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How can Iran's black market exchange rate be managed?

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Abstract

The Iranian currency (rial) depreciated on average 12.2 per cent per annum against the U.S dollar during the period 1960-1998 but, despite continued two-digit rates of inflation, the rial has witnessed only a meagre 1.7 per cent fall in its value in the post 1998 era. This paper examines this perplexing issue by identifying the major long-run determinants of the black market exchange rate. This paper uses the multivariate cointegration test, a threshold regression model and annual time series data (1960-2008) to determine exactly at what exchange rate the effect of relative prices on the exchange rate has been subject to an asymmetry adjustment process. We found that the relative CPIs in Iran and the U.S., total stock of foreign debt and the price of crude oil are the major long-run determinants of the black market exchange rate. However, the impact of relative prices (as measured by the magnitude of its elasticity) has significantly diminished from almost unity in the pre 1998 period to less than one-fourth since 1998. Based on our results, if oil prices continue to plunge, liquidity and inflation are out of control and at the same time Iran accumulates more external debt, the exchange rate will eventually exhibit an unprecedented and explosive depreciation in the coming years. No previous study has examined this issue using a threshold regression model without splitting the entire sample into two sections according to an endogenously determined threshold for the exchange rate.

Keywords: Iran, Black market exchange rate, Threshold regression

1. Introduction

A volatile and constantly depreciating exchange rate can adversely affect a number of key macroeconomic variables such as private investment, GDP growth, and the demand for money. In fact, the black market exchange rate and its deviation from the official exchange rate in Iran can be considered as a proxy measure for general public confidence in the performance of the economy (Valadkhani, 2003). This market forms a very important Iranian institution that operates in specific streets of Tehran and other large cities and in varied shops. One set of actors in this market may be overseas visitors, Iranians returning from trips abroad, Iranians now resident in other countries and visiting family and friends, etc. who have various quantities of a most valuable commodity, *viz.* other countries' currencies. Another set of actors comprise what can be termed "the real buyers" of these scarce commodities. This set includes businesspersons involved in international trade, particularly importers, Iranians about to travel overseas for any purposes, *e.g.* business trips, the provision of medical services, visiting relatives resident abroad, etc.

However, these "real buyers" will not physically undertake transactions with suppliers of other currencies on the streets. This market is characterised by middlepersons or agents, who close the link between buyers and sellers. These agents will be typically unemployed or underemployed Iranians who may well be frontpersons for wealthy opportunistic entrepreneurs who have recognised that a government policy for the price of other countries' currencies is a non-market clearing price. In both the pre- and post-revolution periods, Iran has operated a fixed exchange rate regime, albeit with periodic devaluations. Prior to the 1979 Islamic Revolution, the official exchange rate between the rial and the US$ was approximately 70-80 rials per dollar. At that time, the gap between the official and the black market exchange rate was about 7-10 rials. However, the gap between the black market and the official rate has massively widened through time.

It is very interesting to note that since 1989 a new source of government revenue originated from the sale of foreign currencies. The exchange rate was devalued by approximately 25 per cent over the period 1989-1992, but in spite of such a devaluation, the black market for foreign currencies persisted. The government's exchange rate policy had the effect of making the government a beneficiary of its own policy. The gap between the black market and the official rates has rendered a windfall gain for both the government and some foreign currency dealers in the parallel market. For this reason, it is apparent that the substantial segment of "other revenue" in the government annual budget is attributable to the sale of foreign currencies by the Central Bank in the black market. The share of "other revenue" in the government budget increased from an average of 14 per cent in the revolutionary and war period (1978-1988) to 36.2 per cent in the four years following the end of the Iraqi war (*i.e.* 1989-1992). It should be noted that the Central Bank started its direct intervention in the black market in 1988 (Valadkhani, 1997).

Overestimation of government revenue and/or underestimation of expenditure placed the Iranian government in a critical situation during the revolutionary and war period (1978-1988). On average the ratio of the budget deficit to total government expenditure trebled in this period compared to that of the oil boom period (1973-1977). In 1989 the budget deficit was for instance so large as to represent an unprecedented rate of 51 per cent of total expenditure. This ratio was reduced to 6.7 per cent in 1993 (Nourbakhsh, 1993). It seems that the sale of foreign currencies by the Central Bank in the black market played a major role in this achievement.

It should also be mentioned that the black market for foreign currencies is linked very closely with the government's policies. In the 1980s the government experienced a substantial budget deficit and, as a result, government indebtedness to the Central Bank increased substantially. Under these circumstances soaring inflation was inevitable. This, in turn, amplified the gap between the official rate and the black market exchange rate for foreign currencies. For example, the gap between the official and black market exchange rates increased from an average of 175 rials per US dollar in the early 1980s to 1400 rials in 1989 (Valadkhani, 1997).

