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#### **Fiscal Imbalances, Capital Inflows, and the Real Exchange Rate: The Case of Turkey**

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#### **Abstract**

This paper examines the links between fiscal policy, capital inflows, and the real exchange rate in Turkey since the late 1980s. After an overview of recent macroeconomic developments in Turkey, a vector autoregression model is estimated linking government spending, interest rate differentials, capital inflows, and the temporary component of the real exchange rate. Positive shocks to government spending and capital inflows lead to an appreciation of the temporary component of the real exchange rate, whereas positive shocks to the uncovered interest rate differential lead to a capital inflow and an appreciation of the temporary component of the real exchange rate. The findings highlight the role of fiscal adjustment in restoring macroeconomic stability.

#### **JEL Classification Numbers:**

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## **Fiscal Imbalances, Capital Inflows, and the Real Exchange Rate: The Case of Turkey**

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## Summary

This paper examines the links between fiscal policy, uncovered interest rate differentials, the real exchange rate, and capital inflows in Turkey since the late 1980s. The first part reviews recent macroeconomic developments in Turkey. It shows that capital inflows coincided with a period of significant deterioration in fiscal balances, high interest rates, and an appreciating real exchange rate. The second part estimates a vector autoregression (VAR) model that includes the temporary component of the real exchange rate, government spending and (net) private capital inflows, both measured as a percentage of GNP, as well as the interest rate differential adjusted for exchange rate changes.

Although the constraints imposed on the specification of the VAR by the small sample size prevent firm conclusions, the findings are broadly in line with recent macroeconomic developments in Turkey: positive shocks to government spending lead to an appreciation of the temporary component of the real exchange rate, while capital inflows respond to shocks to uncovered interest rate differentials; positive shocks to capital inflows also lead to an appreciation of the temporary component of the real exchange rate. The analysis highlights the importance of fiscal adjustment for restoring macroeconomic stability in Turkey. Although the real appreciation observed in the early 1990s appears to have had a relatively weak effect on the growth rate of exports, it contributed to a sharp increase in imports and a deterioration of the current account balance. As illustrated by the currency crisis that took place in early 1994, market correction of real exchange rate misalignment may occur in traumatic fashion and may be associated with increased volatility in asset prices and disruptions in economic activity. Restoring fiscal equilibrium would promote a more orderly adjustment in relative prices.



## I. Introduction

The Turkish economy has opened up substantially over the past 15 years through extensive reforms in the external and financial sectors, while registering relatively high growth rates. Nevertheless, except through the first half of the 1980s, macroeconomic balances have deteriorated almost continuously, with inflation gradually taking a chronic nature, and the economy becoming increasingly dollarized; to a large extent, this deterioration has been a reflection of slow progress in the area of fiscal reform. Despite this mixed record, Turkey began to receive substantial capital inflows in the late 1980s, following the full liberalization of the capital account. These inflows, despite their positive contribution to external account balance, have complicated macroeconomic management considerably, in part owing to their volatile nature.

A wide literature has now developed on the causes of, policy response to, as well as the overall experience with capital inflows.<sup>1</sup> Motivated by this recent research and the increasing importance of capital flows on the Turkish economy, this paper explores the links between fiscal imbalances, capital inflows and the real exchange rate in Turkey since the late 1980s. Section II provides an overview of recent macroeconomic developments. Section III presents an empirical analysis of the links between government spending, uncovered interest differentials, private capital inflows, and the real exchange rate, based on vector autoregression techniques. The concluding section summarizes the main results of the paper, and assesses their implications.

## II. Overview of Macroeconomic Developments

Over the past 15 years, the Turkish economy has registered relatively high growth rates (about 5 percent per annum), aided by an outward-oriented

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<sup>1</sup>See Calvo, Leiderman and Reinhart (1996) and Fernández-Arias and Montiel (1996) for a review of the issues. This research mainly focuses on the experiences of the Latin American and East Asian countries. To our knowledge, Abdel-Motaal (1995) is the only recent study that discusses the Turkish experience, along with a number of Middle-Eastern and North African countries.

strategy.<sup>2</sup> Enhanced integration with the world economy has been perhaps the most remarkable achievement of economic policy during this period. Exports grew by an impressive 14-15 percent per annum (in US dollar terms) and, by the end of the 1980s, the current and capital accounts were fully liberalized. Reforms in the financial sector also enhanced the depth and sophistication, as well as the outward-orientation, of domestic financial markets.

The performance in restoring internal balances, however, was disappointing. Inflation averaged 60 percent throughout the 1980s, reflecting the lack of a strong and sustained fiscal adjustment program, combined with continued reliance on domestic financing during the second half of the 1980s. Whereas the overall orientation of economic policies was aimed at strengthening the relative role of the private sector, the share of the economy's resources claimed by the public sector increased in real terms. The public sector borrowing requirement (PSBR) rose from an average 4-5 percent in the first half of 1980s to about 10 percent in the early 1990s, with the share of government consumption in GNP also rising during the period.

Furthermore, the increase in the net domestic financing needs of the public sector led to significant crowding-out of the private sector in domestic financial markets. The pace of privatization and reform of the key public enterprises (despite their adverse budgetary impact) was also disappointing.<sup>3</sup>

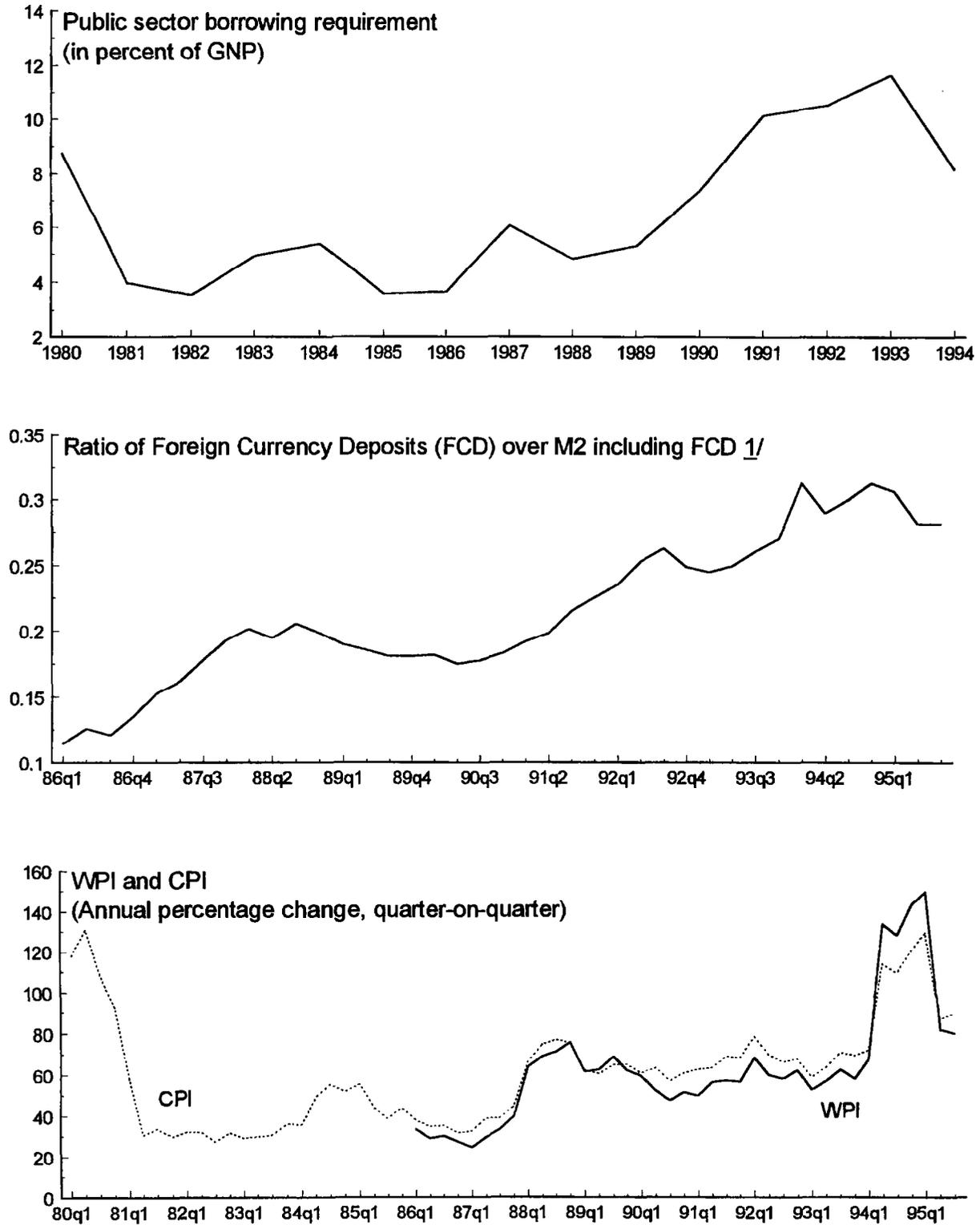
The deterioration in macroeconomic balances became much more pronounced during the second half of the 1980s (Figure 1). Reflecting lax financial policies and the stalling stabilization efforts, annual inflation jumped to almost 75 percent in 1988, and exceeded 100 percent in 1994—fuelled in part by a large depreciation of the nominal exchange rate (see below). In the fiscal area, from 1988 onward, the PSBR increased every year through 1993, mostly driven by higher expenditure, resulting largely from wage increases for public sector workers and civil servants, generous agricultural support policies, as well as continued worsening of the performance of the state enterprise sector (OECD, 1995).

