Research Department Working Paper *No:14*

EFFECTS OF THE INTEREST RATE DEFENSE ON EXCHANGE RATES DURING THE 1994 CRISIS IN TURKEY

The Central Bank of the Republic of Turkey

Effects of the Interest Rate Defense on Exchange Rates During the 1994 Crisis in Turkey

İnci Gümüş

Abstract

This paper aims at evaluating the relationship between interest rates and exchange rates during the 1994 currency crisis in Turkey in order to explain whether high interest rates had the effect of appreciating the nominal exchange rates. Using weekly data and applying a vector error-correction model, it is found that raising interest rates had the significant long-run effect of depreciating the nominal exchange rates in contrast with the conventional wisdom.

1. Introduction

A standard policy prescription in exchange rate crises has been raising the interest rates as a way of tightening the monetary policy in order to stabilize the exchange rate. The relationship between interest rates and exchange rates during crises has been the subject of a controversial literature and this controversy became more intense in the aftermath of the East Asian currency crisis. As a condition of the IMF program, the Asian crisis countries implemented tight monetary policies and raised the interest rates substantially, the results of which have been analyzed in different papers.

The traditional view about the relationship between exchange rates and interest rates stresses that raising the interest rates support the exchange rates in a crisis. Higher interest rates raise the return that an investor obtains by investing in the country and therefore reduce the capital flight. Also, by increasing interest rates, it can be made very costly for speculators to take short positions in the currency under attack, and therefore speculation may be discouraged. Tight monetary policy can also signal the commitment of the monetary authority to defending the currency and be effective in restoring the confidence. These together support the currency and lead to an exchange rate appreciation.

On the other hand, several economists defend a revisionist view arguing that raising interest rates during the crises may further weaken the currency. High interest rates worsen the financial position of the debtors, inducing bankruptcies and raising the default probabilities. Even though a higher interest rate, by itself, may make investment in local currency-denominated assets more attractive, higher default probabilities and riskiness may offset this effect and discourage the foreign investors. Reduction in the net worth of firms as a result of increasing interest rates can lead to bankruptcies which in turn affect the firms' creditors and the banking sector. This can lead to a credit crunch and worsen the financial situation, resulting in capital outflows and exchange rate depreciation. It is also pointed out that interest rates have to be increased to very high rates in order to make domestic investment attractive. This view has been defended strongly by Furman and Stiglitz (1998) and Radelet and Sachs (1998).

This paper aims at examining the relationship between the interest rates and exchange rates in Turkey during the 1994 crisis using the methodology of Dekle, Hsiao, and Wang (2002) in order to understand whether higher interest rates led to an appreciation of the currency. Results of the vector error-correction estimation imply that raising interest rates has had the long-run effect of depreciating the exchange rate supporting the revisionist view.

The rest of the paper is organized as follows. In section 2, the theoretical and empirical aspects of the relationship between interest rates and exchange rates are reviewed. The behavior of the interest rates and exchange rates in Turkey during 1994 crisis is presented with graphs in section 3. In section 4, the methodology and the results are explained and section 5 is the conclusions.

2. Relationship between interest rates and exchange rates

a) Theory

The relationship between interest rates and exchange rates is given by the uncovered interest parity equation:

$$i_t - i_t^* = E_t(e_{t+1}) - e_t + RP_t$$

where i_t is the domestic interest rate at time t, i_t^* is the foreign interest rate at time t, e_t is the domestic exchange rate at time t, $E_t(e_{t+1})$ is the expected exchange rate at time $t+1$, and RP_t is the country risk premium at time t. Risk premium incorporates both the exchange rate risk premium and the default risk premium on domestic bonds.

According to the uncovered interest parity condition, a rise in the domestic interest rates will lower e_t; appreciate the exchange rate if $E_t(e_{t+1})$ and RP_t are kept constant. This is the effect that is suggested by the traditional view.