Because of this increasing gap between the official rate and the black market rate, the government devalued the rial to 1750 per US dollar in an attempt to restore the equilibrium in the foreign exchange market and foster non-oil exports. Notwithstanding the fact that Iran used a multiple-exchange-rate system in the allocation of scarce hard currency earnings, this system was not successful. According to Farzin (1995) at one time during the war the number of exchange rates applicable to various categories of imports and exports exceeded seven.

The main reason for the deterioration in the value of the rial is the monetisation of the enormous budget deficit during and after the Iraq war. It should be mentioned that, to some extent, psychological and socio-political factors have also played an undeniable role. The growing gap between the government official and black market exchange rates directed scarce resources to unproductive sectors. The profitability of the trade sector, particularly small-scale trade such as sidewalk and small vendors, stimulated rent-seeking activities at the expense of goods-producing sectors. The currency devaluation policies also coerced economic agents, particularly the government and semi-government enterprises, into having an enormous demand for money (Bahmani-Oskooee, 1996). In other words, while the purchasing power of the rial decreases, people, including the government and semi-government enterprises, demand more money to cover their transactions. It is also argued that the income elasticity of the demand for money has decreased since the 1979 revolution. This means "the same rate of expansion in private sector liquidity is likely to have more inflationary consequences after than before the revolution" (Pesaran, 1995, p.5). This decline in income elasticity is also a manifestation of an inefficient banking system.

Bahmani-Oskooee (1995a, p. 278) points out that in 1993 the black market exchange rate was 2400 rials to the US$, involving a 30-fold depreciation of the rial. In March 1993 the Iranian government embarked upon the exchange rate unification policy with consultation of the IMF (International Monetary Fund). The major objective of this policy was to unify the multiple exchange rate regimes into a single equilibrium rate by the massive intervention of the Iranian Central Bank. However, this policy was not successful on various grounds, *viz.* the lack of an appropriate government social safety net to support vulnerable strata, the incorrect initial exchange rate announced by the Central Bank, and the unsuitable timing of the unification. See Farzin (1995) for a detailed explanation of these reasons and an assessment of the foreign exchange reform in Iran.

Therefore, in late 1995 the Iranian authorities once again decided to administer, or implement, the existing regulations relating to the fixed exchange rate system and "cracked down" on the participants in the black market. The Iranian police, with powers to arrest both buyers and sellers, began to be active in trying to prevent transactions in this market. According to Valadkhani (2004) black market exchange rate was approximately 8314 rials to the US$ in 2003. More recently, the Banking system buys and sells foreign currencies from individuals at a rate marginally below the black market rate, which is currently (April 2009) around 9990 rials per each $US. Abstracting from political and social effects associated with this black market, the important question in this study is to determine the economic factors, which give rise to the prices in the black market for foreign currencies.

The structure of the paper is as follows. In Section 2 a theoretical model is postulated, which captures the long-run determinants of the black market exchange rate using a threshold regression model. Sources of our time series data for the period 1960-2008 as well as the summary statistics of the data and the unit-root results are discussed in Section 3. Section 4 presents the empirical econometric results and policy implications of the study. Section 5 provides some concluding remarks.

