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Currency substitution in Turkey

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Although currency substitution is a widely observed phenomenon in both developed and developing countries, most of the studies on currency substitution in small open economies have focused on high inflation South American countries. This paper extends the previous analysis to a newly industrializing, high-inflation economy, namely Turkey. A vector autoregression model has been estimated employing the certain policy variables to investigate the dynamics of currency substitution in the economy. Dynamic impulse responses show that the residents have a preference for substituting foreign currencies for domestic currency because of real-exchange-rate depreciations. The results suggest that to stop or to reverse the on-going currency-substitution process a policy aiming to increase the expected real return on domestic assets should be adopted.

I. INTRODUCTION

The phenomenon of currency substitution – the replacement of domestic currency in its traditional roles by foreign currencies – has been extensively analysed in the economic literature. Early studies on currency substitution were conducted for countries with hyperinflation, especially Germany for the period 1921–23. Later, interest in studying currency substitution in developed countries increased with the opening up and integration of financial markets. It has been argued that currency substitution is the main source of domestic money-demand instabilities, making monetary targeting more difficult for the authorities. Hence, it has been suggested that greater international monetary cooperation is required among developed countries (McKinnon, 1982). However, empirical findings on the degree of currency substitution in developed countries, as well as its effect on money-demand equations, are mixed (Kremers and Lane, 1990; Imrohoroğlu, 1991). For example, Giovannini and Turtelboom (1992) provide evidence on the presence of instabilities in the USA and Canada, but not in Japan and Germany.

In developing countries, the existence of currency substitution has been investigated in relation with macroeconomic instabilities and regulation of financial markets (Calvo and Végh, 1992). It appears that the degree of currency substitution in these countries is strongly related to underdeveloped financial markets and high and volatile inflation rates. Another line of research examines the effect of currency substitution on inflationary finance and *seigniorage* (Végh, 1989).

Despite the fact that currency substitution is a widely observed phenomenon under different exchange regimes in both developed and developing countries, most of the studies on the subject in developing countries have concentrated on high-inflation South American countries.[1] This paper extends the previous analysis of currency substitution to a newly-industrializing and persistently above-average-inflation economy, namely Turkey. In the Turkish case it is particularly interesting to investigate the dynamics of currency substitution. After a stabilization and financial liberalization programme in early 1980, the Turkish economy experienced moderate to high levels of inflation. However, the Turkish economy is different from the Latin American economies in that the level of inflation does not show large swings: it averaged yearly 36.0% between 1982 and 1987 with a standard deviation of 10.4, and 61.0% between 1988 and 1992 with a standard deviation of 8.0, indicating its structural nature. Despite the relatively high levels of inflation, the economy did not experience major macroeconomic distortions or undergo frequent stabilization programmes. In other words, the economy seems to have learned to live with above-average inflation without suffering from major instability.

[1] Canto and Nickelsburg (1987), Ortiz (1983), Ramirez-Rojas (1985), Rogers (1992) and Savastano (1992) are some of these studies. See Giovannini and Turtelboom (1992) for a list of country studies.

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As a result of the financial-liberalization measures introduced during the 1980s, there has been substantial development in the Turkish financial markets. Nevertheless, they are not yet fully developed or integrated with the rest of the world. In this respect, the Turkish economy shows similarities with other developing countries.

The focus of this study is the change in foreign-currency-denominated deposits relative to a broad definition of money supply ($M2Y$). Unlike previous studies, a vector autoregressive (VAR) model is employed to capture the internal dynamics of currency substitution, interest rates, and the expected depreciation of the Turkish lira. The study employs monthly data covering the sample period of January 1986 to January 1992. It is shown that currency substitution exists in the economy mainly as a result of expectations of the real depreciation of the Turkish lira. The empirical results suggest that in order to stop or reverse currency substitution, residents' confidence in domestic currency must be re-established.

The paper is organized as follows. Section II gives a brief overview of the currency-substitution process and its implications in the Turkish economy. Section III discusses the main currency-substitution models and outlines a VAR model for estimation purposes; the time series properties of the variables are also investigated and the results of the VAR model are presented. Section IV contains some concluding remarks.

II. SOME STYLIZED FACTS AND IMPLICATIONS

Following a period of economic and political difficulties in the late 1970s, the Turkish government started implementing a comprehensive economic stabilization programme in January 1980. The programme was aimed at the convertibility of the Turkish lira, a flexible exchange-rate policy, export promotions and import liberalization as means of improving the balance of payments situation. To this end, an efficient foreign-exchange system had to be established. Restrictions on residents' dealings in foreign currencies were therefore gradually lifted, and residents were allowed to open foreign-exchange deposit accounts from January 1984.