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<sup>2</sup>Following the severe debt crisis that occurred in 1978-79, a comprehensive stabilization program was launched in early 1980. See Kopits (1987) for an account of these measures and the performance of the Turkish economy during the first half of the 1980s.

<sup>3</sup>This feature of the Turkish economy (a fast-opening economy with growing imbalances in public finances) became apparent at a very early stage in the liberalization process. See, for example, Celasun and Rodrik (1989).

Figure 1  
Turkey: Financial indicators



Source: International Financial Statistics, Bloomberg, and Turkish State Institute of Statistics.

1/ These figures differ from data published by the CBRT, and somewhat underestimate dollarization, owing to valuation issues.



Despite the deterioration in fiscal balances, reforms in the financial and external sectors continued, with the Central Bank of the Republic of Turkey (CBRT) taking important steps to alter the institutional setting of monetary policy making. The CBRT shifted increasingly toward a reliance on indirect monetary policy instruments (Gökçe, 1995). The interbank money and foreign exchange markets were opened in 1986 and 1988, respectively, open market operations were introduced in 1987, and bank lending and borrowing rates were fully liberalized in 1988.<sup>4</sup> After laying the groundwork, the CBRT began to implement a monetary program in 1989 with the objective of controlling the volume and structure of its balance sheet, and in 1990—with a view to restoring credibility against the ongoing deterioration in public finances—it began to announce the program.<sup>5</sup> On the external front, following the elimination of all quantitative restrictions, as well as the removal of all restrictions on current payments and transfers,<sup>6</sup> the Turkish capital account was fully liberalized in August 1989, partly encouraged by the current account surplus in 1988, the first time since the early 1970s. Thereafter, a number of decrees allowed both residents and nonresidents to conduct buying and selling operations in securities (in Turkey and abroad) and commercial banks to engage freely in foreign exchange transactions (see IMF, 1990). Although capital account liberalization was a gradual process, this was perhaps the second and the final most critical step, following the decision at end-1983 when residents were permitted to hold foreign exchange deposit accounts and transfer funds through these accounts freely (Kumcu, 1995). With the opening of the capital account, the early reliance on official

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<sup>4</sup>Deposit ceilings were reinstated and removed several times prior to 1988, although the policy of maintaining positive real interest rates remained in place through most of the period. See Atiyas and Ersel (1995) for a review of financial liberalization in Turkey.

<sup>5</sup>Instruments for monetary control were also diversified over time, with the CBRT relying increasingly on repurchase (“repo”) operations in the daily management of the currency.

<sup>6</sup>Prior to the opening of the capital account, Turkey made important progress in trade liberalization. Quantitative restrictions, pervasive in the late 1970s were eliminated by the mid-1980s. By the end of the 1980s, virtually all substantive controls over international payments and transfers were removed; in March 1990, Turkey accepted the Article VIII status in accordance with the Articles of Agreement of the International Monetary Fund. See Baysan and Blitzer (1990) for a detailed review of changes in Turkey’s trade regime in the 1980s.

financing and workers' remittances,<sup>7</sup> shifted to private inflows, which are by their very nature more sensitive to changes in relative rates of return (Figure 2). At the same time, the Government experienced a sharp increase in external debt service, resulting mainly from heavy repayment obligations on long-term debt—itsself largely associated with the expiration of grace periods from previous debt reschedulings. In the absence of a substantive fiscal adjustment, and to avoid undue pressures on the balance of payments, domestic agents were allowed to borrow freely in international capital markets. A significant shift by the banking sector to short-term borrowing in international financial markets helped improve the capital account of the balance of payments, offsetting to some extent the deterioration in the service component of the current account. A sharp increase in portfolio investment in the Istanbul Stock Exchange—which was reflected in the recovery of the stock market index, measured in dollar terms (Figure 3)—also contributed to the improvement in the capital account. Supported by strong inflows, the sum of the current and capital accounts (including errors and omissions) was in surplus during 1990-95, except for 1991 when uncertainties surrounding the Gulf War led to a substantial outflow of capital. International reserves of the CBRT increased considerably during the period, notwithstanding some sharp swings, particularly in 1994. As these surpluses found their way into the banking sector, and as uncertainties in economic prospects remained high, foreign currency deposits (in proportion of the money supply) began to increase (Figure 1).<sup>8</sup> Interestingly enough, the increased degree of dollarization was accompanied by a real exchange rate appreciation (or, equivalently, a rise in the purchasing power of the Turkish lira) during most of the period (Figure 4)<sup>9</sup>—except for the sharp correction that took place in early 1994 (see below).

The rate of economic growth, despite remaining high on average, became

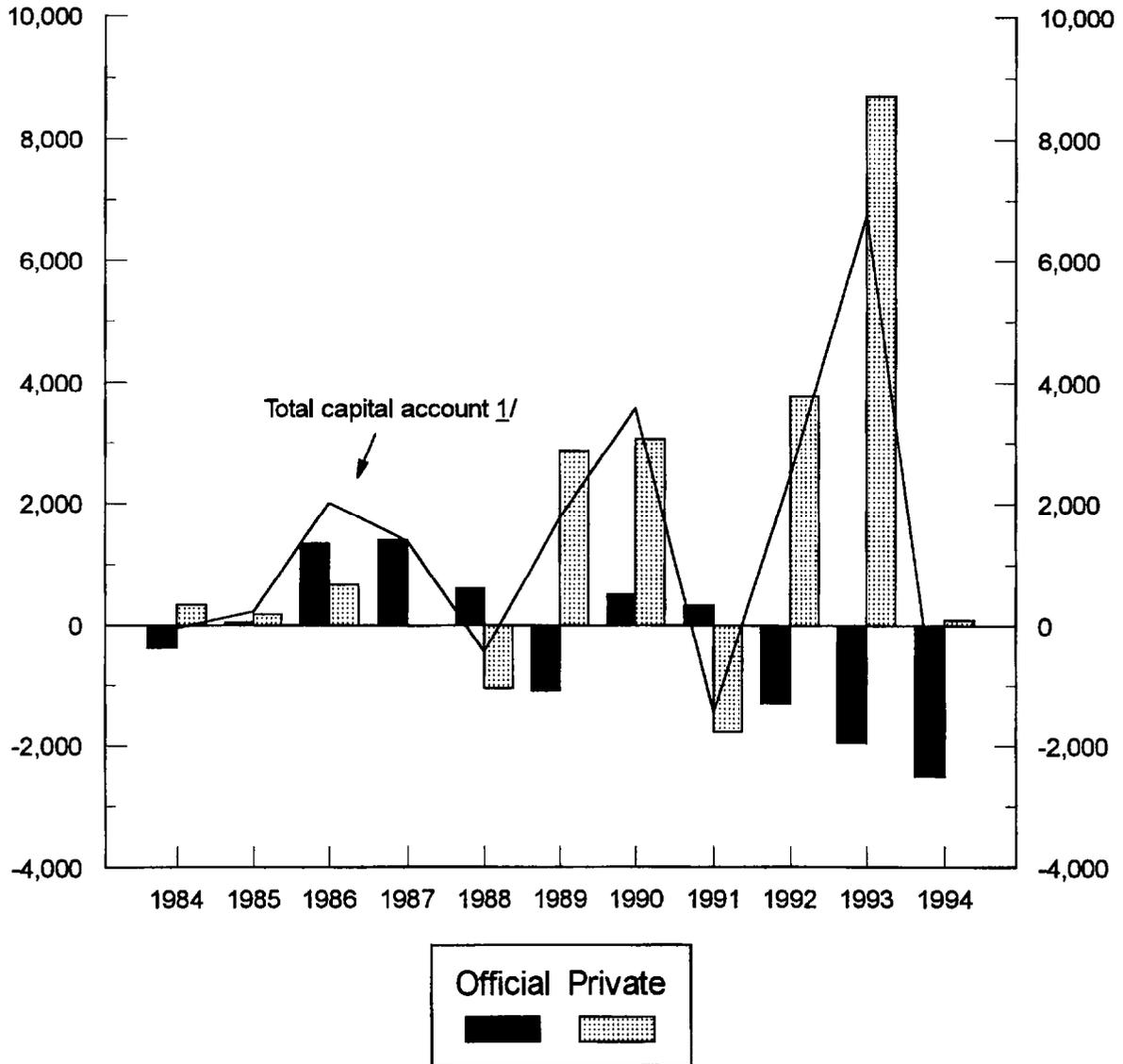
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<sup>7</sup>See Rodrik (1990) and VanWijnbergen (1990).

