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# The Black Market Exchange Rate and Demand for Money in Iran*

Using the Johansen-Juselius cointegration analysis and exclusion test, this paper demonstrates that in a country where there is a black market for foreign currencies, it is the black market exchange rate and not the official rate that should enter into the formulation of the demand for money. Iranian data over 1959–1990 period are employed to demonstrate this point.

Several studies on the demand for money, for example, Arango and Nadiri (1981), Bahmani-Oskooee and Pourheydarian (1990), McNown and Wallace (1992), Arize and Schwiff (1993) and Bahmani-Oskooee and Rhee (1994) included *official* exchange rates in their formulation of money demand.[1] In this paper we demonstrate that for countries that have a black market for their currencies, it is the *black* market exchange rate and not the official rate that enters into the money demand function. We do so by employing Iranian annual data over the 1959–1990 period. It should be noted that over this entire period there was always a black market for foreign currencies, dominated by the U.S. dollar. However, it is mostly after the Islamic revolution of 1978–79 that the black market rate has distanced itself from the official rate.[2] Section 1 outlines the appropriate specification of the money demand function in a developing country. Section 2 presents the empirical results. Section 3 concludes. Data definition and sources are provided in an appendix.

## 1. Money Demand Function

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. 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 devel-

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[1]For the intuition behind the relation between the demand for money and exchange rate see Arango and Nadiri (1981) and Bahmani-Oskooee and Pourheydarian (1990).

[2]For more on the history of foreign exchange policy in Iran see Pesaran (1992) and for sources of the decline in the value of the rial see Bahmani-Oskooee (1995a).



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oped. Second, the interest rate has usually been set by the Iranian Central Bank and remained fixed for long periods. Third, no interest rate data are available for the post revolutionary period. 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. Due to lack of a well developed stock market, most Iranians speculate in land or housing markets. During the post-1979 period when inflation has been very high, Iranians even speculate in the market for durable commodities such as new or used cars. Therefore, the money demand function that we intend to estimate for Iran takes the following form.

$$\text{Log } M_t = a + b \text{ Log } Y_t + c\, \Delta\text{Log } P_t + d \text{ Log } EX_t + \epsilon_t\,, \tag{1}$$

where $M$ is the demand for real cash balances; $Y$ is the real GDP; $P$ is the price level; and $EX$ is the exchange rate defined as the number of Iranian rials per U.S. dollar. Note that the inflation rate is measured by $\Delta\text{Log } P_t = \text{Log } P_t - \text{Log } P_{t-1}$. Depending on whether the monetary aggregate is defined as M1 or M2, and the exchange rate as official (*OEX*) or black market rate (*BEX*), variants of Equation (1) are subject to empirical analysis.

## 2. The Results

In this section we estimate different variants of Equation (1) using Iranian annual data for the 1959–1990 period. Following recent advances in the econometrics literature, the methodology is based on the Johansen-Juselius (1990) cointegration technique.

The first step in applying the cointegration technique is to determine the degree of integration of each variable in Equation (1), that is, the number of times that each variable needs to be differenced in order to achieve stationarity. The common practice is to use the ADF test. However, inspection of the data on each variable revealed the presence of a structural break (due to the revolution) in each series around 1978–79, except for the official exchange rate. Thus, while the simple ADF test is used to determine the degree of integration of the official exchange rate (*OEX*), a modified version by Perron (1989) who incorporated a structural break, is used for the other variables.[3] The results not reported, but available from the author upon request revealed that indeed all variables in Equation (1) are integrated of order one or $I(1)$.

[3]For more on the structural break in Iranian data and formulation of the Perron (1989) test see Bahmani-Oskooee (1995b).

We are now in a position to apply the Johansen-Juselius (1990) cointegration technique. They generate two likelihood ratio tests, known as $\lambda$-max and trace tests, to determine the number of cointegrating vectors using the maximum-likelihood estimation procedure.[4] The results of the $\lambda$-max and the trace tests for different combinations of variables, not reported but available from the author upon request, showed that when the official exchange rate (*OEX*) was included in M1 or M2 money demand, there was evidence of one cointegrating vector. However, when the black market exchange rate was included, there were two cointegrating vectors in the M1 equation and three vectors in the M2 equation.[5]