However, the constancy of $E_t(e_{t+1})$ and RP_t are questionable at times of crisis. Increases in the interest rates may increase the borrowing costs of corporations, induce bankruptcies, hurt the banking system worsening the financial situation and leading to a capital flight. Therefore, risk premium can be positively correlated with interest rates. In terms of the uncovered

interest parity equation, as i_t increases, RP_t also increases and if this increase is high enough, it can lead to a depreciation of the currency, i.e. an increase in e_t. This is the perverse effect that is defended by the revisionist view.

b) Empirical Evidence

The empirical work examining the interest rate-exchange rate nexus during crises can be divided into two main categories, those using cross-country data, and those using high frequency (daily or weekly) time-series data, with the results being mixed in both categories. Cross-country studies evaluate the effect of interest rates on exchange rates across many crisis episodes in different countries. Among these studies are Goldfajn and Gupta (1999), Furman and Stiglitz (1998) and Kraay (2000).

Goldfajn and Gupta (1999) study a large number of currency crisis episodes that have led to real exchange rate undervaluations. Defining a successful recovery as one that occurs through a nominal appreciation rather than an increasing inflation, they compare the overall probability of success with the probability of success for the cases where monetary policy was tightened through higher interest rates. They find that except for the cases where both currency and banking crises are present, tight monetary policy increases the probability of success substantially (from 26% to 37%).

Furman and Stiglitz (1998) look at cases where short-term nominal interest rates have been temporarily increased, in a sample of nine developing countries and find that these episodes were followed by a depreciation of the currency rather than an appreciation. The same result is obtained for all of the countries in their sample but it is significant only for the low-inflation ones, which include East Asia.

Kraay (2000) looks at several currency crisis episodes from 1960 to 1997, grouping these as successful speculative attacks, the ones that ended in a sharp nominal devaluation, and failed speculative attacks, those that did not end in a devaluation, in a sample of 75 developed and developing countries. He then checks whether interest rates systematically increase during failed speculative attacks and whether raising interest rates increases the probability that a speculative attack fails using a probit model. He finds no evidence in favor of the conventional wisdom that high interest rates defend currencies during speculative attacks.

The other line of empirical work that analyzes the effects of tight monetary policy on exchange rates is the time-series studies that use high frequency data. As for the cross-country studies, the results of these mostly VAR based time series studies are also mixed.

Goldfajn and Baig (1998) run a VAR model using daily nominal interest rate and exchange rate data for five Asian crisis countries (Korea, Indonesia, Malaysia, Thailand, and Philippines). They find no evidence of overly tight monetary policies in these countries in 1997 and early 1998. With regard to the relationship between interest rates and exchange rates, they find that higher interest rates are associated with stronger exchange rates even though the effects are insignificant.

In the paper, from which the methodology of this paper is adapted, Dekle, Hsiao, and Wang (2002) estimate a VAR model using weekly data to test the effectiveness of tight monetary policy on exchange rates in Korea, Malaysia, and Thailand during the Asian crisis and its aftermath. Their findings are supportive of the traditional view that raising interest rates appreciate the exchange rates thus but the impact is found to be small.

Dekle, Hsiao, and Wang (2001) conduct the same type of analysis for Korea, adding bankruptcy rate among the other variables. They again find that higher interest rates lead to an exchange rate appreciation.

Among the papers that do not use VAR are Gould and Kamin (2000) and Cho and West (2001). Gould and Kamin try to reduce the endogeneity problem of the interest rates by using measures of international credit spreads and of stock market returns as proxies for country risk premium. Adding these variables to the regressions to better identify the independent impact of interest rates on exchange rates, they find that credit spreads and stock prices significantly affect the exchange rates during financial crises whereas interest rates do not have significant and consistent effects for the five Asian crisis countries that have been analyzed.

In contrast with the VAR based models, Cho and West (2001) estimate a structural model on weekly data for Korea, Philippines, and Thailand. The way they go about for seeing the effect of interest rate increase is testing whether the risk-premium increases and whether this

is enough to cause a depreciation of the exchange rates. As a result they find that an exogenous increase in the interest rates led to exchange rate appreciation in Korea and Philippines, and to an exchange rate depreciation in Thailand during the crisis period.

In the case of Turkey, there are no papers of which I am aware that analyzes the effect of interest rate defense on exchange rates during crises, even though a few papers can be cited that examine this effect without specifically looking at the crisis periods. Agenor, McDermott, and Ucer (1997) estimate a VAR model in order to examine the links between fiscal policy, uncovered interest rate differentials, the real exchange rate, and capital inflows in Turkey since the late 1980's. According to their results, an increase in the interest rate differential leads to an appreciation of the real exchange rate and the effect is significant.