<sup>8</sup>This was a continuation and strengthening of a trend that began in 1984, when foreign exchange deposits were allowed in the banking system, as noted above; see Scacciavillani (1995) and Selcuk (1994) on dollarization in Turkey.

<sup>9</sup>Beginning in 1981, the CBRT followed a purchasing power parity-oriented policy whereby, the nominal exchange rate (based on a weighted-average of the U.S. dollar and the Deutschmark) was depreciated at a rate above the inflation differentials. The policy was abandoned in late 1988, as the CBRT adopted a more market-oriented exchange rate regime.

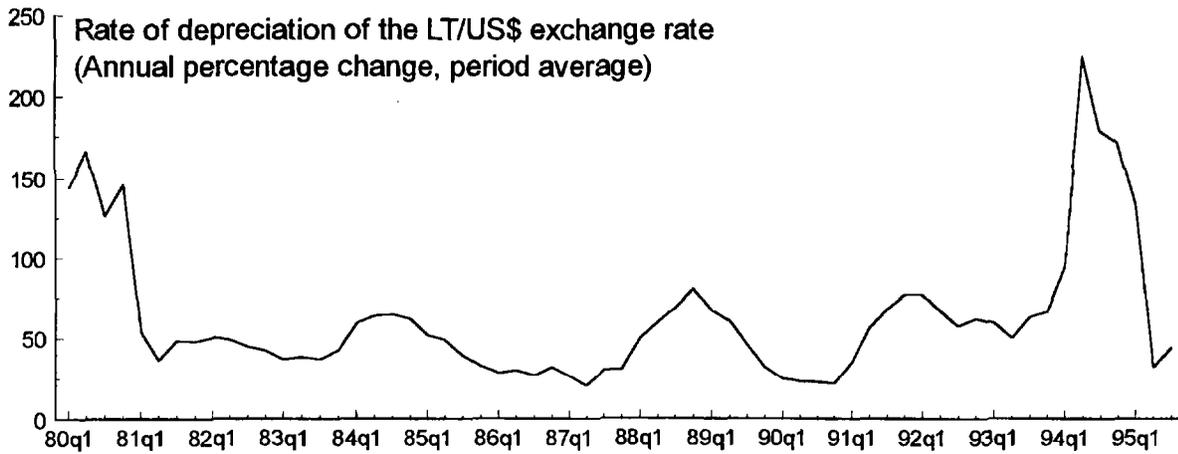
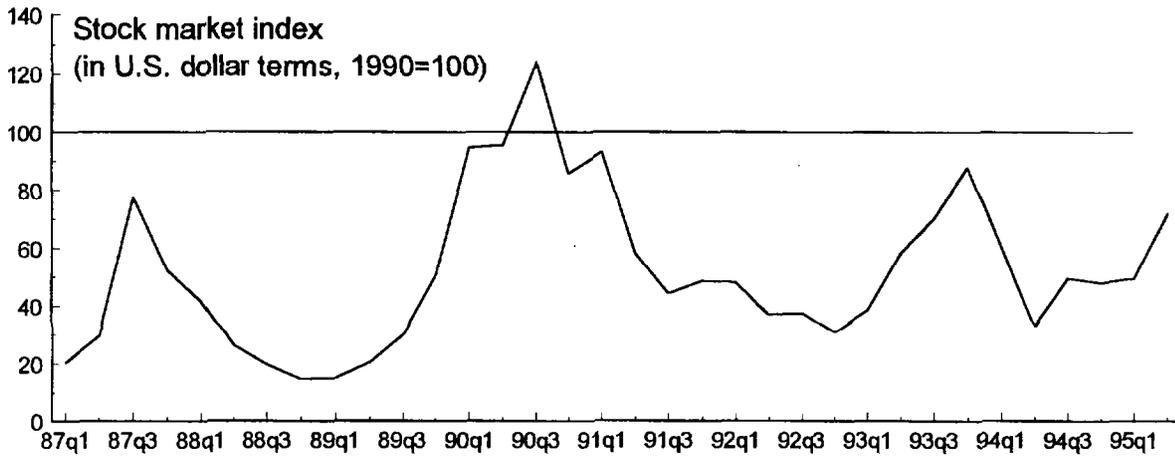
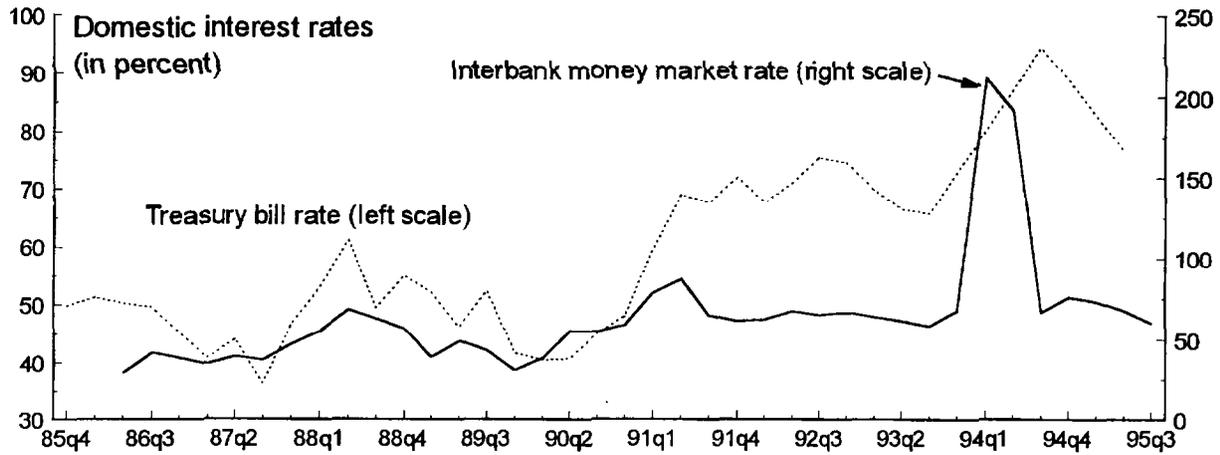
Figure 2  
Turkey: Capital account  
(in millions of U.S. dollars)



Source: International Financial Statistics.