The presence of foreign currencies, predominantly the Deutsch mark, in residents' portfolios has a long history in Turkey. The increasing number of the Turkish workers, mainly in Germany, has made the Deutsch mark a close substitute for the Turkish lira, especially among the rural population with relatives who have been abroad since the late 1960s. However, this in itself cannot be viewed as currency substitution. What is implied by the notion of currency substitution is the gradual and persistent replacement of a domestic currency by other currencies such as the Deutsch mark or the US dollar. In the extreme case of perfect currency substitution, the domestic currency loses all its basic functions and is replaced by other currencies.[2]

Although no reliable data are available on the magnitude of foreign currencies held by the public as a medium of exchange, it is safe to assume that they were not significant until the elimination of foreign exchange controls. No foreign currency was widely used as a unit of account in domestic transactions before the liberalization of the financial system. The process of dollarization (or markization,) in the Turkish economy therefore, started during the mid-1980s.

Since then, the Turkish lira has been losing its basic functions. Today, it is hard to imagine anyone holding non-interest bearing Turkish lira viewing them as a store of value in an environment with a persistent and above-average inflation. Classified advertisements often quote prices in US dollars or Deutsch marks. Comparison of prices at different points of time is also made in foreign currencies. There are even legislative proposals to index-link certain monetary penalties to a foreign currency, indicating that the function of domestic money as a unit of account is being lost.

The increasing number of 'exchange windows' in the cities, not just in tourist areas, are serving local residents. Long queues in front of these windows, especially on days when salaries are paid, suggest that foreign currencies are also replacing the Turkish lira in daily transactions. In fact, there is no difficulty in settling any transaction in foreign currency

Figure 1 shows foreign currency deposits by residents in Turkey between January 1984 and August 1992. Figure 2 shows currency substitution–approximated as the ratio of foreign currency deposits by residents to the sum of M2 and foreign currency deposits–in the same period.[3] At the end of 1988, currency substitution reached 24%. Although there was a sharp increase in the real-exchange-rate index during 1989 and 1990 (30%), currency substitution did not fall

[2] The term currency substitution has different meanings in different studies. For example, Calvo and Végh (1992) define currency substitution as 'the use of different currencies as a media of exchange', whereas others define currency substitution as the replacement of domestic currency by other currencies as an asset (Handa, 1988). Another group of authors define currency substitution as a situation in which the demand for both currencies is influenced by other economic variables, most often the relative cost of holding either (Miles, 1978; Rogers, 1990). For a detailed discussion, see Giovannini and Turtelboom (1992)

[3] This is the definition used in the currency substitution literature (see Ortiz, 1983; Ramirez-Rojas, 1985; Rogers, 1992). Since it includes only deposits in foreign currencies but not foreign currencies in circulation, it is only a rough approximation and should be taken as the lower bound of actual currency substitution in the economy. We use the same definition to make direct comparison possible. For the data sources and definitions see Appendix A.