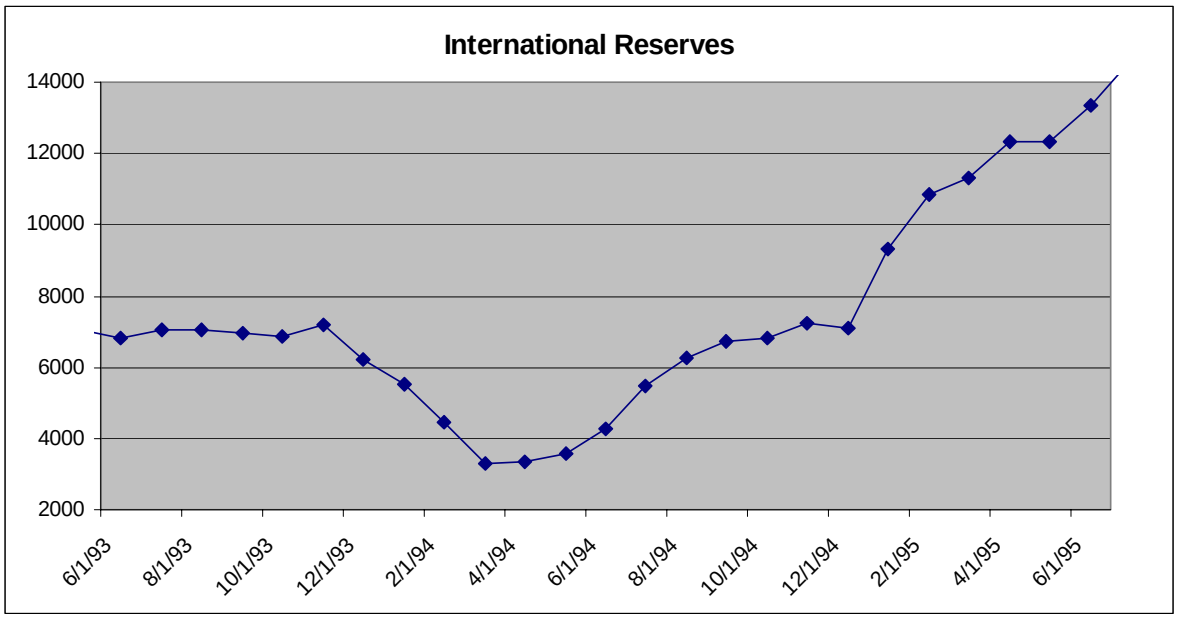
Berument (2001) uses the spread between the interbank interest rate and the depreciation rate of the domestic currency as an indicator of the monetary policy and estimates a VAR model covering the period from 1986 to 2000. He finds that tight monetary policy leads to the appreciation of the currency.

Aysoy and Kıpıcı (2002) construct a small-scale quarterly macro econometric model of the Turkish economy covering the period from 1987 to 2001. They find that an increase in the overnight interest rate results in a depreciation of the nominal exchange rate.