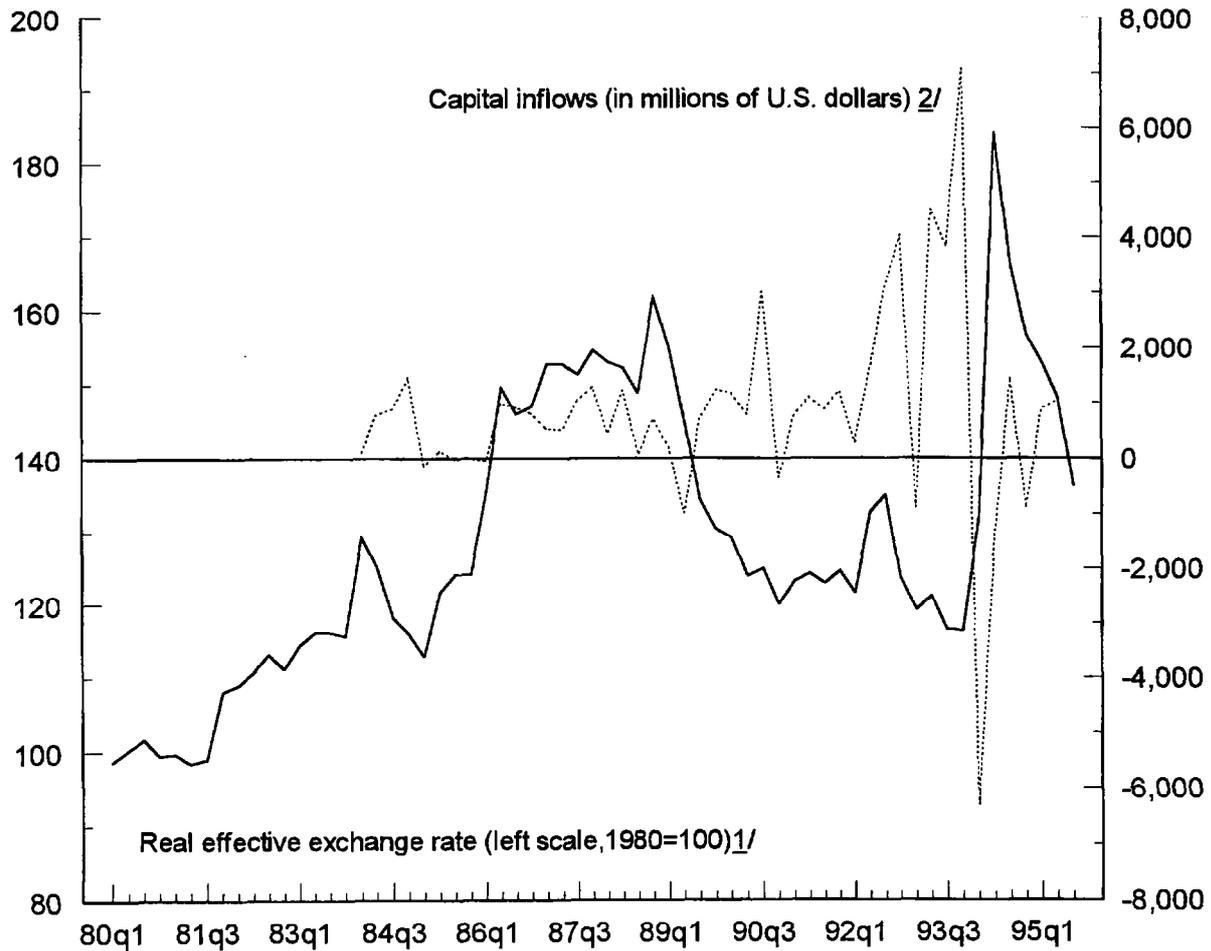
1/ Total and private capital accounts include errors and omissions.

**Figure 3**  
**Turkey: Financial indicators**



Source: International Financial Statistics, Bloomberg, and Turkish State Institute of Statistics.

Figure 4  
Turkey: Real exchange rate and capital inflows



Source: IFS and Information Notice System, IMF.

1/ An increase is a depreciation.

2/ Calculated as the sum of net direct investment from abroad, net portfolio investment liabilities, other net investment liabilities, and net errors and omissions; data not available before 1984.



increasingly volatile in the late 1980s. Modest expansion in 1989 was followed by an aggregate demand-led boom in 1990 and a sharp contraction in 1991, the latter reflecting uncertainties surrounding the Gulf crisis. In 1992-93, the economy rebounded strongly, expanding by about a cumulative 14 percent. This was associated with strong import growth, large increases in public and private-sector real wages, and (particularly in 1993) further deterioration in fiscal balances resulting in increased recourse to central bank financing. While the Government's reliance on net domestic financing has been increasing throughout, it initially refrained from monetization of the deficits by issuing short-term debt at high interest rates. However, as domestic interest payments rose in 1993, the importance of short-term advances from the CBRT in the financing of the deficit increased. In 1993, the monetization of debt led to substantial liquidity build-up in the economy and a loss of monetary control. Owing to the inconsistent nature of the fiscal-monetary policy mix, the monetary program was not announced in 1993.<sup>10</sup>

Capital inflows have clearly taken place against a background of inconsistent policy mix, at least through early 1993. While the PSBR was expanding from around 4 percent in mid-1980s to over 12 percent in 1993, the CBRT ventured, at times, to maintain strict control over monetary growth, resulting in high interest rates and an appreciating exchange rate. As interest rates remained high, the private sector was pushed to borrow offshore. Evidently, the policy stance was unsustainable. Expansionary economic policies, (particularly in 1993) and the resulting high growth rate led to a deterioration of external accounts and culminated in a foreign exchange crisis in early 1994. While excessive liquidity expansion in the form of central bank advances to the Treasury set the stage, major blows to credibility occurred through a manipulation of interest rates by way of canceling treasury bill auctions, or offering small amounts, as well as the announcement of the 1994 budget which included virtually no adjustment in the fiscal stance. Furthermore, downgrading of Turkey's credit-rating by two leading international agencies may also have played an important role. Following the foreign exchange crisis, a stabilization program was launched in early 1994 which included fiscal adjustment, monetary tightening, and a

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<sup>10</sup>In late 1993, senior management at the CBRT resigned reflecting disagreements over the course of economic policies. In effect, CBRT's room for monetary policy implementation became particularly constrained during that period, as it was driven by volatile foreign exchange flows and the net domestic financing needs of the Government.

relatively ambitious structural reform agenda. Despite some success in arresting further deterioration in public finances, the PSBR rose again in 1995, thereby reigniting inflationary pressures and raising inflationary expectations.<sup>11</sup>

The Turkish economy recovered from the crisis relatively quickly, aided by the sharp depreciation of the currency, and is estimated to have grown by about 8 percent in 1995, compared to a sharp contraction in 1994 (about 6 percent). While the increase in the external debt service ratio initially raised concerns about Turkey's ability to meet its external commitments without debt rescheduling, the improvement in the current account and a reversal in short-term capital flows not only allowed debt-service to be fully met but also led to a rapid build-up of foreign reserves, to a level that exceeded pre-crisis levels. Continued off-shore borrowing by banks in response to high domestic interest rates appeared to have been the main factor. In response, the CBRT imposed a tax (equivalent to 6 percent) on borrowing from abroad in September 1995. After a temporary slowdown, it appeared that substantial borrowing by banks had already resumed in early 1996.

### III. Vector Autoregression Analysis

The foregoing discussion presented some evidence that warrants a formal testing of the links between fiscal imbalances, high interest rates, capital inflows, and real exchange rate appreciation. This section provides an analysis along these lines, by way of estimating an (unrestricted) vector autoregression (VAR) model. We begin by describing the exact specification of the variables included in the system and examine their time-series properties. We then focus on the analysis of the short-run dynamic interactions among these variables by using standard innovation accounting techniques: impulse response functions (IRFs) and variance decompositions

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<sup>11</sup>The stabilization program in April 1994 was supported by a stand-by arrangement from the IMF, which has been extended, but the last drawing was not completed, as elections began to dominate the economic agenda in late 1995. In general, political developments have been a critical factor in Turkey's boom and bust cycles over the past 15 years.

(VDCs).<sup>12</sup> As is well known, the IRFs show the estimated response of each variable to a one standard deviation impulse in the fundamental shocks, whereas the VDCs account for the percentage of the forecast error variance of each variable explained by the particular shock. Ultimately, we are interested in the response of the real exchange rate and capital flows to shocks to government spending and uncovered interest rate differentials, as well as in the intreraction between capital flows and the real exchange rate.

### 1. Data: Sources and Time Series Properties

Quarterly data covering the period 1987:1 to 1995:1 (33 observations in all) were used to estimate the parameters of the VAR model. All series were obtained from the IMF's *International Financial Statistics*, except for the estimates of gross national product (GNP) and government consumption, which were obtained from the Turkish State Institute of Statistics.

The variables were constructed as follows. The *fiscal variable* is defined as  $g_t = G_t/Y_t - X_t\hat{\Psi}$  where  $G_t$  is government expenditure (expressed in billions of 1987 Turkish liras),  $Y_t$  is GNP in billions of 1987 Turkish liras and  $X_t$  is a vector of deterministic variables consisting of a constant, three seasonal dummies, used to deseasonalize  $g_t$ . The *interest rate differential* between the domestic rate of return on Turkish bonds and the domestic rate of return on foreign bonds is given by

$\rho_t = (1 + i_t/100)^{1/4} - (1 + i_t^*/100)^{1/4}(s_{t+1}/s_t)$ , where  $i_t$  is the interest rate on 3-month Turkish treasury bills (weighted average auction rate),  $i_t^*$  is the 3-month eurodollar rate in London, both at annual rates, and  $s_t$  is the spot exchange rate of one US dollar at time  $t$  to  $s_t$  Turkish liras.<sup>13</sup> The *capital*

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<sup>12</sup>It is well-known that estimated coefficients from a VAR convey little information in themselves, but they can be used to solve for a moving average representation of the system, which expresses the current value of each variable as a distributed lag of past innovations in all variables in the system as well as the dependent variable's own current innovation. The VAR model was estimated using the Choleski decomposition and was specified to include two lags for each variable. Although the Choleski method of decomposing the error term would normally make results sensitive to the ordering of the variables in the VAR, the importance of a particular ordering would be much less important in this case, given the weak contemporaneous correlations (see below). Although the use of formal lag-length selection criteria was not feasible (given the small sample size) the residuals of the estimated system appeared to have the desirable properties. See Hamilton (1994) for a thorough exposition of these time-series techniques.