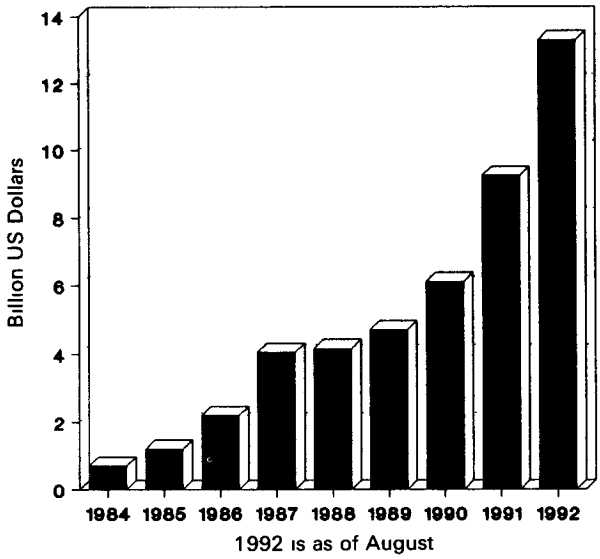

Fig. 1 *Foreign exchange deposits in Turkey*

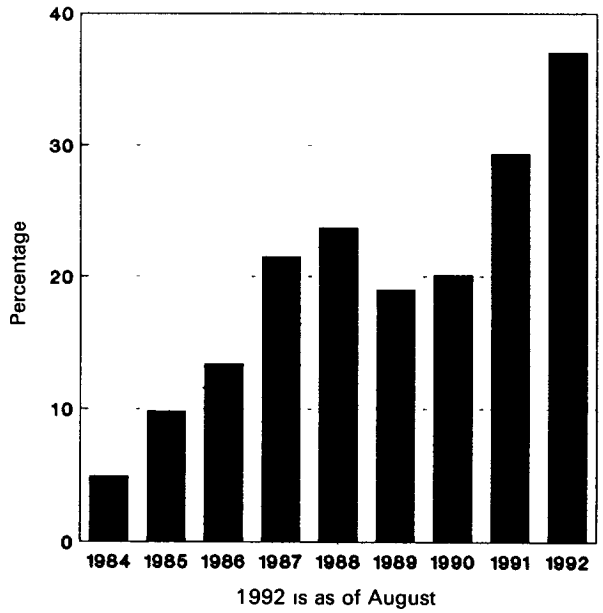

Fig. 2. *Currency substitution in Turkey*

below 19%, indicating that it is a persistent phenomenon.[4] The ratio started to rise again at an increasing rate at the beginning of 1991, reaching 29% at the end of the year.[5] As of August 1992, currency substitution was 37%, and there was no sign that it would fall in the immediate future (see Table 1).

Table 1. *Monthly averages*

Variable[a]	1986–90	1991–92	August 1992
FEDR	3561.7	8482.4	12751.0
Growth	2.5	3.8	5.0
CUR	18.0	28.2	36.7
M1 Growth	3 9	3.7	3.9
M2 Growth	3 7	4.1	5.7
MY Growth	3.9	5.5	6 1
Inflation	3 4	4 2	5.0
TL/$	2412 2	5054 8	7087.8
Growth	2.7	4.5	2 1
TL/DM	868.8	3128.2	4876.5
Growth	3.8	4.7	4 7
TERK	69.3	74 6	69.9
Growth	0.13	−0 6	1.6

Note: [a]FEDR is foreign exchange deposits by residents (million $); *CUR* is currency substitution rate, as defined in the text; *M1*, *M2*, and *MY* are money supply measures, Inflation is the monthly log difference of the price level *P*; *TERK* is the real exchange rate index. See Appendix A for the definitions of variables and the data sources

From a theoretical perspective, the presence of currency substitution in an economy has important implications for conducting effective monetary, fiscal, and exchange-rate policies. The possibility of running an independent monetary policy will be restricted, the volatility of the exchange rate will increase, and fiscal instruments will be weakened (Miles, 1978; Sargent, 1983; Boyer and Kingston, 1987; Bergstrand and Bundt, 1990).

In addition to policy implications, there are other possible effects. Governments generate a certain amount of income from the creation of money, or *seigniorage*. In high inflation economies in particular, this is one of the main sources of income for the government (Edwards and Tabellini, 1991). Replacement of domestic currency by a foreign currency, therefore, implies a widening budget deficit. If the government fails to adjust its fiscal policy in order to compensate for this loss of income (either by a new tax scheme or reducing government spending), currency substitution may become another factor contributing to higher levels of inflation (Fisher, 1983; Végh, 1989).

Another consequence of currency substitution appears in credit markets. An increase in foreign currency-denominated bank deposits will alter the portfolio composition of commercial banks and affect their ability to provide credits in domestic currency. Domestically oriented private firms may be reluctant to borrow in foreign currencies since the

[4] Almost all Latin American economies which experience currency substitution share the same characteristic: once currency substitution starts, it is an almost irreversible process. It is worth noting that *dedollarization* took a form of confiscation in some of these countries: Mexico (August 1982), Peru (July 1985), Bolivia (November 1982).

[5] The average *monthly* growth rate of foreign exchange deposits (in US dollars) between January 1986 and December 1990 was 2.5%, whereas the same rate was 3 8% between January 1991 and August 1992. see Table 1

differentiation of portfolio composition makes a company more vulnerable to the changes in financial markets. High liabilities in foreign currencies may lead to speculative activities, reducing the overall efficiency in the economy (Ortiz, 1983).

III. EMPIRICAL IMPLEMENTATION

The VAR model

The demand for money is handled in different ways in macroeconomic models.[6] Among these, 'currency in utility function' (Sidrauski, 1967), 'cash in advance or Clower constraint' (Lucas and Stokey, 1987), and 'overlapping generations models' (Samuelson, 1958) are some of the well-known approaches (see Blanchard and Fisher, 1989, Chapter 4). The theoretical models of currency substitution are simply an extension of money demand models to a multi-currency case. They can be classified into three categories: cash-in-advance models (Boyer and Kingston, 1987), transaction-costs models and *ad hoc* models.[7] Kareken and Wallace (1981) use a version of overlapping generations model to analyse currency substitution. As noted by Sargent (1983), the Kareken–Wallace model is not readily applicable to time-series interpretation of economic data.

The empirical models of currency substitution can be divided into three groups. In the first, demand functions for both monies are a part of static portfolio balance model (Cuddington, 1983). The second group of models are known as 'transaction-services' models (Miles, 1978; Bana and Handa, 1990). Finally, the third category of currency-substitution models consists of dynamic approaches such as that of İmrohoroğlu (1991).