3- 1994 crisis in Turkey

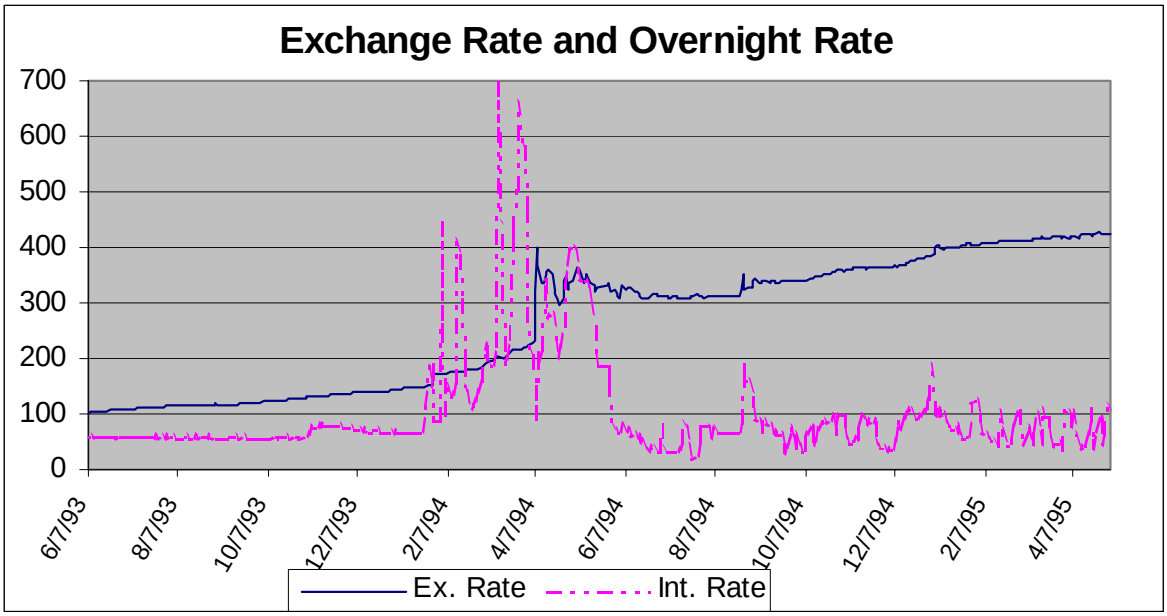
Towards the end of 1993, Turkish government was trying to reduce the very high level of domestic public debt stock by cutting interest rates on Treasury bills (Celasun, 1998). Treasury started to rely on Central Bank's resources instead of domestic borrowing. Cancellation of several Treasury auctions and limited domestic borrowing via Treasury auctions as a result of this policy, led to an excess liquidity in the market and to pressure on the exchange rates in the last months of 1993, which continued in early 1994. This excess liquidity caused a run on foreign currency and loss of international reserves. The decrease in the international reserves started in November 1993 and continued until April 1994 as seen in Graph-1.

Graph-1



Parallel to these, the TL dropped from 14,500 in January 1st to 39,850 in April 7th against the US$, depreciating by more than 100%. A stabilization program was launched on 5th of April and the new monetary program prepared in line with the IMF stand-by agreement was put into effect in May. With the taken measures, the pressure on the exchange rate started to be reduced starting in May as can be seen in Graph-2 by the appreciation of the exchange rate between May and August. The international reserves also started to increase from May onwards.

Graph-2



Looking at Graph-2 it is seen that the overnight interest rate in the interbank money market was raised a little bit in the last two months of 1993. In the first months of 1994, overnight rate was raised substantially from around 70% to 700% as a reaction to the pressure on the exchange rates. By the end of June 1994, overnight rate was reduced to about 30%.

In this paper, the period between the first week of November 1993 and the last week of June 1994 is taken since the pressure on the exchange rates starts to decrease starting in May as seen by the behavior of the exchange rate and the increase in the international reserves as well as the reduction in the overnight rate. The controversy about the effect of interest rate defense is only for the crisis periods, and the aim of this paper is to analyze this in the context of 1994 Turkish crisis. Therefore, the sample period is chosen to reflect the exchange market pressure leading to the depreciation of the currency.

4- Econometric Methodology and Results

In this section, the effects of high interest rates on exchange rates during the 1994 Turkish crisis will be analyzed using the econometric methodology of Dekle, Hsiao, and Wang

(2002). In their paper Dekle, Hsiao, and Wang estimate a VAR model with the logarithmic transformations of the spot exchange rate, the domestic interest rate, and the domestic-US inflation rate differential as the variables using weekly data for Korea, Malaysia, and Thailand. As there are two opposing views about the role of interest rate defense during economic crises, the authors say that the right model for the Asian crisis is unknown and structural estimation can lead to biased results. Since a VAR is an unrestricted reduced-form model that can correspond to different structural models, they estimate a VAR to avoid the possibility of estimating the wrong model.

Applying the same methodology as theirs, the weekly spot exchange rate, domestic interest rate and domestic-US inflation rate differential data are used in this paper for Turkey from November 1993 to the end of June 1994. This eight month period is chosen to represent the crisis period as explained in the previous section. The overnight interest rate is used as the domestic interest rate variable, since it represents the policy instrument used by the Central Bank to tighten the monetary policy in order to stabilize the movements in the exchange rate.