<sup>13</sup>Where missing observations existed, they were substituted for by predicted values based on an estimated relationship between the treasury bill rate and the Turkish interbank rate (weighted average annualized rate in the overnight interbank market).

*flow* variable is defined in proportion of GNP as  $f_t = F_t/P_tY_t$ , where  $P_t$  is the GNP deflator and  $F_t$  is the domestic-currency value of net private capital inflows (including errors and omissions)—or, equivalently, the capital account excluding official flows plus errors and omissions.  $z_t$  is the inverse of the *real effective exchange rate* index, as calculated by the IMF, so that a rise in  $z_t$  corresponds to a real depreciation.

In line with standard procedures, we checked for the stationarity, prior to estimating the VAR, using the Augmented Dickey-Fuller (ADF) test and the Philipps-Perron (PP) test (see Dickey and Rossana, 1994). As shown in Table 1, we found that (the logarithm of) the real exchange rate  $lz_t$  is nonstationary in levels, whereas the other three series—the interest differential, as well as government spending and capital flows both in percent of GNP—are stationary in levels.

Table 1  
Order of Integration: Unit Root Test Statistics

		ADF test	PP test
	<i>k</i>	test statistic	
$g_t$	4	-3.926***	-6.886***
$\rho_t$	0	-4.091**	-3.838**
$f_t$	0	-3.589**	-3.271*
$lz_t$	0	-1.601	-1.427
$lz_t^c : HP$	1	-3.096**	-2.314
$lz_t^c : FD$	0	-4.898***	-6.443***
$lz_t^c : NP$	1	-3.643***	-2.527

Notes: Variables are as defined in the text. Estimation period is 1987:2-1995:1. Each regression includes a constant term and a time trend. The value of  $k$  corresponds to the highest-order lag for which the corresponding  $t$ -statistic in the regression is significant. Asterisks \*, \*\* and \*\*\* denote rejection of the null hypothesis of a unit root at the 10%, 5% and 1% significance levels. Critical values are from MacKinnon (1991).

To avoid mixing stationary and nonstationary variables in the VAR, and in order to use standard VAR techniques, we use the temporary component of the real exchange rate. This component, denoted  $lz_t^c$ , is calculated by decomposing the original series into nonstationary (trend) and stationary (cyclical or transitory) components. From an economic point of view, the use of the temporary component of the real exchange rate is motivated by our focus on high-frequency factors in the determination of changes in relative prices, as opposed to low-frequency ones, such as changes in productivity across sectors.

We calculate the temporary component of the real exchange rate using three alternative techniques: the Beveridge-Nelson (BN) approach, the Hodrick-Prescott (HP) filter, and a non-parametric (NP) method. To illustrate these techniques, suppose that the observed variable  $x_t$  is the sum of a trend  $x_t^*$  component and a cyclical component,  $x_t^c$ :

$$x_t = x_t^* + x_t^c. \quad (1)$$

At period  $t$ , the econometrician can observe  $x_t$  but cannot measure either  $x_t^*$  or  $x_t^c$ . The BN approach is motivated by the observation that many macroeconomic time series are well-captured by ARIMA processes. Specifically, suppose that the series  $x_t$  follows an ARIMA( $p, 1, q$ ) process. Beveridge and Nelson (1981) showed that any such process can be represented in terms of a stochastic trend plus stationary component, where the former is a random walk (possibly with drift) and the latter is an ARMA( $p, q$ ) process.

Formally, the model for  $\{x_t\}_{t=0}^T$  can be written as

$$P(L)(1 - L)x_t = \mu + Q(L)\varepsilon_t, \quad (2)$$

where  $L$  is the lag operator,  $P(L) = \sum_{h=0}^p \rho_h L^h$ ,  $Q(L) = \sum_{h=0}^q \alpha_h L^h$ ,  $\mu$  a constant term, and  $\varepsilon_t$  is an *i.i.d.* error. Inverting  $P(L)$  gives  $(1 - L)x_t = \alpha + B(L)\varepsilon_t$ , where  $\alpha = (\sum_{h=0}^p \rho_h)^{-1}\mu$ , and  $B(L) = P(L)^{-1}Q(L)$ . Recursively substituting for  $x_t$  and assuming that  $x_0 = \varepsilon_\tau = 0$  (for  $\tau \leq 0$ ) yields

$$x_t = \alpha t + B(L) \sum_{\tau=1}^t \varepsilon_\tau.$$

which can be rewritten as (Blackburn and Ravn, 1991):

$$x_t = \alpha t + b \sum_{\tau=1}^t \varepsilon_\tau + G(L)\varepsilon_t, \quad (3)$$

where  $b = \sum_{h=0}^{\infty} b_h$ ,  $G(L) = \sum_{k=0}^{\infty} g_k L^k$ , and  $g_k = -\sum_{h=k+1}^{\infty} b_h$ . The trend and cyclical components are given by, respectively,  $x_t^* = \alpha t + b \sum_{\tau=1}^t \varepsilon_{\tau}$  and  $x_t^c = G(L)\varepsilon_t$ . The implicit assumptions are that these components are perfectly correlated and that the trend follows a random walk with drift. The equivalent representation is thus:<sup>14</sup>

$$x_t^* = x_{t-1}^* + \alpha + b\varepsilon_t, \quad x_t^c = G(L)\varepsilon_t.$$

The second technique used here to defining the cyclical component of the real exchange rate is the Hodrick-Prescott (HP) filter. The technique consists essentially in specifying an adjustment rule whereby the trend component of the series  $x_t$  moves continuously and adjusts gradually. Formally, the unobserved component  $x_t^*$  is extracted by solving the following minimization problem:

$$\underset{x_t^*}{Min} \sum_{t=1}^T (x_t - x_t^*)^2 + \lambda \sum_{t=2}^T [(x_{t+1}^* - x_t^*) - (x_t^* - x_{t-1}^*)]^2. \quad (4)$$

Thus, the objective is to select the trend component that minimizes the sum of the squared deviations from the observed series, subject to the constraint that changes in  $x_t^*$  vary gradually over time. The Lagrange multiplier  $\lambda$  is a positive number that penalizes changes in the trend component. The larger the value of  $\lambda$ , the smoother is the resulting trend series.<sup>15</sup> By manipulating the first-order condition of the minimization problem, a time domain representation of the HP filter can be developed in which the trend component  $x_t^*$  is represented by a two-sided symmetric moving average expression of the observed series:

$$x_t^* = \sum_{h=-\infty}^{\infty} \alpha_{|h|} x_{t+h}, \quad (5)$$

where the parameters  $\alpha_{|h|}$  depend on the value of the Lagrange multiplier  $\lambda$ . The third decomposition technique that we use is described in the Appendix. It exploits the fact that it is possible to estimate a trend function nonparametrically without reference to a specific form. The

<sup>14</sup>The difficulty with the BN approach results precisely from its flexibility: in practice, identifying the polynomials  $P(L)$  and  $Q(L)$  requires considerable judgement, and choosing among alternative parameterizations can be arbitrary.

<sup>15</sup>We follow here the usual practice of setting  $\lambda$  to 1600 with quarterly time series.

estimation can be performed in the spirit of the classical decomposition and has become popular in recent times.<sup>16</sup>

The aim of nonparametric estimation of  $x_t^*$  in (1) is to approximate  $x_t$  subject to the condition that  $x_t^*$  be smooth. This can be accomplished by constructing a weighted mean of  $x_t$ , as

$$\hat{x}_t^* = \sum_{t=1}^T W_{Tt}(z)x_t, \quad (6)$$

where  $W_{Tt}(z)$  represents the weights assigned to the  $t$ -th observation  $x_t$ , and it depends on the distance between  $t$  and  $z$ . A specific form of the weights is described in the Appendix. The nonparametric method has three distinct advantages. First, it is not necessary to specify the functional form of  $x_t^*$  (unlike the BN decomposition), although it is necessary to assume that the trend has an adequate number of derivatives so that it is smooth relative to  $x_t$ . Consequently, using nonparametric regression allows truly flexible functional forms to be considered. Second, the method can readily be adjusted so that the degree of smoothing is based on statistical criteria. Since the degree of smoothing is determined on statistical grounds and does not require the specification of an arbitrary smoothing parameter (unlike the HP filter), different researchers analyzing the same data will obtain the same trend estimates. Third, the method can easily be extended to take account of isolated jump points in the data that would otherwise corrupt the analysis.