A common feature in the empirical work is that the *expected* rate of depreciation of domestic money is the essential variable explaining the demand for foreign currencies. However, since the expected rate of devaluation is not readily measurable, different studies employ different variables such as the interest-rate or inflation-rate differential to approximate the expected rate of depreciation.

With the exception of Rogers (1992), previous empirical studies on currency substitution have employed single-equation money-demand-function estimates. This paper uses a multivariate VAR without referring to a particular model. In a VAR model, each variable is a function of its lagged values as well as the lagged values of other variables in the system. Since all the right-hand side variables are predetermined, the ordinary least squares (OLS) estimate of the system is consistent. The VAR approach also enables us to interpret the separate sources of stochastic disturbances to the currency-substitution process (Sims, 1980, 1992; Blanchard, 1989).

Our objective is to identify the responses of currency substitution to shocks in certain policy variables in the Turkish economy. In light of this, the currency-substitution variable in the system (CUR) is defined as the ratio of foreign-currency deposits by residents to the broad definition of money supply. It is assumed that currency substitution is mainly influenced by the nominal returns on domestic assets (R), and the expected change in exchange rate.[8] Since the expected change in exchange rate is not measurable, the trade-weighted real-exchange-rate index (TRX) and the nominal exchange rate between the Turkish lira and the US dollar (EXC) are used to approximate this variable. The TRX variable is included in the system to capture the exchange-rate policy followed by the policy makers.[9] The data set consists of monthly variables for the period January 1986 to January 1992.[10] All variables are in natural logs except for the interest rate.

Time series properties of the variables

Recent research on time-series analysis shows that it is important to determine the stochastic properties of the series before using them in a modelling exercise in order to avoid spurious results (Granger and Newbold, 1974; Engle and Granger, 1991).

The augmented Dickey–Fuller test and the Sims test are used to determine whether a particular series is stationary (possibly with a trend) or difference stationary (Dickey and Fuller, 1981; Sims, 1988). The equation below is estimated to implement both the Dickey–Fuller and the Sims test:

$$\Delta X_{it} = \beta_0 + \beta_1 t + \beta_2 X_{i,t-1} + \sum_{l=1}^{p} \alpha_l \Delta X_{i,t-l} + \varepsilon_{it} \quad (1)$$

where X_i is the variable to be tested, and Δ is the first

[6] What should be understood by the term *money* in different economies is another controversial issue, to define money as a measurable variable is beyond the scope of this study

[7] See Giovannini and Turtelboom (1992) for a simple exposition of these models.

[8] It follows from the small open economy assumption and the development stage of the financial system in Turkey during the sample period that there are no significant capital flows in the economy The foreign interest rates are therefore not included in the system. The small economy assumption also implies that there is no international demand for the domestic currency The type of currency substitution under investigation is thus called asymmetric

[9] Ortiz (1983) interprets the deviation of real exchange rate from its long-term trend value as convertibility risk. This assumption implies that the real exchange rate has a deterministic trend which is 'an exception rather than the rule for economic time series' (Harvey, 1989, p. 290)

[10] Although residents were allowed to open foreign-exchange deposits at the beginning of 1984 we exclude the first two years to eliminate any start-off effects.

difference operator. Note that test results are sensitive to the truncating lag parameter p. The lag length for each variable is determined according to the Akaike information criterion (AIC) and the Schwarz criterion (SC) (Campbell and Perron, 1991).

It is known that the Dickey–Fuller unit-root test and its modified versions have a low power against the alternative of a root close-to, but below, unity (Sims, 1988). Using only the Dickey–Fuller test would be misleading since it is possible to have a stationary process which fails the test. The Sims test has a clear interpretation, explicitly stating the required prior probability in favour of a unit root in the series.[11]

The test results are presented in Table 2. On the basis of the test statistics, we fail the reject the null hypothesis that all of the series have a unit root. Consequently, the first differences of the series, which were stationary, are used throughout the study.[12]

Estimation of VAR

The VAR model is estimated with a constant term and the first-differences of the variables with three lags. The number of lags in the system is determined according to the Sims (1980) likelihood ratio test. First, the system is estimated with three lags. Later, the same model is tested as a restriction of the models with longer lags. The null hypothesis of no difference between two models with different lags could not be rejected. For example, using modified χ^2, proposed by Sims (1980, note 18), we obtain $\chi^2(27) = 25.37$ for six lags and $\chi^2(54) = 54.75$ for nine lags. The corresponding significance levels are about 0.55 and 0.46. Consequently, it was decided to estimate the model with three lags.[13]

