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An Econometric Analysis of the Determinants of Inflation in Turkey

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Abstract

High and variable inflation has been a central feature of the Turkish economy since the 1970s. This paper seeks to shed some light on the determinants of inflation in Turkey by analyzing price determination within the framework of a multi-sector macroeconomic model during 1970–95. The main findings are that monetary variables (initially money, more recently the exchange rate) play a central role in the inflationary process, that public sector deficits contribute to inflationary pressures, and that inertial factors are quantitatively important. Policymakers' commitment to active exchange rate depreciation on several occasions in the past 15 years has also contributed to the inflationary process.

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SUMMARY

Turkey has experienced high and variable inflation since the 1970s. Various stabilization programs implemented over the years have brought only temporary relief, and inflation remains a major challenge for policymakers.

This paper examines the possible causes of inflation in Turkey during 1970–95, a period in which the Turkish economy underwent profound structural changes. The theoretical approach adopted in this paper incorporates both long- and short-run dynamics within a macroeconomic model comprising the goods, money, labor, and external sectors. The inflation equation was estimated for two subperiods (1970–80 and 1981–95) to allow for structural shifts.

The econometric analysis supports an interpretation of Turkish inflation in which monetary variables (initially money, more recently the exchange rate) play a central role in the inflationary process; inertial factors are quantitatively important; and public sector deficits are found to have an important direct effect on inflation. Policymakers' commitment to active exchange rate depreciation on several occasions in the past 15 years has also contributed to the inflationary process. These conclusions are broadly in line with the results from other developing countries, albeit perhaps with the exchange rate having a stronger role in the inflationary process than it typically does.

I. INTRODUCTION

Turkey has experienced high and variable inflation since the 1970s. Various stabilization programs implemented over the years have brought only temporary relief, and inflation remains a central feature of the Turkish economy. A sizable literature has emerged that examines elements of the inflationary process in Turkey, typically focusing on a single determinant of inflation. This study seeks to throw additional light on the determinants of inflation in Turkey by analyzing price determination within the framework of a simplified multi-sector macroeconomic model, along the lines proposed by Bruno and Melnick (1994).

Inflation in Turkey was in line with that of industrial countries through 1970, but accelerated throughout the 1970s to a high of some 100 percent in 1980 (Figure 1). Implementation of a major stabilization program saw a sharp drop in inflation to some 30 percent a year during the early 1980s, but this was soon reversed as inflation trended upwards from the mid-1980s, reaching a peak of 120 percent in 1994 (following an exchange market crisis) before dropping back to 88 percent in 1995. During the 1980s, wide-ranging structural reforms were introduced, notably in the financial and external sectors, that transformed a heavily regulated inward-looking financially repressed economy into one in which market forces and external competition play a central role in resource allocation. Inflation during the late 1980s and early 1990s therefore took place in the context of an economic structure very different from that of the 1970s, but with one constant theme—a large, albeit fluctuating, public sector borrowing requirement (Figure 2).

The paper is organized as follows. Section II presents a review of the literature under three broad classifications. Section III outlines the theoretical framework adopted in this study. Section IV reports and discusses the empirical results and Section V offers some concluding remarks.

II. LITERATURE REVIEW

Studies on inflation in Turkey fall largely in three groups: (A) those which focus on a purely monetary approach and point to the clear relationship between money and prices ; (B) those which employ a public finance approach and indicate that monetary expansion occurs in response to fiscal imbalances; and (C) those which analyze structural and cost-push factors. The latter highlight the importance of oligopolistic pricing and cost pressures stemming from wage increases and devaluations, while in most instances recognizing that for structural and cost-push factors to operate, monetary policy must also be accommodative.

A. The Monetary Approach

The monetary approach assumes a stable demand for real money balances determined by real income and returns on alternative assets. Given aggregate supply constraints in the short run, an expansionary monetary policy will result in higher prices. OECD (1995) finds that, in the long run, wholesale price inflation is exclusively determined by the money supply, while Togan