First, Augmented Dickey-Fuller (ADF) tests are conducted to test for the presence of unit roots in the logarithmic transformations of the exchange rate, e_t, the overnight interest rate, i_t, and the inflation rate differential, p_t. The order of lags to conduct the ADF tests are chosen by starting from a higher order and reducing the order until the t-statistic corresponding to the highest-order lag turns out to be significant. The test statistics and critical values are given in Table-1. The test statistics for the stationarity of the levels of e_t and i_t, indicate the presence of a unit root for both 1% and 5% significance levels whereas for p_t, 5% significance level indicates stationarity. To be certain about this variable, a Phillips-Perron test is also conducted. The test statistic for this test is -2.4226 and the 99% and 95% critical values are -3.6422 and -2.9527 respectively, which confirms the presence of a unit root for p_t, as well. The test statistics for the first differences of all of the variables lead to rejection of the null hypothesis of a unit root, which indicates that all of the variables are integrated of order 1, I(1).

Table 1. Unit root tests

Variable	Order	ADF Test Statistic	99% Critical Value	95% Critical Value
e_t^*	3	-2.199883	-4.2949	-3.5670
i_t	0	-1.021170	-3.6422	-2.9527
p_t	1	-2.986826	-3.6496	-2.9558
Δe_t	0	-3.988588	-3.6496	-2.9558
Δi_t	0	-5.427130	-3.6496	-2.9558
Δp_t	3	-4.183606	-3.6752	-2.9665

* The test for the stationarity of e_t includes an intercept term and a time trend, the others only include intercept terms.

Second, the variables are tested for cointegration using the Johansen test. Table-2 presents the test results. The first row tests the hypothesis of no cointegration and the second row tests the hypothesis of at most one cointegrating vector. Comparison of the likelihood ratio test statistics with the 99% and 95% critical values indicate that no cointegration hypothesis is rejected at both significance levels and the hypothesis of at most one cointegrating vector cannot be rejected at either significance level. Therefore it is concluded that there is a cointegrating vector for the considered variables.

Table 2. Johansen's Cointegration Test

Eigenvalue	Likelihood Ratio test statistic	99% Critical Value	95% Critical Value	Hypothesized number of CE's
0.697005	47.63341	41.07	34.91	None
0.220921	10.61819	24.60	19.96	At most 1

* Cointegration test is conducted with an intercept term in the cointegrating vector and no trend in the cointegrating vector and in the variables.

Since a cointegrating relationship is found between the variables, the appropriate estimation procedure is a vector error-correction model. Cointegration implies that there is a long-run equilibrium relation between the variables and the short-term dynamics of the

variables are influenced by the deviation from equilibrium. A vector error-correction model for the considered variables is of the following form:

$$\Delta y_t = \theta_1 \Delta y_{t-1} + \theta_2 \Delta y_{t-2} + \ldots\ldots + \theta_p y_{t-p} + \alpha\beta' y_{t-1} + \varepsilon_t$$

where $y_t = (e_t, i_t, p_t)$, $\Delta = (1\text{-}L)$ and L denotes the lag operator, α and β are 3 x 1 vectors. $\beta' y_{t-1}$ is the cointegrating vector representing the deviation from the long-run equilibrium of the variables and α is the speed of adjustment parameter showing the response to the previous period's deviation from the long-run equilibrium. θ_i, on the other hand, show the impact effect of the variables.

To determine the lag order of the model Akaike (AIC) and Schwarz (SC) information criteria are used. The minimum value of AIC is obtained with 2 lags whereas SC reaches its minimum with 1 lag (values are given in Table-3). To choose between 1 lag and 2 lags, a likelihood ratio test is conducted. The likelihood ratio test statistic for the null hypothesis of 1 lag and the alternative hypothesis of 2 lags is 27.0656 and the chi-square value with 9 degrees of freedom for 5% and 1% significance levels are 16.919 and 21.666, respectively. As the null hypothesis is rejected at both significance levels, the lag order is taken to be 2 lags.

Table 3. AIC and SC statistics for different lags of the VEC model

Lag Order	AIC	SC
1	3.202234	**3.935102**
2	**3.036731**	4.193173
3	3.265439	4.853462

Since the lag order is determined to be 2 lags, the estimated model is:

$$\Delta y_t = \theta_1 \Delta y_{t-1} + \theta_2 \Delta y_{t-2} + \alpha\beta' y_{t-1} + \varepsilon_t$$

Estimation results are given in Table-4.