Table 2. *Unit root test results*

Variable[a]	Lags	Φ_1	Φ_2	Φ_3	Marginal alpha
CUR	12	−2.31	3.08	2.25	0.233
TRX	7	−3.05	5.18	3.46	0.245
R	1	−2.01	2.15	1.52	0.110
EXC	2	−2.17	5.73	2.49	0.155

Note: [a]Φ_i represents the F-statistic from the regression (1) for the following hypothesis:

Φ_2: $\beta_1 = \beta_2 = 0.0$
Φ_3: $\beta_0 = \beta_1 = \beta_2 = 0.0$

and Φ_1 is the usual regression t-statistic. The alternative hypothesis in each case is the stationarity of the series. The critical values at the 5% significance level with $n = 100$ are −3.45 for the Φ_1, 6.49 for the Φ_2, and 4 88 for the Φ_3 (Fuller, 1976, p. 373; Dickey and Fuller, 1981, p. 1063). The marginal alpha represents the necessary prior probability which would force the Sims test not to reject the unit root hypothesis. The smaller the marginal alpha, the stronger the rejection of the data in the unit root hypothesis.

Tables 3 and 4 report the estimation results. Although the standard errors of the coefficients are upwardly biased due to (multi-) collinearity, a considerable number of coefficients are statistically significant (Table 3). In particular, the first and the third lags of the change in nominal rate (R) and the first lag of the growth rate of the real-exchange-rate index (TRX) have a statistically significant negative effect on the growth rate of currency substitution. The results indicate that the real appreciation of the Turkish lira and an increase in the nominal returns on domestic assets may reverse the currency-substitution process.

F-statistics are given in Table 4. It is evident that the change in exchange rate policy (TRX), and the change in nominal interest rates (R) have overall significant explanatory power in the growth rate of currency substitution. The F-statistic of the lags of TRX is 2.67 with a 6% marginal significance level. The same statistic for the lags of the change in R is 2.42 with a 7% marginal significance level. The lagged values of the growth rate of the currency substitution are also significant in explaining the currency substitution, confirming the previous observation that the process is persistent.

The low adjusted R^2 values for the equations in Table 4 should not be interpreted as an indication of poor specification since all the variables are monthly changes. Theoretically, if the model is specified correctly, the errors from each equation should be white noise with zero autocorrelations. The correlograms and estimated autocorrelations of the error terms revealed no evidence of model misspecification. It can be shown that the differencing of a white noise series creates a first-order moving average (MA) process with a (MA) parameter equal to 1.0, so that the first-order autocorrelation coefficient is −0.50. The estimated first-order autocorrelation coefficients for the first differences of the errors from the estimated model were between −0.48 and −0.51, leading to the conclusion that there was no misspecification in the estimated model.

[11] The Sims test is basically a Bayesian posterior odds ratio, described as a weighted average of the likelihood function over all the points consistent with the null hypothesis divided by a weighted average of the likelihood function over all the points in the alternative. See Selçuk (1993) for an application of both tests to the major macroeconomic variables in the Turkish economy.

[12] Phillips (1987) shows that the Dickey–Fuller tests are affected by the autocorrelated errors from Equation 1. An informal inspection of the correlograms did not indicate any autocorrelation in errors Engle and Granger (1987) show that a VAR system in differences would be misspecified if the variables are cointegrated. The augmented Dickey–Fuller test (Engle and Granger, 1987) is used to test the null hypothesis of no cointegration between the variables. In all cases, the tests fail to reject the null hypothesis of no cointegration. Results are available upon request.

[13] In order to test the robustness of the lag selection procedure, the evidence on the serial correlation in the VAR error term, as measured by the Ljung–Box Q-statistic discussed in Doan (1990) is also checked. There were no significant changes in the Q-statistic at higher-order lag models.

Table 3 *The coefficients of the estimated VAR model*

	Equation			
Lags[a]	*CUR*	*TRX*	*R*	*EXC*
CUR(−1)	0.041	0.032	−8.01	0.077
	(0.39)	(0 56)	(−0.8)	(1 27)
CUR(−2)	0.134	0 024	21.37	−0.06
	(1.25)	(0.40)	(2.12)	(−0.9)
CUR(−3)	0.224	−0.17	−2.75	0.093
	(2.02)	(−2.8)	(−0.3)	(1 43)
TRX(−1)	−0.69	0 270	−42.4	0 083
	(−2.7)	(2 00)	(−1.9)	(0 59)
TRX(−2)	0 049	−0.18	56.12	0.332
	(0.18)	(−1.2)	(2.30)	(2.19)
TRX(−3)	−0.24	0.190	−45.3	−0.12
	(−0.9)	(1.25)	(−1.8)	(−0.8)
R(−1)	−0.03	0.001	0.076	−0 001
	(−1 9)	(0.55)	(0.56)	(−2.3)
R(−2)	0.095	−0.01	−0 03	0.002
	(0.78)	(−1.6)	(−0 2)	(2.26)
R(−3)	−0.03	0.002	−0.14	−0.00
	(−2.2)	(1.78)	(−1 1)	(−0.4)
EXC(−1)	0.143	−0 18	25.44	0.644
	(0.57)	(−1 3)	(1 08)	(4.40)
EXC(−2)	0.214	−0 72	22.93	0.057
	(0.79)	(−0 5)	(0.90)	(0.35)
EXC(−3)	−0.44	0 010	−30.6	−0 26
	(−1.9)	(0.69)	(−1 4)	(−0.2)
Constant	0.0117	0.007	−0.521	0 792