Figure 1. Turkey: Inflation Developments, 1970-95 1/
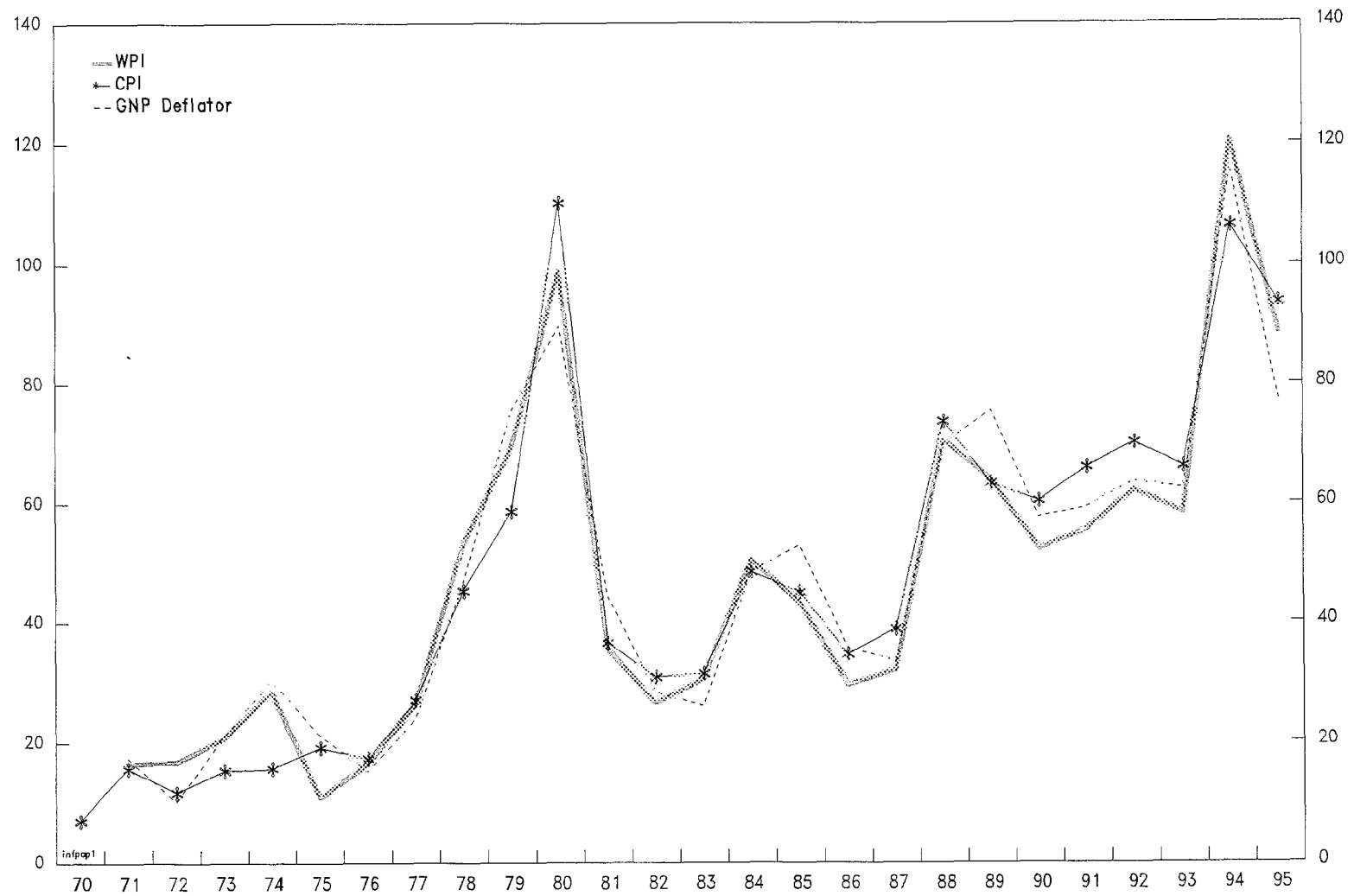
Sources: Turkish authorities; and IMF, International Financial Statistics.

1/ Period average percentage changes.

Figure 2. Turkey: Public Sector Developments, 1972–94
(In percent of GNP)

PUBLIC SECTOR BORROWING REQUIREMENT

TOTAL EXPENDITURE AND REVENUE

DOMESTIC AND FOREIGN BORROWING

Source: Turkish authorities.