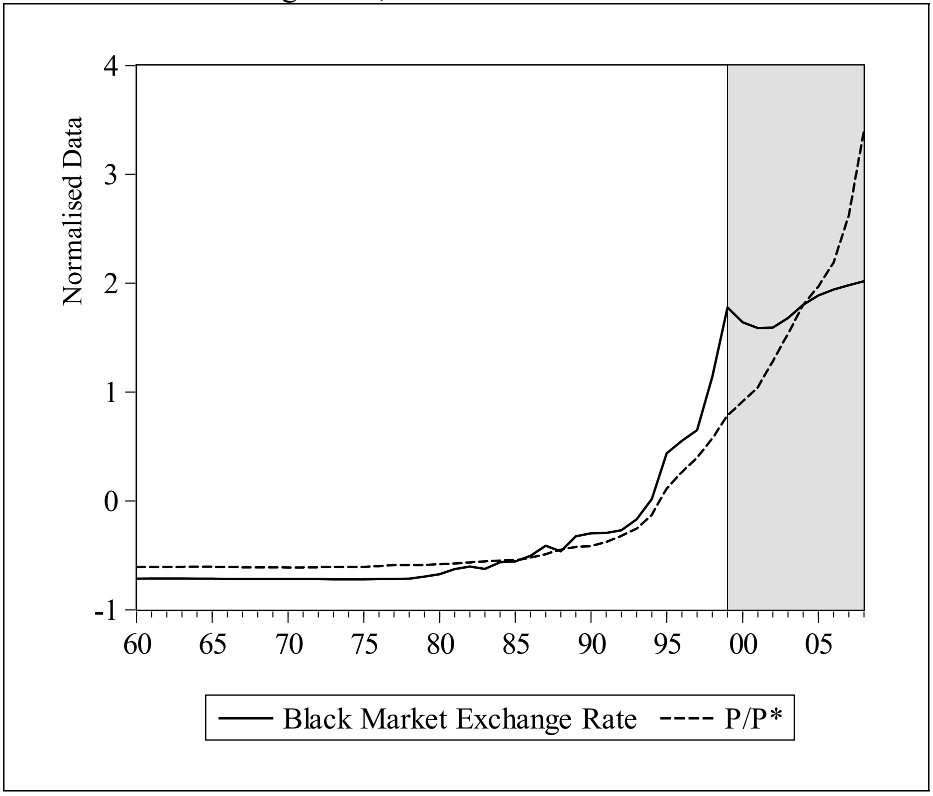
2. Theoretical Framework

Bahmani-Oskooee (1995a and 1995b) has made an important empirical contribution by applying cointegration techniques in his econometric analysis of those factors that determine the black market exchange rate. According to his empirical results, not only the consumer price index is cointegrated with the nominal stock of money, real GDP, the black market exchange rate, and the world export price index (as a proxy for import prices), but also the black market exchange rate has a long-run relationship with the consumer price index, the nominal stock of money, the real GDP, and the world export price index. Bahmani-Oskooee's policy conclusion is that the black market exchange rate cannot be stabilised unless the Iranian government seriously curbs inflation.

Consistent with the monetary approach to the exchange-rate determination modelling, this conclusion is also supported by Figure 1, which shows the time series data on the relative consumer price indices in Iran (*P*) and the U.S. (P^*) and the black market exchange rate (*BE*) for the US dollar in local currency during the period 1960-2008. According to this graph, it seems that after 1998 (the shaded area in Figure 1) the relationship between *BE* and the relative prices has been subject to a significant regime shift. In the post 1998 period similar to the past trend while the rate of inflation continued to soar significantly (15 per cent per annum on average), *BE* has depreciated much less than the anticipated figure for the period 1960-1998 (only 1.7 per cent per annum). In the two separate periods of 1960-1998 and 1979-1998 (referred to as the post Islamic Revolution era) the annual percentage changes in the consumer price index were 13.4 and 19.4 per cent, whereas the corresponding changes for *BE* were 12.1 and 17.1 per cent, respectively.

One can thus conclude that while prior to 1998 there was an almost one-to-one relationship (to be confirmed later in this paper) between these two variables, this relationship mysteriously faded away in the post 1998 era. We double checked the accuracy of the data from Iran' Central Bank ensuring no changes in the definition or the source of the data occurred through time. Since there was no inaccuracy in the data, one could then conclude that an "invisible hand or force" has kept the Iranian currency from further depreciation since 1998 and in this paper it is postulated that this dilemma could be attributable to the price of crude oil. As stated earlier, the sale of foreign currencies by the Central Bank can not only provide a major source of government revenue in its annual budget but also it keeps the value of rial from further depreciation. Based on Figure 1, it appears that relatively higher inflation no longer devalues the local currency in the post 1998 as much as it did in the pre 1998 era. There are some empirical studies which have elucidated this relationship in pre 1998 period: for example see Dadkhah (1987) and Bahmani-Oskooee (1993).

Figure 1. The relative CPIs in Iran (P) and the U.S (P^*) and the Black Market Exchange Rate, 1960-2008



Sources: See Table I.

In his analysis of the black market exchange rate, Pesaran (1992) also emphasised the interaction of inflation and the rates of inflation in Iran's major trading partners (measured by bilateral and multilateral real exchange rate indices). He showed that when Iranian prices increased more than did those of her trading partners, the black market exchange rate rose. Pesaran's analysis, as does that of Bahmani-Oskooee (1995b), points to the crucial factor of Iran's persistent inflation as one of the determinants of the rising price (in Iranian rials) for major international currencies. For a concise review of the literature on black market exchange rates see Siddiki (2000) Bahmani-Oskooee (2005). In this study the long-run equation for the black market exchange rate is specified as follows:

$$\ln\left(BE\right)_t = \alpha_0 + \theta \ \ln\left(P/P^*\right)_t + \beta \ln\left(ED\right)_t + \gamma \ln\left(PO\right)_t + v_t \qquad (1)$$

Where BE is the black market exchange rate (the price of \$US in Iranian rial); P and P^* denote the consumer price index (1982=1) in Iran and the U.S, respectively, ED denote Iran's total external debt (in million dollar); and PO is the price of crude oil (\$US per barrel).