A major question to which we turn next is whether all variables in each case really belong to cointegrating space. In each case, the convergence toward a long-run equilibrium could be due to a strong relation among some of the variables and not all of the variables. To determine which variable(s) should be excluded from the cointegrating space, we apply the likelihood ratio (LR) test for the exclusion of each variable in each case. Johansen (1988, 237) and Johansen and Juselius (1990, 194) show that the LR test of excluding a variable (or restricting the coefficient of that variable to zero) is based on the estimated eigenvalues of unrestricted and restricted cointegrating space according to

$$-2\text{Ln}(Q) = T \sum_{i=1}^{r} \ln \{(1 - \lambda_i^*)/(1 - \lambda_i)\} , \qquad (2)$$

where $r$ is the number of cointegrating vectors, $\lambda^*$ is the eigenvalue of the ith vector from the restricted space and $\lambda$ is the eigenvalue of the ith vector from unrestricted cointegrating space. They show that quantity (2) is distributed as $\chi^2$ with $r(p - s)$ degrees of freedom where $r$ is the number of cointegrating vectors, $p$ is the dimension of unrestricted cointegrating space and $s$ is the dimension of restricted space. In each case, since we are restricting one coefficient to zero, $s = p - 1$. Thus, the degrees of freedom for each $\chi^2$ statistic is actually equal to $r(p - p + 1) = r$, that is, number of cointegrating vectors in each case. Therefore, below in Table 1 we report the cointegrating vectors and, inside the bracket, the calculated $\chi^2$ statistic for each case.

In interpreting the results reported in Table 1, several points deserve mention. First, all possible cointegrating vectors in each case are reported. Second, we normalize all models on the monetary aggregate M1 or M2 by setting their coefficients at $-1$. As can be seen from Table 1, the null of restricting the coefficient of the official exchange rate (*OEX*) in cases 1 and

[4]Due to limited number of annual observations we employ two lags in the procedure.

[5]Note that all calculations are carried out using MFIT3.0, a package by Pesaran and Pesaran (1991).

TABLE 1. *Maximum Likelihood Estimates of Cointegrating Vectors.*

| Case | Log $M1$ | Log $M2$ | Log $Y$ | $\Delta$Log $P$ | Log $OEX$ | Log $BEX$ |
|---|---|---|---|---|---|---|
| 1 | −1.00 [8.8][a] | — | 1.04 [8.5] | 0.12 [0.1] | 1.80 [2.8] | — |
| 2 | −1.00 [12.4][b] | — | 1.12 [11.4] | −1.89 [4.4] | — | 0.35 [12.5] |
| | −1.00 | — | 1.21 | −4.79 | — | −0.20 |
| 3 | — | −1.00 [8.8][a] | 1.16 [6.5] | 0.25 [0.1] | 0.59 [0.5] | — |
| 4 | — | −1.00 [17.1][c] | 1.39 [14.9] | −1.37 [11.7] | — | 0.25 [13.1] |
| | — | −1.00 | 1.33 | −1.61 | — | 0.02 |
| | — | −1.00 | 0.27 | 9.70 | — | 0.08 |

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.

3 (M1 and M2 money demand functions respectively) cannot be rejected. However, in cases 2 and 4 where the black market exchange rate has entered into the M1 and M2 functions, the null of restricting the coefficient of *BEX* to zero is rejected. Only in case 4 (M2 demand) do all variables carry a significant $\chi^2$ statistic, indicating that they all belong to cointegrating space. Thus, in Iran, the most appropriate formulation of the demand for money will be the one that includes M2, real income, the inflation rate, and the black market exchange rate as its arguments. Furthermore, in this last case all coefficients carry their expected signs (except the rate of inflation in the third vector). The positive coefficient of the *BEX* variable implies that as the Iranian rial depreciates (*BEX* increases), demand for M2 increases, supporting the wealth effect argument in the literature.

## 3. Summary and Conclusion

The main contribution of this paper is that in countries 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. Applying Johansen's cointegration technique and the exclusion test to Iranian data over the 1959–1990 period, it is concluded that the more stable long-run demand for money in Iran will include real M2, real GDP, the inflation rate, and the black market exchange rate as its arguments.

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## Data Appendix

All data are annually for the period 1959–1990 and collected from: (a)- International Financial Statistics of IMF, various issues and (b)- World Currency Yearbook.

*Variables:*

- *M1* = Nominal M1 figures are deflated by the GDP deflator to obtain real M1. All data are from source *a*.
- *M2* = Nominal M1 is added to Quasi money to obtain nominal M2 figures. Nominal M2 is then deflated by GDP deflator. All data come from source *a*.
- *GDP* = Gross Domestic Product in 1980 prices. Source *a*.
- *P* = Price level, proxied by the Consumer Price Index, CPI (1980 =100), source *a*.
- *BEX* = Black Market Exchange Rate. Monthly rates defined as number of Iranian rials per U.S. dollar are available from source *b*. Average of 12 monthly rates are used as the annual figure for each year except for 1990 which is the author's own observation.
- *OEX* = Official Exchange Rate. Official nominal rate is period average rate from source *a*.