Figure 5 shows the temporary components of the real exchange rate derived from three different filters. As to the BN technique, starting from an ARMA(2,2)—given the small sample size—we could not identify a stable ARMA process for the first-differences of the logarithm of the real exchange rate.<sup>17</sup> We thus used, as a third filter, the first differences of the logarithm of the real exchange rate. The basic assumption here is that the trend component of the series is a random walk with no drift. Thus, the series  $x_t$  has a unit root which is entirely due to the trend component. With  $x_t = x_{t-1} + \varepsilon_t$ , an estimate of the cyclical component is therefore given by

$$x_t^c = x_t - x_{t-1}. \quad (7)$$

<sup>16</sup>A useful reference for this type of estimation is Härdle (1990) and Ullah and Vinod (1993).

<sup>17</sup>This simply indicates that the first differences of the real exchange rate series is close to white noise. This is confirmed by a simple examination of the autocorrelation and partial autocorrelation functions.

## 2. Variance Decompositions

We estimated the VAR using  $g_t$ ,  $\rho_t$ ,  $f_t$ , and the three alternative measures of  $lz_t^c$ , in the order specified.<sup>18</sup> We also added a constant term and a dummy variable that takes the value 1 in the first quarter of 1994, in order to control for the particularly pronounced changes in the variables of the system. As Table 2 indicates, results obtained with all three alternative decompositions of the real exchange rate are quite similar. Although the percentage contribution of each variable to itself is very high, some of the results are noteworthy. The contribution of the variance of the interest rate differential to the variance of the temporary component of the real exchange rate is about 10 percent after one quarter, and reaches almost 50 percent after two quarters. This may reflect the impact of changes in domestic interest rates on private absorption and hence the relative price of nontraded goods. The contribution of the variance of the government spending-to-output ratio, as well as of capital flows, to that of the real exchange rate are also relatively large. Results obtained by using the nonparametric filter (our preferred method) indicate that the former reaches 35 percent during the second quarter (not shown), and then declines to about 18 (15) percent in the fourth (sixteenth) quarter. The relative importance of capital flows reaches about 23 percent in the fourth quarter and stabilizes at about 26 percent after 8 quarters.

## 3. Dynamic Response to Shocks

The effects of shocks to government spending and interest rate differentials, as well as the dynamic interaction between capital flows and real exchange rate are now assessed using IRFs. The dotted lines shown around the IRFs in Figures 6 and 7 are the two standard deviation bands, which are used as a measure of significance. A number of results are noteworthy.

First, the results obtained with all three alternative methods of decomposing the real exchange rate are broadly similar, indicating robustness of our results to the choice of a specific filter.

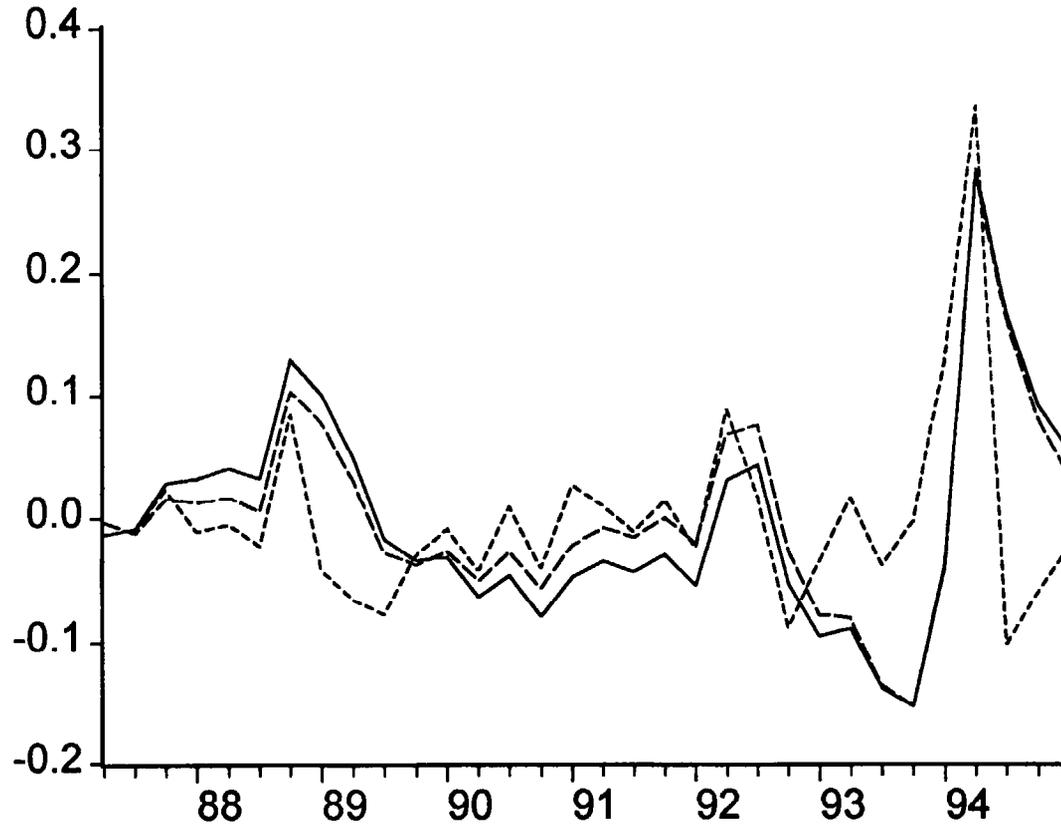
Second, shocks to government spending (in proportion of GNP) have a significant impact on the temporary component of the real exchange rate (Figure 7), with an increase in  $g_t$  leading to a (temporary) real

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<sup>18</sup>Placing  $g_t$  as the first variable in the VAR is consistent with the assumption that it is the most "exogenous" in the system. Therefore, it is given the maximum chance of influencing other variables.

Figure 5

Turkey: Temporary Component of the Logarithm of the Real Exchange Rate



— Hodrick-Prescott filter    - - - - First-differences filter    - · - · Nonparametric filter



Table 2. Variance Decompositions

Quarters	HP filter				FD filter				NP filter			
	$g_t$	$\rho_t$	$f_t$	$lz_t^c$	$g_t$	$\rho_t$	$f_t$	$lz_t^c$	$g_t$	$\rho_t$	$f_t$	$lz_t^c$
	<u>Decomposition of <math>\rho_t</math></u>											
1	5.0	94.0	0.0	0.0	1.7	98.3	0.0	0.0	10.5	89.5	0.0	0.0
4	7.1	77.8	10.3	4.8	5.3	86.8	7.0	0.9	11.6	68.2	13.8	6.5
8	7.0	75.3	12.0	5.7	5.9	83.8	8.8	1.6	11.2	63.7	17.0	8.1
12	6.9	75.1	12.3	5.8	5.8	83.5	9.0	1.7	11.0	62.7	17.9	8.4
16	6.8	75.1	12.2	5.8	5.8	83.4	9.1	1.7	10.9	62.4	18.2	8.4
	<u>Decomposition of <math>f_t</math></u>											
1	2.2	0.5	97.4	0.0	3.9	3.3	92.9	0.0	2.2	0.2	97.6	0.0
4	5.6	22.8	67.8	3.8	3.3	42.1	51.5	3.1	8.5	17.7	68.0	5.8
8	4.8	30.2	58.9	6.1	3.2	43.3	50.2	3.3	7.4	23.8	61.0	7.8
12	4.6	31.1	58.0	6.3	3.2	43.7	49.8	3.3	7.3	25.0	59.4	8.3
16	4.6	31.2	57.8	6.4	3.2	43.8	50.0	3.4	7.2	25.3	59.0	8.5
	<u>Decomposition of <math>lz_t^c</math></u>											
1	11.1	0.3	9.1	79.6	15.9	0.1	0.4	83.6	15.8	0.7	14.4	69.1
4	12.2	52.3	12.4	23.1	17.0	54.2	2.2	26.5	18.4	35.8	23.4	22.4
8	11.1	52.2	14.5	22.3	16.7	55.1	6.1	22.1	16.0	36.7	25.8	22.0
12	10.8	52.5	14.6	22.0	16.3	55.2	6.8	21.6	15.2	36.9	26.1	21.8
16	10.8	52.5	14.7	22.0	16.3	55.3	6.9	21.5	15.1	36.9	26.2	21.8

Note:

The numbers in the table indicate the proportion of the variance of the interest rate differential, capital inflows, and the temporary component of the (logarithm of) the real exchange rate attributable to each of the variables in the system, after the number of quarters specified in the first column.

appreciation. This effect is consistent with theoretical predictions, and illustrates the type of relative price movements induced by an increase in government expenditure. At a given level of private expenditure, an increase in government spending on home goods—the main component of public sector outlays in Turkey—requires an increase in the relative price of nontraded goods to reduce private demand and maintain market equilibrium. The lower the elasticity of the supply of nontraded goods in the short run, the larger the required real appreciation.<sup>19</sup> The response of capital inflows to shocks in government spending on the other hand does not appear to be significant.