Table 4. Parameter estimates for the VEC model

	Δe_t	Δi_t	Δp_t
Δe_{t-1}	0.372405 (1.95669)	1.327748 (1.09577)	19.86339 (2.79215)
Δe_{t-2}	-0.310345 (-1.75421)	-0.476962 (-0.42347)	8.706746 (1.31666)
Δi_{t-1}	-0.058646 (-1.63762)	0.002415 (0.01059)	4.108265 (3.06910)
Δi_{t-2}	0.016367 (0.41560)	0.218844 (0.87284)	5.417193 (3.68008)
Δp_{t-1}	0.000962 (0.19794)	0.048121 (1.55590)	0.165299 (0.091033)
Δp_{t-2}	-0.005816 (-1.10499)	-0.037285 (1.55590)	0.124580 (0.63326)
V_{t-1}^{*}	-0.033706 (-2.32269)	0.012914 (0.13978)	2.897902 (5.34101)

***** Cointegrating vector:

$$V = e_t - 0.909302\, i_t - 0.167367\, p_t - 6.024920$$
$$(-3.42107) \quad (-1.67565) \quad (-5.59075)$$

*The numbers in parentheses are the t-statistics.

Looking at the estimation results, it is seen that the long-run equilibrium relation between the variables takes the form

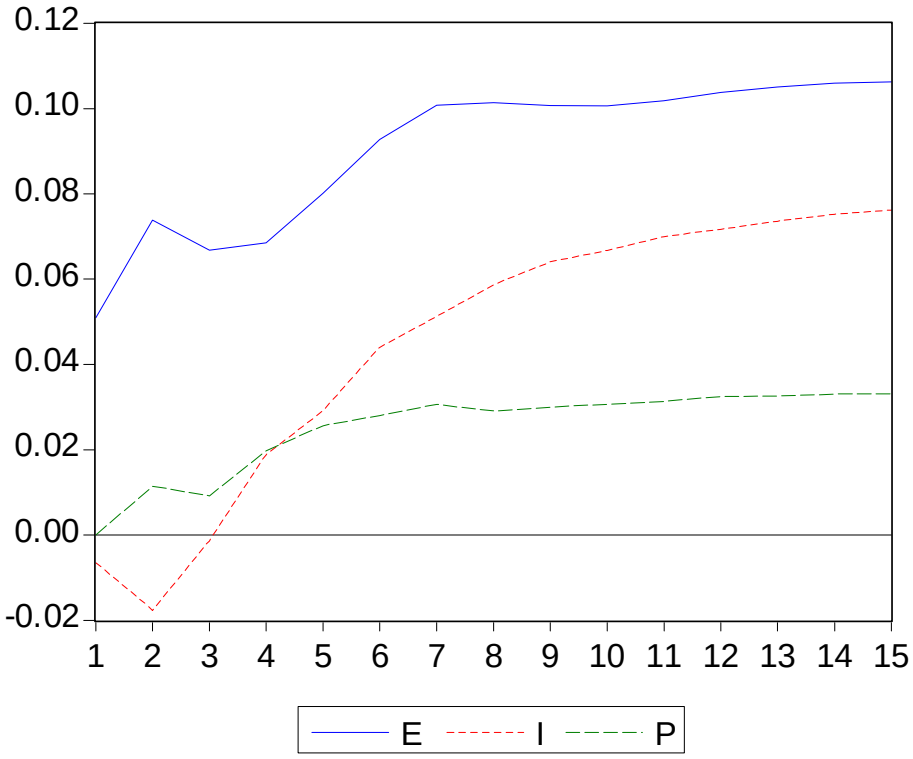
$$e_t = 6.024920 + 0.909302\, i_t + 0.167367\, p_t$$
$$(5.59075) \quad (3.42107) \quad (1.67565)$$

The positive and statistically significant coefficient of i_t indicates that the long-run effect of raising the interest rate is a depreciation of the exchange rate, which is in line with the revisionist view. This coefficient shows that the long-run elasticity of the exchange rate with respect to the interest rate is 0.91. The short-run effect of the interest rate variable is

somewhat ambiguous. The coefficient of Δi_{t-1} is negative whereas the coefficient of Δi_{t-2} is positive and both of them are insignificant.