[a] Due to possible (multi-) collinearity between the variables, the *t*-statistics, given in the parentheses, may not be very informative

Table 4 *Summary statistics of the VAR model: January 1986–January 1992*

					F-tests			
Equation[a]	SEE	$\bar{R}^2$	*Q*(24)	*D–W*	*CUR*	*R*	*TRX*	*EXC*
CUR	0 032	0.224	21 36	1.99	2 56	2 42	2.67	1.25
					(0.06)	(0 07)	(0.06)	(0.30)
TRX	0.018	0 140	12.62	1.89	2.56	2 07	1.88	1.11
					(0 06)	(0.11)	(0 14)	(0.35)
R	2.97	0.110	15.39	2 00	1.64	0.54	3 06	1 40
					(0 19)	(0.66)	(0.04)	(0 25)
EXC	0.018	0 317	14 87	1 98	1.56	2 97	2.03	10 3
					(0 21)	(0 04)	(0.12)	(0.00)

Note: [a]*CUR*, *EXC* and *TRX* are monthly growth rates, *R* is monthly change. Since the estimated VAR model includes lagged dependent variables, *D–W* statistics are not valid. They are included to compare equations. The significance levels of *F*-statistics are in parentheses.

Impulse responses and innovation accounting

If the data vector in a VAR model is stationary, the MA representation of the model can be used to see the response of the system to a unit standard-error shock in the innovation vector. The shock is maintained only for one period, hence it is called 'impulse'. The impulse responses of the growth rate of currency substitution to a unit standard-error shock in other variables in the system are presented in Figs. 3–6.[14]

[14] Different orderings of the variables in the system may produce different responses. The ordering was *TRX*, *EXC*, *R*, and *CUR* Some other orderings were also tried but the results did not change significantly. The results are available upon request

