 - 1996 is not reliable.

We did not test the second model for Iranian economy, because we could not find time series for stock wealth. In addition the official rates of interest are constant and there are no published time series for black market rate of interest. To test the third model, we estimated the regression equation for 1966 - 1996 period:

$$\log e = 7.19+0.51\,(m-m^*)- 1.44\,(y-y^*) +0.29\,(P-P^*)$$

(1.61) t= (25.5) (4.99) (-5.85)

d= 0.57 R-squared=0.95

Result obtained are not reliable due to low Durbin - Watson statistic. To solve the autocorrelation problem, we used the Durbin's two step procedure. The estimated equation was:

$$\log e = 11.02-0.82\,(m-m^*)- 0.43\,(y-y^*)+1.28\,(P-P^*)$$

(2.50) t= (2.98) (-1.69) (-1.35)

d= 1.71 R-squared= 0.98

Considering t-statistics for estimated parameters of equation, only t for coefficient of $(P-P^*)$ is significant. In our opinion, this is because as shown in figure 3, between e and Iran's consumer price index there is a strong correlation. Again, like first model we eliminated the data for 1966 - 1979. Using the data for 1980 - 1996 period, our result was similar to results obtained for 1966 - 1996 period.

To test the fourth model we run the data for period of 1966 - 1996 and 1980 - 1996. For the first period, we found the following equation:

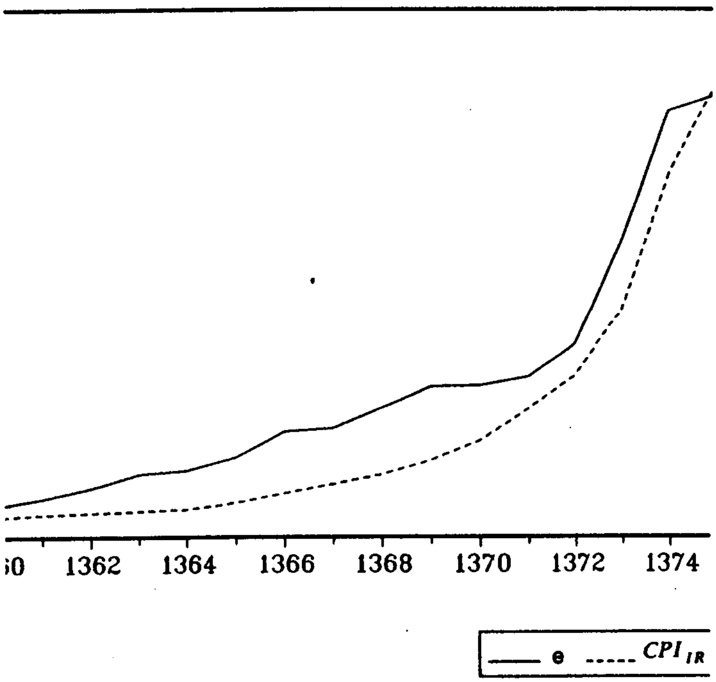

Figure 3

$$\log e = 2.86 + 0.38^{\log MIR} - 0.47^{\log MUSA} + 2.21^{\log GNPUSA} - 1.58^{\log GNPUSA}$$

t=(o.35) (0.72) (-0.29) (0.82) (-5.22)

F= 144 d=0.60 R-squared=0.95

The result obtained are unreliable, because t-statistics are insignificant and Durbin - Waston statistic is very low. But the F-statistic is significant. So, we can guess that the regression suffers from collinearity. To see if collinearity is strong or weak, we regressed independent variables on each other. We found the two following equations:

$logGNPUSA = c + 1.05\ logGNPUSA$

t= (60)

R- squared=0.99

Figure 4; shows the strong correlation between above variables.

$logGNPUSA = c + 0.217 logGNPUSA$

t= (9.24)