Third, the responses of both the real exchange rate and capital flows to the interest rate differential are significant, and have the right signs: an increase in the differential leads to a capital inflow and an appreciation of the real exchange rate (Figure 6). If the increase in the differential is interpreted as resulting from a tightening of monetary policy or, more generally, as indicative of an inconsistent mix of monetary and fiscal policies, this result also appears in line with the Turkish experience.<sup>20</sup> Finally, as would be expected from the previous result, a positive shock to capital inflows leads to a real appreciation.

#### IV. Summary and Conclusions

This paper examined the links between fiscal policy, uncovered interest rate differentials, the real exchange rate, and capital inflows in Turkey since the late 1980s. The first part reviewed macroeconomic developments in Turkey over the recent past, and described the context within which capital inflows took place. It indicated that capital inflows coincided with a period of

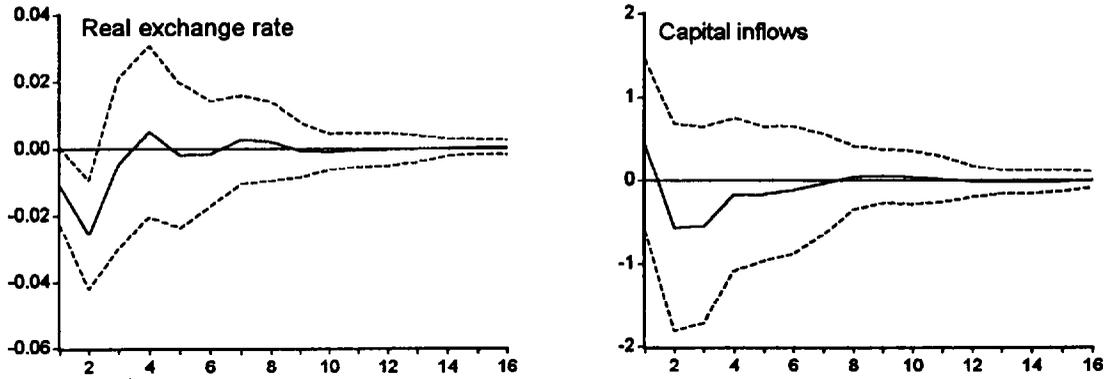
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<sup>19</sup>See for instance Agénor (1996) and Penati (1983). In principle, if the induced reduction in private spending is very large (so that total domestic absorption would fall), and/or if the elasticity of supply of nontraded goods to relative price changes is high, the net effect on the real exchange rate could be a depreciation. However, a real appreciation appears consistent with the above overview of recent developments.

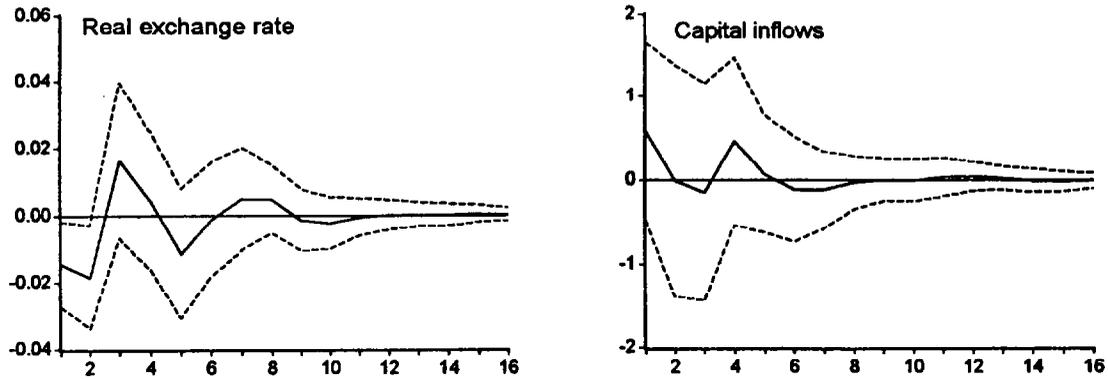
<sup>20</sup>Noting that the interest differential includes ex-post, one quarter-ahead changes in the spot exchange rate, an increase in the differential could also be interpreted, under rational expectations, as expectations of appreciation in the next period's spot rate. Lack of survey data on exchange rate expectations in Turkey prevented a more formal analysis of this effect.

Figure 6  
Response to one Standard Deviation Innovation  
in the Government Spending-Output Ratio  
( $\pm 2$  standard errors)