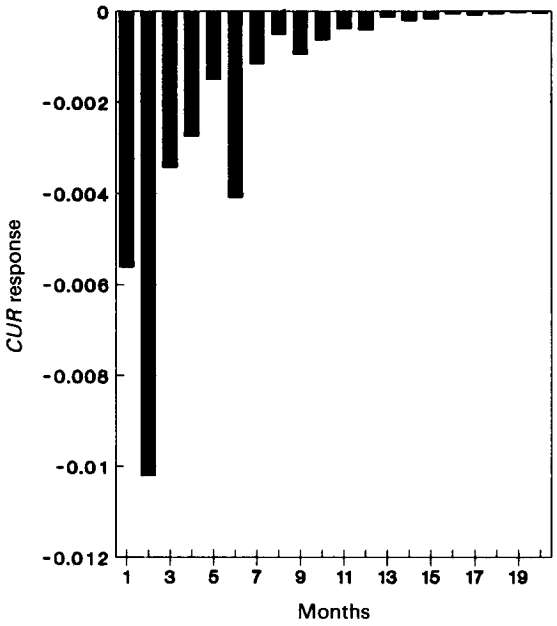

Fig. 3. *Shock to real exchange rate (1.6% real appreciation of Turkish lira)*

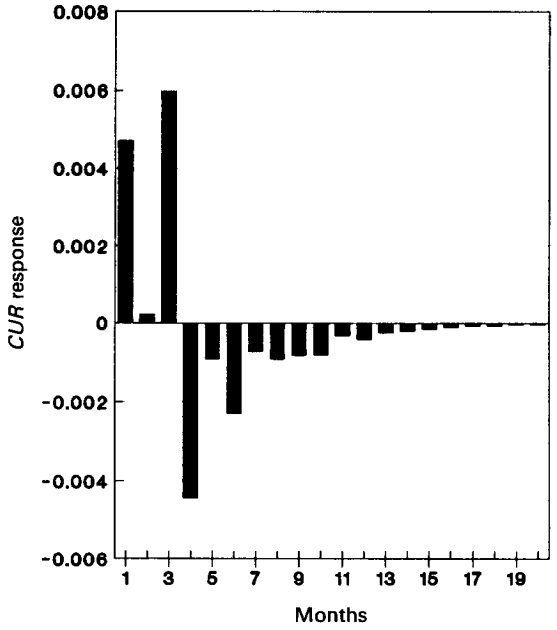

Fig 5 *Shock to nominal exchange rate (1.6% devaluation of Turkish lira)*

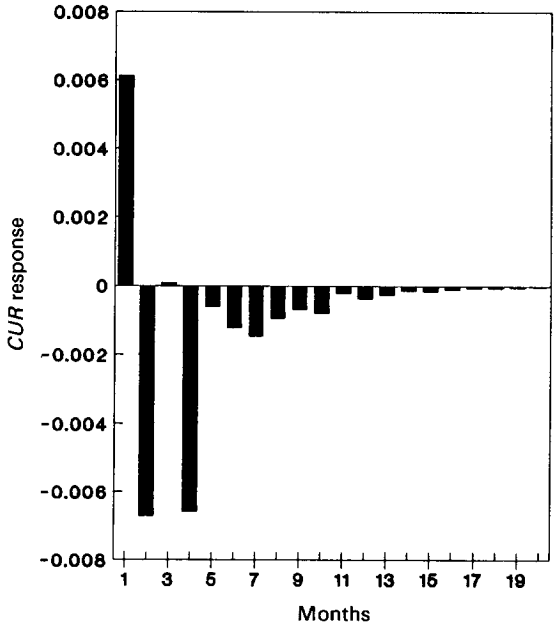

Fig. 4. *Shock to nominal interest rate (2 6 percentage point increase)*

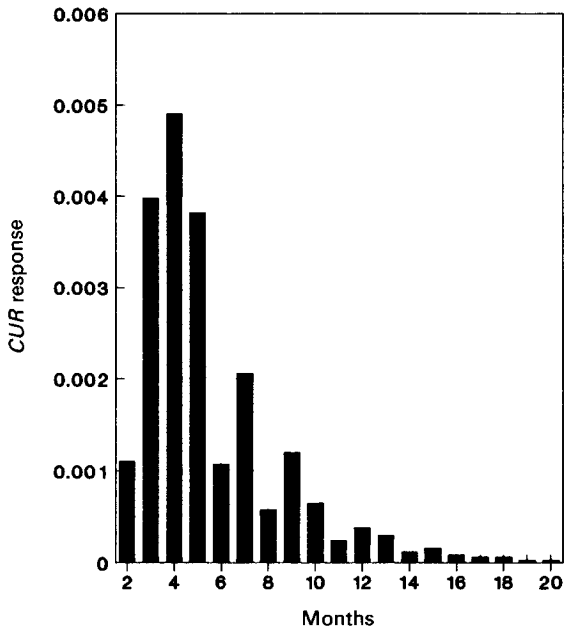

Fig 6 *Shock to CUR (2.8 percentage point increase in growth of CUR)*

In Fig. 3, 1.6% unexpected real appreciation of the Turkish lira has a negative effect on the growth rate of currency substitution for about ten months. The effect reaches to 1% decrease of the growth rate of *CUR* in the second month following the shock and slowly dies out over longer horizons. Similarly, a 2.5 percentage point unexpected increase in nominal interest rates–although positive for the first month–has a negative effect on the growth rate of CUR. These results are in line with previous empirical studies on currency substitution in different countries.

It has been suggested that a country may benefit from an on-going currency substitution when the government undertakes a stabilization programme which is consistent and credible to economic agents. An increase in the nominal interest rate, supported by a real appreciation of the domestic currency, may induce a shift towards the domestic money,

Table 5. *Percentage of forecast error produced by each innovation*

Error in	Steps	STD error	Innovation in *TRX*	*EXC*	*R*	*CUR*
TRX	1	0.016	100.0	0 00	0.00	0.00
	2	0.017	94.74	0 88	4.12	0.26
	3	0.018	90 57	4.69	4.47	0.27
	4	0.018	86.38	4.41	4.66	4.56
	5	0.018	84.93	4.44	5 00	5.62
	6	0 019	84.80	4.61	5 00	5.61
	9	0.019	84.15	4.57	5 12	6.16
	12	0.019	84.04	4.59	5 16	6 21
EXC	1	0.016	15.50	84 50	0.00	0.00
	2	0.020	12.72	81 20	4.94	1.14
	3	0.021	14.53	79 95	4.51	1 01
	4	0 021	13.89	79.11	5.23	1 77
	5	0.021	13.61	78.56	5.12	2.72
	6	0.022	13.48	78.71	5 13	2.69
	9	0.022	13.46	78.54	5.14	2.86
	12	0.022	13.48	78.51	5.14	2.87
R	1	2.686	3.43	8.54	88.04	0.00
	2	2.856	11.71	9 63	78.09	0.58
	3	3.037	12 11	14.66	69.25	3.98
	4	3.067	12 28	14 64	69 14	3.94
	5	3.079	12 47	14.57	68 66	4.30
	6	3.082	12.54	14.63	68.50	4.33
	9	3.087	12.54	14 63	68 38	4.46
	12	3.088	12.55	14.63	68 35	4.47
CUR	1	0.029	3.89	2.72	4 59	88.83
	2	0.031	14.04	2 30	8.54	75.13
	3	0.032	14 32	5.60	8.01	72 06
	4	0.033	13 78	6 88	11.20	68.14
	5	0.034	13 59	6 86	11 07	68.47
	6	0.034	14.73	7 17	10 97	67 13
	9	0.034	14 77	7.26	11.13	66.84
	12	0 034	14.79	7.32	11 17	66 71