In order to have a valid model for the black market exchange rate, there should be at least one cointegrating vector in the system. The Johansen (1991, 1995) multivariate cointegration technique is used in this paper to test the existence of a long-run equilibrium relationship among the variables specified in equation (1). A brief description of this technique is presented below.

Let us consider the following VAR of order q:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_q y_{t-q_t} + w_t \qquad (2)$$

where y_t is a *k*-vector of I(1) variables (*e.g.* in this study k=4), and w_t is a vector of white noise residuals. Following Johansen (1995), equation (2) can also be rewritten as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{q-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \qquad (3)$$

where $\Pi = \sum_{i=1}^{q} A_i - I$, and $\Gamma_i = -\sum_{j=i+1}^{q} A_j$

The rank (*r*) of Π determines the number of cointegrating vectors. If Π has a reduced rank (*i.e.* *r*<*k*), then there exist $k \times r$ matrices α and β each with rank *r*, where $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. The elements of α represent the adjustment parameters and each column of β in the literature is referred to as the cointegrating vector. Thus the important issue is how to determine the number cointegrating vectors (or *r*). In this paper the trace statistics will determine *r*. The trace statistics test the null hypothesis of *r* cointegrating relations against the alternative of *k* cointegrating equations. For more details see Johansen (1991, 1995).

Let us assume that: a) all the variables in equation (1) are I(1); b) the resulting residuals are I(0); and c) there is only one cointegrating vector in the system. Hence, against the background of the preceding discussion, the following threshold regression for the black market exchange rate can be used to capture the asymmetric impacts of the relative prices on *BE*:

$$\ln(BE)_t = \alpha_0^- + \alpha_0^+ + \left[\theta^- \ln\left(P/P^*\right)_t^- + \theta^+ \ln\left(P/P^*\right)_t^+\right] + \beta \ln(ED)_t + \gamma \ln(PO)_t + v_t \qquad (4)$$

It should be noted in equation (4) depending on whether the black market exchange rate is below or above a certain threshold value(τ), the expected positive long-run effects of relative prices on the dependent variable will then be θ^- and θ^+. Also *BE* is also allowed to be subject to a shift in its intercept term: α^- for the time period when $BE_t < \tau$ and α^+ for the time period, when $BE_t \geq \tau$. Based on the actual data presented in Figure 1, one expects that $\theta^- > \theta^+$ but the sign and relative magnitudes of the two intercept terms are subject to our empirical investigation. The asymmetric definitions of the relative prices can be briefly stated as follows:

$$\left(P/P^*\right)_t^- = min\left\{\left(P/P^*\right)_t^-, 0\right\} \Rightarrow \begin{cases} \left(P/P^*\right)_t^- = \left(P/P^*\right)_t \text{ if } BE_t < \tau \\ \text{and} \\ \left(P/P^*\right)_t^- = 0 \text{ if } BE_t \geq \tau \end{cases} \qquad (5)$$

$$\left(P/P^*\right)_t^+ = max\left\{\left(P/P^*\right)_t^+,0\right\} \Rightarrow \begin{cases} \left(P/P^*\right)_t^+ = \left(P/P^*\right)_t \text{ if } BE_t \geq \tau \\ \text{and} \\ \left(P/P^*\right)_t^+ = 0 \text{ if } BE_t < \tau \end{cases} \quad (6)$$

It is important to note that this specification assumes that the impact of the nominal stock of money, as proposed by Bahmani-Oskooee (1995b), is captured by the consumer price index. It is expected that the Iranian currency can appreciate (*BE* declines in magnitude) as prices in Iran increase less than prices in the U.S, as external debt declines, and as the price of oil rises. Petrodollars provide more market power to Iran's central bank to set their desired benchmark price for foreign currencies in the market. Therefore, it can be hypothesised that if the price of oil is plunging and if the stock of external debt is on the rise and price rises in Iran are higher than those in the U.S economy, particularly when $BE < \tau$, then the price of dollar in local currency would rise. Based on these theoretical postulations, it is then expected that $\beta > 0$, $\theta^- > \theta^+ > 0$ and $\gamma < 0$.

It should be noted that when the null of $\theta^- = \theta^+$ cannot be rejected, the relative prices no longer exert asymmetric effect on *BE* before or after an optimum threshold value or τ and this can be empirically verified by conducting a standard *F*-test. Given that the value of the threshold is unknown, its value should be empirically determined despite the fact that based on Figure 1 it is suspected that such a threshold must have occurred around 1998-1999. Having said that, we need to determine an accurate and optimum value for this threshold endogenously using a formal model. A consistent value of the threshold can be found by undertaking a grid search by first sorting the BE_t sequence in an ascending order as proposed by Enders and Siklos (2001). According to Tong (1990, p.99), this type of threshold regression model 'allows the analysis of a complex stochastic system by decomposing it into a set of smaller sub-systems' without the need for splitting the sample period, which creates a problem regarding the lack of degree of freedom in each side of our sample.