Using the estimated model, the impulse response functions of the exchange rate to a one standard deviation shock to all of the variables are calculated assuming an ordering of $\{i_t, e_t, p_t\}$. This ordering corresponds to the assumption that i_t is only affected by the lagged values of e_t and p_t but not contemporaneously, whereas e_t and p_t are affected by the contemporaneous value of i_t. However, the patterns of the impulse response functions are robust to different orderings.

Graph-3. Impulse response of the exchange rate to one standard deviation shocks



As seen in the above graph, the initial impact of a shock to interest rate is appreciation of the exchange rate which lasts for two periods. From second period onwards exchange rate starts to depreciate and this effect lasts for the rest of the periods. The effects of shocks to exchange rate and inflation variables are depreciation of the currency as expected.

The estimation results and impulse response function support the revisionist view for the 1994 Turkish crisis. Even though the increase in interest rates lead to exchange rate appreciation on impact, this result is insignificant and the significant long-run result implies exchange rate depreciation. The long-run effect starts to exert its influence after two weeks and leads to depreciation from that point onwards.

5- Conclusions

In this paper, the relationship between the exchange rate and interest rate has been analyzed during the 1994 currency crisis in Turkey using a vector error-correction model. Estimation results show that higher interest rates are associated with exchange rate depreciation in the long-run, supporting the revisionist view. Even though the impact effect of an interest rate increase is exchange rate appreciation, this effect is insignificant. Therefore, it can be said that interest rate defense has not been successful in appreciating the exchange rate in the 1994 Turkish crisis.

References

Agenor, P. R., C. J. McDermott, and E. M. Ucer (1997), "Fiscal Imbalances, Capital Inflows, and the Real Exchange Rate: The Case of Turkey," IMF Working Paper no. 97/1.

Aysoy, C. and A. N. Kıpıcı (2002), "A Quarterly Macroeconometric Model of the Turkish Economy," manuscript, Central Bank of the Republic of Turkey.

Berument, H. (2001), "Measuring Monetary Policy for A Small Open Economy: Turkey," Bilkent University Working Paper.

Celasun, O. (1998), "The 1994 Currency Crisis in Turkey," World bank Working Paper no.1913.

Cho, D. and K. D. West (2001), "Interest Rates and Exchange Rates in the Korean, Philippine and Thai Exchange Rate Crises," forthcoming in M. Dooley and J. Frankel (eds.), *Managing Currency Crises in Emerging Markets.*

Dekle, R., C. Hsiao, and S. Wang (2002), "High Interest Rates and Exchange Rate Stabilization in Korea, Malaysia, and Thailand: An Empirical Investigation of the Traditional and Revisionist Views," *Review of International Economics*, 10 (1), 64-78.

Dekle, R., C. Hsiao, and S. Wang (2001), "Do High Interest Rates Appreciate Exchange Rates During Crisis?: The Korean Evidence," *Oxford Bulletin of Economics and Statistics*, 63 (3).

Goldfajn, I. and T. Baig (1998), "Monetary Policy in the Aftermath of Currency Crisis: The Case of Asia," IMF Working Paper no. 98/170.

Goldfajn, I. and P. Gupta (1999), "Does Monetary Policy Stabilize the Exchange Rate Following a Currency Crisis?," IMF Working Paper no. 99/42.

Gould, D. M. and S. B. Kamin (2000), "The Impact of Monetary Policy on Exchange Rates During Financial Crises," Board of Governors of the Federal Reserve System International Finance Discussion Papers no. 669.

Furman, J. and J. E. Stiglitz (1998), "Economic Crises: Evidence and Insights from East Asia," *Brookings Papers on Economic Activity*, Vol.2, 1-135.

Kraay, A. (2000), "Do High Interest Rates Defend Currencies During Speculative Attcaks?" World Bank Working Paper no. 2267.

Radelet, S. and J. D. Sachs (1998), "The East Asian Financial Crisis: Diagnosis, Remedies, Prospects," *Brookings Papers on Economic Activity*, Vol.1, 1-74.