R-squared=0.74

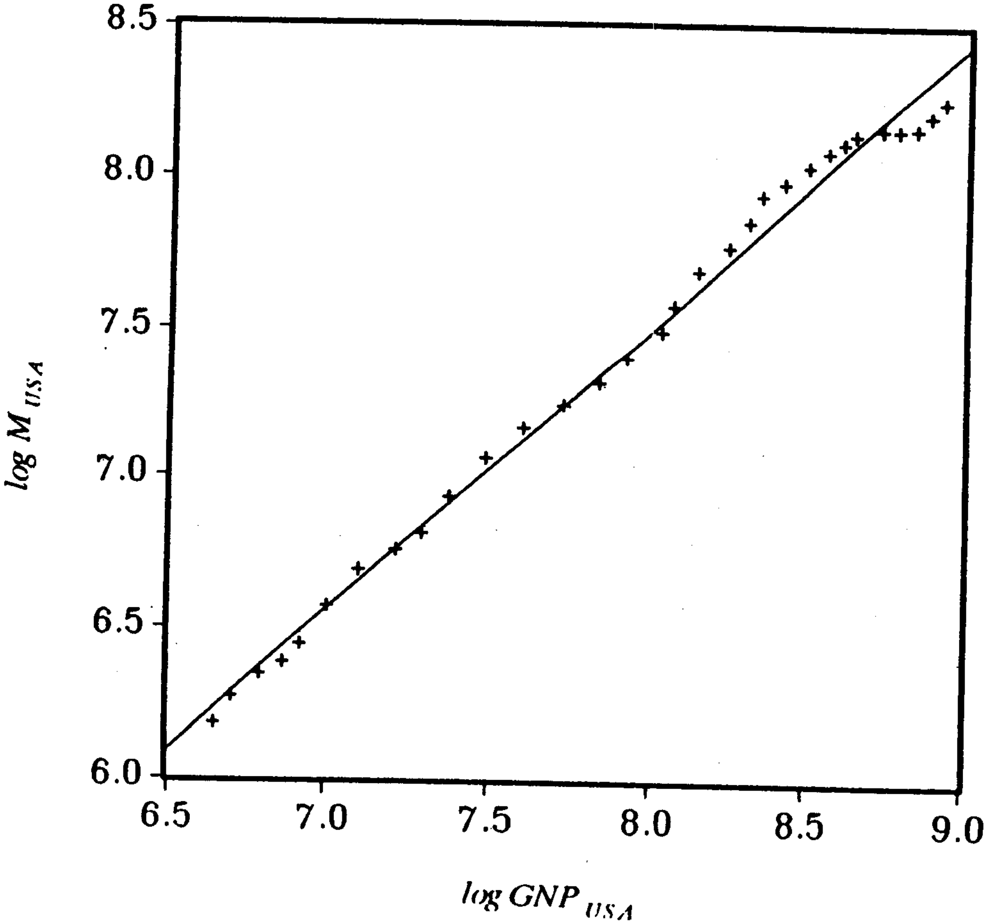

Figure 4

Figure 5 shows the above regression. The above results, indicate strong collinearity in estimated regression equation for fourth model. On the other hand, based on Klein suggestion, as the R-squared betwween independent variables is greater than R-squared of our regression, there is a strong collinearity. To solve the problem, we had to omit.logGNPUSA and logGNPIR

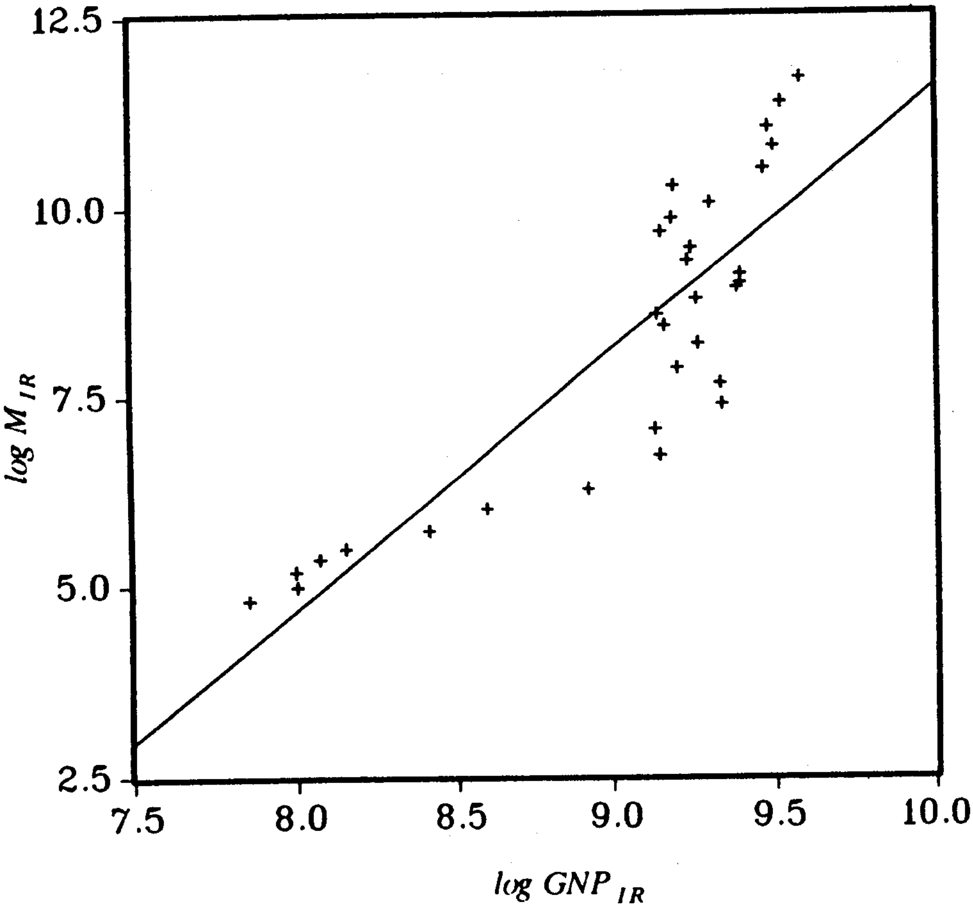

Figure 5

which are explained by logMUSAand logMIR. After omitting two variables the equation estimated was:

$$\log e= -2.58 + 0.47^{\log GNPUSA} + 0.59^{\log GNPUSA}$$

$$t= (-0.61) \quad (1.55) \quad (0.65)$$

d= 0.17 R-Squared=0.86

The above result indicates that our estimate, due to its insignificant t-tatistics and low Durbin - Watson statistic, is unacceptable. For second period (1980-1996) we found that in our regression equation, like the equation for the first period, the problem of collinearity still exists. Omitting logGNPs from the model and using Durbin's two step procedure, only t- statistic for coefficient of $^{\log MIR}$ was significant. Using cointgration methods, we found out that we can not estimate any meaningful regression equation for log e and $^{\log MIP}$

Conclusion

Taking into account, results obtained by testing model 1,3 and 4, for Iranian economy for two periods [(1966-1996) and (1980-1996)], we found insignificant and unreliable results. So, our hypothesis that two countries money supply affect the Rial-Dollar exchange rate, is rejected.

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