and further appreciation (Ramirez-Rojas, 1985). The impulse responses of *CUR* suggest that this may be valid for Turkey. On the other hand, an unexpected devaluation of the nominal exchange rate between the Turkish lira and the US dollar seems to have a temporary mixed effect on the *CUR* growth rate. Although it is positive for the first three months, the response reverses itself starting from the fourth month after the shock and goes down to zero after a year, returning on its initial level of growth. On the basis of Fig. 6 it is safe to assume that the total effect is around zero. Note that the definition of the real exchange rate already includes the dollar exchange rate as one of its components. It is therefore more appropriate to conclude that the nominal devaluation has little, if any, effect on the growth rate of currency substitution as long as the real exchange rate does not change.

Finally, a unit standard-deviation shock to the growth rate of *CUR* causes positive further increases in currency substitution for the next ten months; an average of 0.2 percentage point increase in the growth rate per month. This, once again, confirms the previous observation that currency substitution has its own dynamics.

Forecast standard errors over various horizons and the proportions of forecast errors produced by each innovation in the system are presented in Table 5. In the short run, the main source of variations in *CUR* seems to be innovations in *CUR* itself. In the long run (after three months), around 25% of its variance is accounted for by innovations in the change in exchange-rate policy (*TRX*), and the change in the nominal interest rate (*R*). Note that for a stationary process, forecast error tends to converge to some upper bound as the forecast horizon increases. The third column of Table 5 reveals that this is the case for all of the variables in the system.

IV. CONCLUSION

This paper has investigated the dynamic responses of currency substitution to the shocks in major policy variables in the Turkish economy.

It is shown that there is a positive relation between the real depreciation of the Turkish lira and currency substitution in Turkey. It is known that the Turkish policy makers adopted a policy of real depreciation in the 1980s in order to promote growth of exports.[15] The impulse response of currency substitution and the estimated coefficients of *TRX* in the *CUR* equation point out the danger of losing the ability to run an independent monetary policy. Policy makers in the economy have to trade off a better balance of payments situation, supported by the real depreciation of the Turkish lira, and resulting in higher levels of currency substitution, and the ability to run a monetary policy more efficiently. Also note that the *seigniorage* was an important way of financing the budget deficit in the Turkish economy during the 1980s. Increasing currency substitution reduces the income from *seigniorage*, which may result in higher levels of inflation.

Furthermore, the estimation results and impulse responses show that the nominal interest rate on domestic assets is another significant variable in the currency-substitution process. Any decrease in nominal returns on domestic assets increases on-going currency substitution, making these assets less attractive.

The results also show that the existence of currency substitution is an important element to be taken into account in conducting a stabilization programme. If a government undertakes a consistent and credible stabilization programme, an increase in nominal interest rates supported by a real appreciation of the currency may induce a shift towards the domestic currency, resulting in an increase in real balances, and further appreciation.

APPENDIX

In this appendix, definitions of the variables and data sources are given. The data set is available from the author for replication purposes. All variables are monthly and seasonally unadjusted.

CUR Currency substitution rate: $[((FEDR * EXC)/1000.0)]/[M2+((FEDR * EXC)/1000.0)]$

EXC Central bank monthly average exchange rate (TL/$). *The Central Bank of Turkey Monthly Statistical Bulletin* (CBMSB) June 1991, p. 86; August 1992, p. 46.

FEDR Foreign exchange deposits by residents (million $): *The Central Bank of Turkey Quarterly Bulletin*, February 1991, p. 130; CBMSB August 1992, p. 34.

M2 Money supply (TL billion) − currency in circulation + total deposits − public deposits: CBMSB June 1991, p. 71 and August 1992, p. 29.

P Average price index (1983:12 = 100): CBMSB June 1991, p. 87 and August 1992, p. 40.

R The highest after-tax annual interest rate (percentage points): CBMSB June, 1991, p. 84 and August 1992, p. 40.

TRX Trade-weighted real effective exchange rate index (1981 = 100). CBMSB June 1991, p. 84 and August 1992, p. 50.

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