To have enough observations in each side, BE_t is first sorted in ascending order, and based on the middle 60 per cent of the observations, the minimum ($85 for *BE*) and maximum ($8008) gird search values are determined. Within 7923 trials (=8008-85) in our grid search for the best threshold value, the minimum value of grid will be incremented each time by $1 sequentially till the maximum value is reached. *Ceteris paribus*, any value of the threshold which yields the lowest residual sum of squares in equation (4) will be considered as a consistent estimate of the threshold. It is not counterintuitive to assume that all of the explanatory variables to be at least weakly exogenous as their values are highly likely to be determined outside of our model. Given the results of Johansen multivariate cointegration test and our Hausman test results (not reported in this paper due to the page limit), we found no simultaneity problem in equation (4), whereby justifying the use of OLS estimation method.

3. The Data

Before estimating our model and report our empirical results, it is important to look at the sources and definitions of the data employed in Table I. Annual time series data cover the period 1960 to 2008 for all variables indicated in equation (1). Over this period, Iran's CPI, the relative price index and the black market exchange rate were the most volatile series based on the magnitude of their coefficients of variation (CV). The reported skewness, Kurtosis and Jarque-Bera statistics in Table I indicate that with the exception of the CPI of the US none of the variables are normally distributed. The plots of the data have been presented in Figure 2. As can be seen, Iran's external debt prior to the 1979 Islamic Revolution was basically zero. In order to take the natural logarithm of this variable, those years with value of zero debt were assumed to be equal 0.00001.

An important step before using the Johansen multivariate technique is to determine the time series properties of the data. This is an important issue since the use of non-stationary data in the absence of cointegration can result in spurious regression results. To this end, the Kwiatskowski-Phillips-Schmidt-Shin (KPSS, 1992) test has been adopted to examine the stationarity, or otherwise, of the time series data. The KPSS test has the null of stationarity, and the alternative indicates the existence of a unit root. The empirical results of the KPSS test are also summarised in Table I, suggesting that all the variables employed in this analysis are I(1).

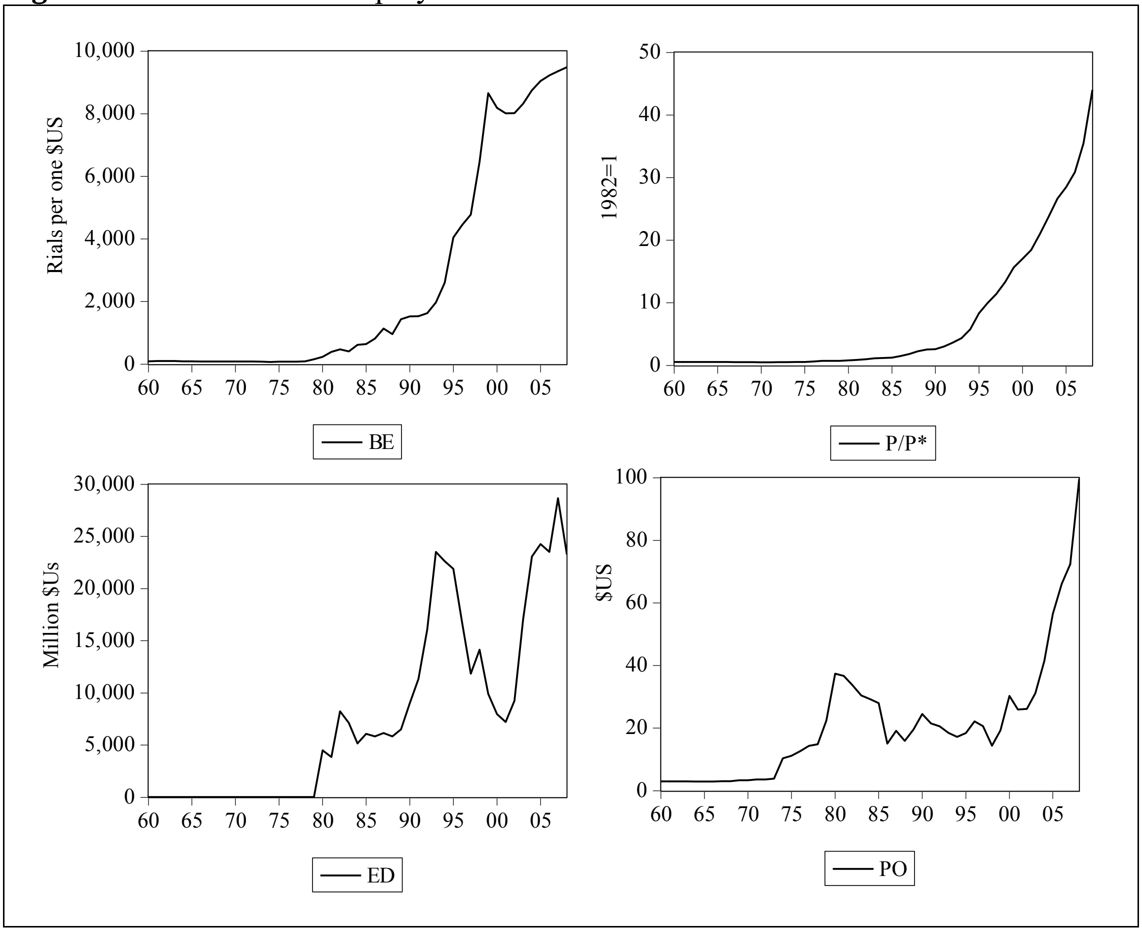
Table I. Summary statistics of the data employed, 1960-2008