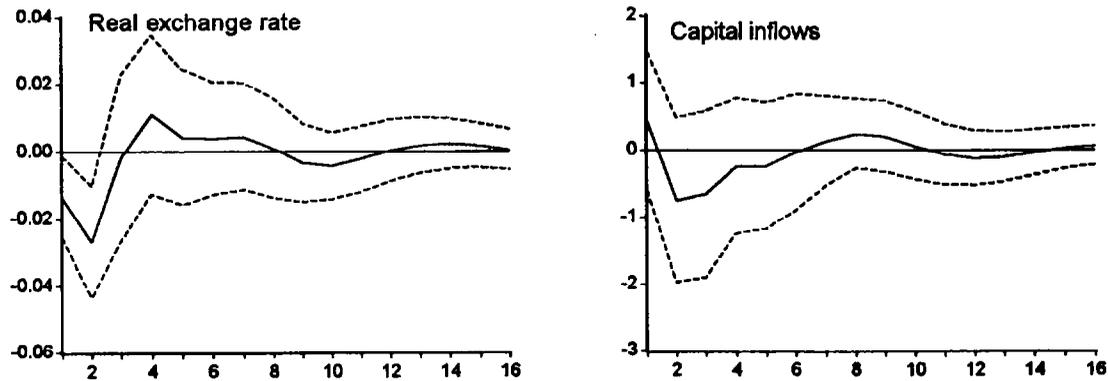
Hodrick-Prescott filter



First-differences filter

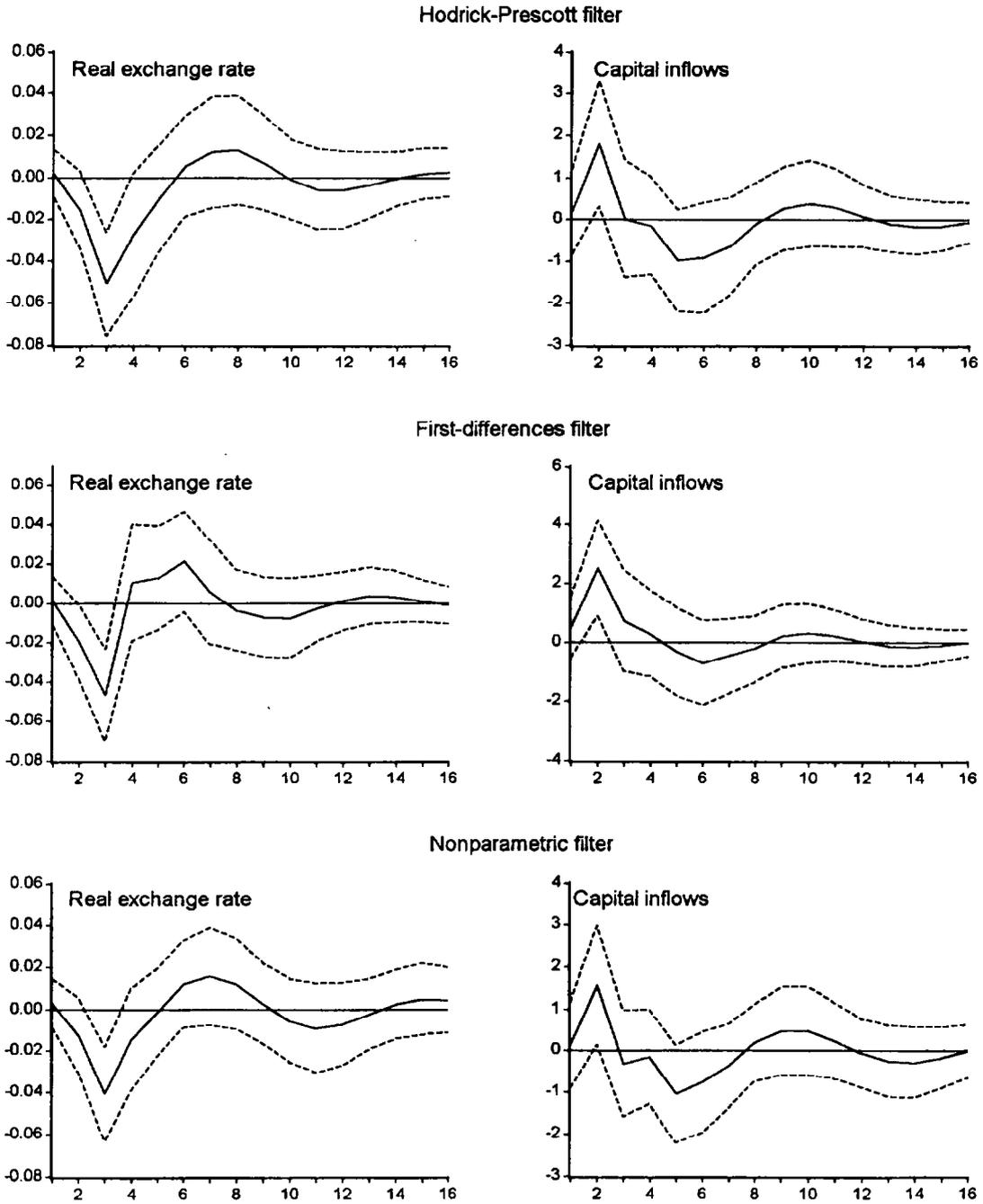


Nonparametric filter



Note: An increase in the real exchange rate is a depreciation.

**Figure 7**  
Response to One Standard Deviation Innovation  
in the Interest Rate Differential  
( $\pm 2$  standard errors)



Note: An increase in the real exchange rate is a depreciation.

significant deterioration in fiscal balances, high interest rates, and an appreciating real exchange rate.

The second part presented a formal testing of the links suggested by our review of the Turkish experience by way of estimating a VAR model which included the temporary component of the real exchange rate, government spending and (net) private capital inflows, both measured as percent of GNP, as well as the interest rate differential adjusted for exchange rate changes. Because there are no widely-accepted criteria for choosing among alternative decomposition methods, we used three alternative techniques for calculating the temporary component of the real exchange rate: the Hodrick-Prescott filter, the first-differences filter, and a nonparametric method, which possesses a number of advantages compared to the two previous ones.<sup>21</sup> All three methods led to broadly similar variance decompositions and impulse response functions.

Although the constraints imposed on the specification of the VAR by the small sample size prevent firm conclusions, our findings are broadly in line with a number of key developments in Turkey. Namely, they suggest that positive shocks to government spending lead to an appreciation of the real exchange rate, while capital flows respond to shocks to uncovered interest rate differentials. Furthermore, the real exchange rate responds significantly, and in the expected direction, to shocks to the interest rate differential, as well as to capital flows.

The lessons that can be drawn from the above analysis are twofold. The first and general one is that the popular view according to which capital inflows "cause" the real exchange rate to appreciate should be taken with care. Capital flows are an endogenous response to perceived changes in relative rates of return between domestic and foreign assets; in turn, domestic rates of return are influenced by macroeconomic equilibrium conditions and the overall policy stance. In particular, policy inconsistencies (such as the combination of an expansionary fiscal policy with a relatively tight monetary policy) tend to generate equilibrium changes in asset prices and yields, which affect capital movements and may put upward pressure on the relative price of nontraded goods through wealth and income effects. The second, and more specific, lesson that can be drawn from our analysis relates to the importance of fiscal adjustment for restoring macroeconomic

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<sup>21</sup>We also attempted to use the Beveridge-Nelson decomposition technique, but (as indicated in the text) our efforts were met with little success.

stability in Turkey. Although the real appreciation observed in the early 1990s appears to have had a relatively weak effect on the growth rate of exports, it contributed to a sharp increase in imports and a deterioration of the current account balance. As illustrated by the crisis that took place in early 1994, market correction of real exchange rate misalignment may occur in traumatic fashion and may be associated with increased volatility in asset prices and disruptions in economic activity. Restoring fiscal equilibrium would create an environment more conducive to private sector activity and promote a more orderly adjustment in relative prices.

## Appendix

### Nonparametric Detrending Method

Consider the decomposition (1), and let the trend component  $x_t^*$  be an unknown smooth regression function. The Nadaraya-Watson estimator  $\hat{x}_t^h$  of  $x_t^*$  has the form

$$\hat{x}_t^h(z) = \frac{T^{-1} \sum_{t=1}^T K_h(z - t/T) x_t}{T^{-1} \sum_{t=1}^T K_h(z - t/T)}$$

where  $K_h(u) = h^{-1}K(u/h)$ ,  $h$  is the bandwidth parameter,  $T$  is the sample size, and  $K(u)$  is a kernel with support  $[-1, 1]$  that satisfies  $\int K(u) du = 1$ . The kernel we will use is the Epanechnikov kernel and is defined as

$$K(u) = 0.75 (1 - u^2) I(|u| \leq 1), \quad (\text{A1})$$

where  $I(|u| \leq 1)$  is the indicator function. This parabolic shaped kernel is a commonly used kernel function which enjoys some optimality properties. The accuracy of kernel smoothers as estimators of  $x_t^*$  is a function of the kernel  $K$  and the bandwidth  $h$ , the most important factor being the choice of  $h$ . Below we outline a data dependent bandwidth selection procedure that optimizes quadratic error measures for the regression curve. The leave-out or cross-validation method is based on regression smoothers in which one, say the  $s$ th, observation is left-out

$$\hat{x}_t^{hs}(X_s) = T^{-1} \sum_{t \neq s} W_{ht}(X_s) x_t. \quad (\text{A2})$$

where  $W_{ht} = K_h(z - t/T) / [T^{-1} \sum_{j=1}^T K_h(z - t/T)]$ . With these modified smoothers, the cross-validation function

$$CV(h) = T^{-1} \sum_{s=1}^T [x_s - \hat{x}_s^{hs}(X_s)]^2 w(X_s) \quad (\text{A3})$$

is formed where  $w(X_s)$  is a trimming function. The CV function validates the ability to predict  $\{x_s\}_{s=1}^T$  across the subsamples  $\{(X_t, x_t)\}_{t \neq s}$ . Now the optimal bandwidth parameter is chosen such that

$$\hat{h} = \arg \min [CV(h)]. \quad (\text{A4})$$

In practice, one needs to construct the cross validation function over a dense grid of  $h$  values and choose the value of  $h$  that corresponds to the lowest value of  $CV(h)$ .

Employing the results of Müller (1992), the above method can be extended to allow the smooth “detrending” function to contain an isolated unknown discontinuity or change point in the curve. Let  $K_+$  and  $K_-$  be one-sided kernel functions with  $\text{support}(K_+) = [-1, 0]$  and  $\text{support}(K_-) = [0, 1]$ , and define the one-sided regression estimates as

$$\hat{x}_t^{h\pm}(z) = \frac{T^{-1} \sum_{t=1}^T K_{h\pm}(z - t/T) x_t}{T^{-1} \sum_{t=1}^T K_{h\pm}(z - t/T)}. \quad (\text{A5})$$

The estimator for the location of the change-point is defined as

$$\hat{\mu} = \inf \left\{ \rho \in Q : \hat{\Delta}(\rho) = \sup_{t \in Q} \hat{\Delta}(t) \right\} \quad (\text{A6})$$

where  $Q \subset (0, 1)$  is a closed interval such that  $\mu \in Q$  and where  $\hat{\Delta}(z) = \hat{x}_+(z) - \hat{x}_-(z)$ . The purpose of defining  $\hat{\mu}$  as a maximizer over  $Q$  instead of over  $[0, 1]$  is to rule out change-points arbitrarily close to the boundary.

Having estimated the location of the change-point we can construct an adjusted “detrending” function,  $\tilde{x}(z, \hat{\mu})$ , which is defined as

$$\tilde{x}(z, \hat{\mu}) = \begin{cases} \hat{x}(z), & |z - \hat{\mu}| > h \\ \hat{x}_+(z), & \hat{\mu} < z \leq \hat{\mu} + h \\ \hat{x}_-(z), & \hat{\mu} - h \leq z \leq \hat{\mu}. \end{cases} \quad (\text{A7})$$

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