Description	$(BE)_t$	$(P)_t$	$(P^*)_t$	$(P/P^*)_t$	$(ED)_t$	$(PO)_t$
Sources	(a)	(a)	(b)	(a) and (b)	(a)	(c)
Unit	Rials per each \$US	Index number (1982=1)	Index number (1982=1)	Relative price index (1982=1)	Million \$US	West Texas Intermediate \$US per barrel
Mean	2550	13.16	1.08	7.13	7766	21.3
Maximum	9489	98.00	2.23	43.93	28647	99.6
Minimum	74	0.17	0.31	0.49	0	2.9
Std. Dev.	3438	22.84	0.62	10.84	8741	19.7
CV	135	174	58	152	113	93
Skewness	1.09	2.04	0.21	1.75	0.88	1.88
Kurtosis	2.46	6.52	1.66	5.16	2.49	7.35
Jarque-Bera	10.22	59.22	4.03	34.56	6.81	67.43
P-value	0.01	0.00	0.13	0.00	0.03	0.00
Variable	$\ln(BE)_t$	$\ln(P)_t$	$\ln(P^*)_t$	$\ln(P/P^*)_t$	$\ln(ED)_t$	$\ln(PO)_t$
KPSS test	1.485♣	0.618♣	1.023♣	0.466♣	0.464♣	0.758♣
Variable	$\Delta\ln(BE)_t$	$\Delta\ln(P)_t$	$\Delta\ln(P^*)_t$	$\Delta\ln(P/P^*)_t$	$\Delta\ln(ED)_t$	$\Delta\ln(PO)_t$
KPSS test	0.265	0.406	0.150	0.442	0.092	0.114

Notes:
(1) According to Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992, Table 1), the 5% asymptotic critical value for the KPSS test is 0.463. (2) ♣ indicates that the KPSS null hypothesis (the series being stationary) is rejected at the 5 per cent significance level.

Sources:
(a) Tabibian *et al.* (2000), the Central Bank (2009).
(b) Bureau of Labor Statistics, Washington, D.C.: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt
(c) Federal Reserve Bank of St. Louis:
http://research.stlouisfed.org/fred2/series/OILPRICE/downloaddata/OILPRICE.xls

Figure 2. Plot of the data employed 1960-2008



Source: See Table I.

4. Empirical Results and Policy Implications

Since all the variables in equation (1) are I(1), the Johansen (1991, 1995) multivariate cointegration technique can now be used to test the existence of a long-run equilibrium relationship for *BE*. The first important step in this test is to determine the optimal lag length (q). Based on the Schwarz information criterion and the Hannan-Quinn information criterion, the optimal lag length is equal to one. Table II reports the results of the Johansen multivariate cointegration test on the black market exchange rate as formulated in equation (1). According to the trace test, there is robust evidence of one cointegrating vector at the 5 per cent level of significance.

Table II. Johansen test for cointegration

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% critical value
None	0.42	66.64*	63.88
At most 1	0.38	41.25	42.92
At most 2	0.24	18.41	25.87
At most 3	0.11	5.68	12.52

Note: * indicates that the corresponding null hypothesis is rejected at 5 % significance level.

Table III. Long-run threshold regression results

$$\ln(BE)_t = \alpha_0^- + \alpha_0^+ + \left[\theta^- \ln(P/P^*)_t^- + \theta^+ \ln(P/P^*)_t^+\right] + \beta \ln(ED)_t + \gamma \ln(PO)_t + v_t$$

Parameters	Estimated elasticities	*t*-statistics*	p-value
α_0^-	5.9262	39.2	0.00
α_0^+	8.1039	44.5	0.00
θ^-	0.9672	16.6	0.00
θ^+	0.2291	2.6	0.01
β	0.0633	6.3	0.00
γ	-0.1024	-1.8	0.08

Order of integration of stochastic residuals: I(0)
Goodness-of-fit statistics:
R^2=0.995 Overall F statistic F =1392

Hypothesis testing using Wald F test:
Asymmetric intercept effect $H_0^1 : \alpha_0^- = \alpha_0^+$: F(1, 42)=52.42 [p-value=0.00]
Asymmetric Slope effect $H_0^2 : \theta^- = \theta^+$: F(1, 42)=35.64 [p-value=0.00]
Slope Coefficient hypothesis:
Before 1998 $H_0^3 : \theta^- = 1$: F(1, 42)=0.318 [p-value=0.58]
After 1998 $H_0^4 : \theta^+ = 0.25$: F(1, 42)=0.060 [p-value=0.81]

Diagnostic tests:		
DW	2.23	
Breusch-Godfrey Serial Correlation LM Test (AR 1-2):	F(2,40)=0.382	[0.68]♣
Normality	$\chi^2(2)$ = 2.33	[0.53]♣
White Heteroskedasticity	F (16, 31) = 3.30♣♣	[0.01]♣
RESET	F (2, 40) =2.30	[0.11]♣
Chow Forecast Test: Forecast from 2004 to 2008	F (5, 37) =0.12	[0.98]♣

Notes: (♣) Figures in square brackets show the corresponding p-values; (♣♣) Due to an unknown form of hetroskedasticity in the residuals we used the Newey-West HAC standard errors and covariance matrix to correct the standard errors and t-ratios.

There are 49 annual observations in the sample period (1960-2008). We have estimated the threshold regression model as specified in equation 4 and presented the results in Table III. Our grid search points to an optimal value of $\tau = 6468$, which has been endogenously determined by the data. This optimal threshold value for the black market exchange rate occurs exactly in the year 1998 when the relationship between P/P^* and *BE* was initially suspected to break down according to Figure 1. As seen from Table III, all of the estimated coefficients are statistically significant at least at the 8 per cent level or better, and have the expected theoretical signs. This equation also performs extremely well in terms of goodness-of-fit statistics. The adjusted R^2 is as high as 0.995 and the overall F test rejects the null hypothesis at the one per cent level. With the except of the White test, this equation also passes each and every diagnostic tests and as a result we have used the Newey-West HAC standard errors and covariance matrix to correct the standard errors and *t*-ratios. The threshold regression model presented in Table III also performs extremely well in terms of out-of-sample forecasting ability for the five years period of 2004 to 2008.

Based on the Wald test results in Table III, we cannot reject both $H_0^3:\theta^- = 1$ and $H_0^4:\theta^+ = 0.25$. Thus one can briefly write our estimated threshold regression model as:

$$\ln\left(BE\right)_t = 0.06\ln\left(ED\right)_t - 0.10\ln\left(PO\right)_t + v_t + \begin{cases} 5.93 + 1.0\ln\left(P/P^*\right)_t^- & \text{if } BE_t < 6468 \\ \text{and} & \\ 8.10 + 0.25\ln\left(P/P^*\right)_t^+ & \text{if } BE_t \geq 6468 \end{cases} \qquad (7)$$

Therefore, one can argue that in the long-term, one per cent increase in relative prices (*P/P**) could result in almost one per cent depreciation of the Iranian currency in the pre 1998 period, when $BE_t < 6468$. But this same percentage increase in (*P/P**) has led to only 0.25 per cent depreciation of the currency since 1998. In terms of the magnitude of the estimated elasticity for *ED*, the results indicate that if external debt increases say by 10 per cent *BE* will depreciate by 0.06 per cent. It is also found that an increase in the price of crude oil by 10 per cent, *ceteris paribus*, could strengthen the value of Iranian rial in the long-run by 1 per cent. In other words, the results reported in Table III indicate that the long-term sources of the continuous depreciation of the Iranian rial are high inflation rates, a massive rise in the stock of foreign debt through time and a fall in the price of oil.

5. Concluding Remarks

In this paper the long-term drivers of the black market exchange rate in Iran have been examined by using annual time series data from 1960 to 2008. The Johansen multivariate cointegration technique was employed to estimate and validate a long-term exchange rate model. The empirical results are broadly consistent with previous studies and the monetary approach to the exchange-rate determination. It is found that in the long-term a reduction in the stock of external debt, a rise in the price of crude oil accompanied by strict monetary and fiscal policies aimed at curbing the rate of inflation can restore and strengthen the value of the Iranian currency. In terms of the magnitude of the estimated elasticities, it seems that the coefficient for the relative prices has diminished from unity during the period 1960-1998 to almost 0.25 since 1998.

Based on our results there is a statistical significant cointegrating vector capturing the long-run determinants of the black market exchange rate in Iran (as defined by equation 1). Hence, one expects that eventually the one-to-one relationship between the relative prices and the exchange rate would prevail and this may lead to a further and faster depreciation of the black market exchange rate in Iran. In sum, if the Iranian government is to continue financing its large budget deficits through monetisation, sooner or later inflation can depreciate the domestic currency on a one-to-one basis. Therefore, curbing inflation should be the number one priority on the policy agenda of the government and this cannot be achieved unless the central bank of Iran operates independently and stop the monitisation of the government's massive fiscal deficits.

References

Bahmani-Oskooee, M. (1993), "Black market exchange rate *versus* official exchange rates in testing purchasing power parity: an examination of the Iranian rial", *Applied Economics*, Vol. 25 No. (4), pp. 465-72.

Bahmani-Oskooee, M. (1995a), "The decline of the Iranian rial during the post-revolutionary period: the monetary approach and Johansen's cointegration analysis", *Canadian Journal of Development Studies*, Vol. XVI No. 2, pp. 277-90.

Bahmani-Oskooee, M. (1995b), "Source of inflation in post-revolutionary Iran", *International Economic Journal*, Vol. 9 No. 2, pp. 61-72.

Bahmani-Oskooee, M. (1996), "The black market exchange rate and demand for money in Iran", *Journal of Macroeconomics*, Vol. 18 No. 1, pp. 171-6.

Bahmani-Oskooee, M. (2005), "History of the rial and foreign exchange policy in Iran", *Iranian Economic Review,* Vol.10 No. 14, pp. 1-20.

Central Bank (2009), *Economic Indicators*, Department of Economic Accounts, Central Bank of Iran, Tehran < http://www.cbi.ir/ >, Accessed February 2009.

Dadkhah, K.M. (1987), "The inflationary process of the Iranian economy: a rejoinder", *International Journal of Middle East Studies*, Vol. 19, pp. 388-91.

Enders, W., and Siklos, P.L. (2001), "Cointegration and threshold adjustment', *Journal of Business and Economic Statistics*, Vol. 19, pp. 166–76.

Engle, R.F. and Granger, C.W.J. (1987), "Cointegration and error correction: representation, estimation and testing", *Econometrica*, Vol. 55 No. 2, pp. 251-76.

Farzin, Y.H. (1995), "Foreign exchange reform in Iran: badly designed, badly managed", *World Development*, Vol 23 No. 6, pp. 987-1001.

Johansen, S. (1991), "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models", *Econometrica*, Vol. 59 No. 6, pp.1551-80.

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P. and Shin, Y. (1992), "Testing the null hypothesis of stationarity against the alternative of a unit root: how sure are we that economic time series have a unit root?", *Journal of Econometrics,* Vol. 54, pp.159-78.

Nourbakhsh, M. (1993), *Summary Proceeding of the Meeting of the Board of Governors: Annual Meeting*, International Monetary Fund, Washington, D.C, 156-8.

Pesaran, M.H. (1992), "The Iranian foreign exchange policy and the black market for dollar", *Middle East Studies*, Vol. 24, pp. 101-25.

Pesaran, M.H. (1995), "Planning and macroeconomic stabilisation in Iran", *DAE Working Papers Amalgamated Series No. 9508*, Department of Applied Economics, Cambridge University, Cambridge.

Siddiki, J. (2002), "Black market exchange rates in India: an empirical analysis", *Empirical Economics*, Vol. 25, pp. 297-313.

Tabibian, M. Rashidi M, and Sadighi, K (2000), *Pre-Data Process System (PDS)*, A database software package, Institute for Research and Economic Development, Tehran.

Tong, H. (1990), *Nonlinear Time-series: A Dynamical Systems Approach*, Oxford University Press, Oxford.

Valadkhani, A. (1997), *A Macroeconometric Model for the Iranian Economy,* An unpublished Ph.D. thesis submitted to The University of Queensland, Brisbane.

Valadkhani, A. (2003), "The causes of unemployment in Iran", *International Journal of Applied Business and Economic Research,* Vol. 1 No. 1, pp. 21-33.

Valadkhani, A. (2004), "An empirical analysis of the black market exchange rate in Iran", *Asian-African Journal of Economics and Econometrics*, Vol 4 No. 2, pp. 141-52.