(1987) and De Santis (1993), using inverted money demand functions, produce estimates of inflation which track the trend of actual inflation rathe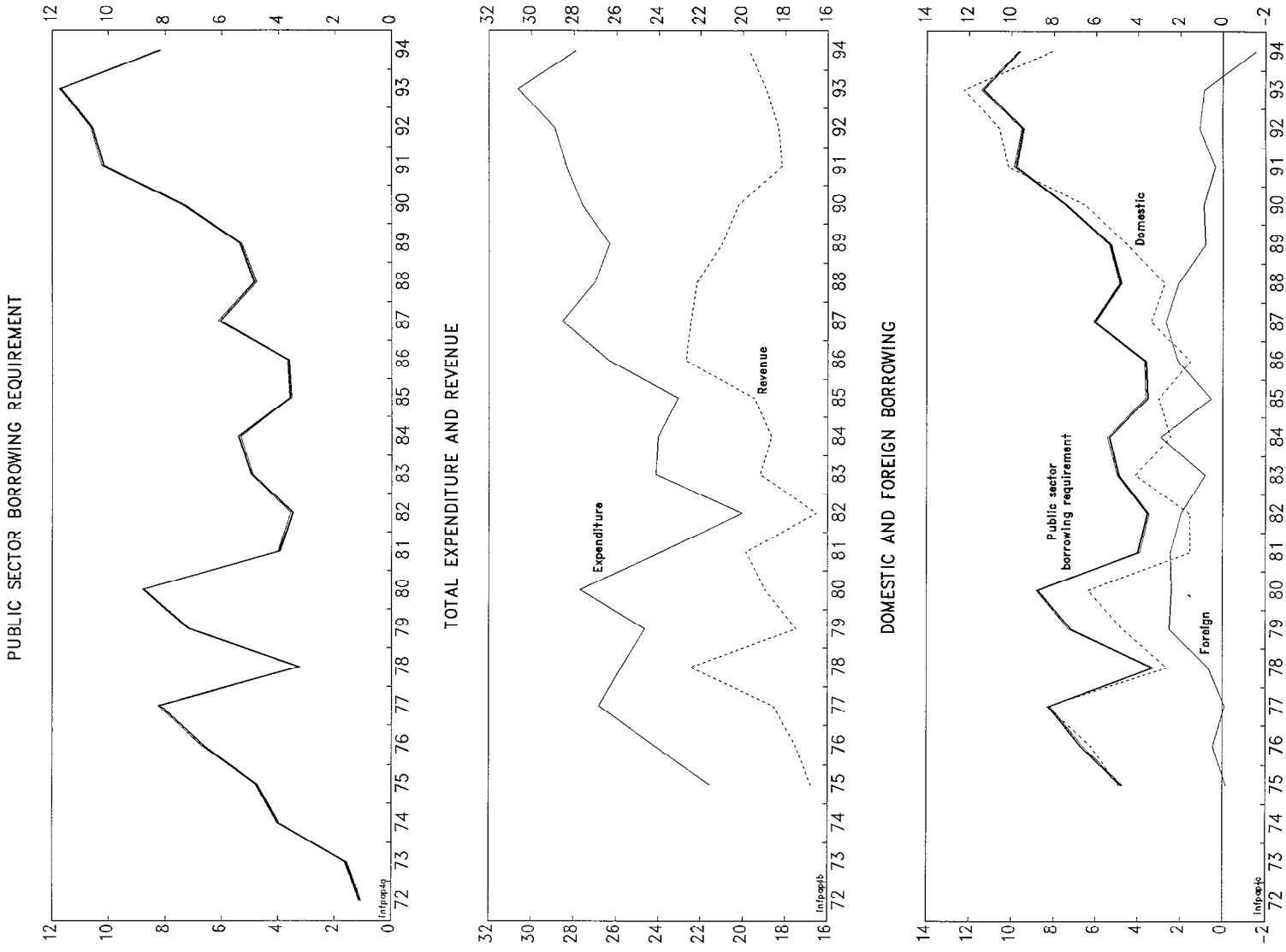r well. Ozatay (1992a) shows that monetary aggregates can help predict movements of nominal income and the GNP deflator.

B. The Public Finance Approach

The public finance approach emphasizes that, given the limits on domestic and foreign borrowing dictated by financial market conditions and solvency requirements, monetization is the residual form of deficit financing.

Rodrik (1991) finds a one-to-one relationship, at the margin, between public sector deficits and inflation, with inflation inertia not significant over the estimation period. He also notes that, during the 1980s, the inflationary consequences of a given deficit were further exacerbated by a decline in the demand for base money due to the relaxation of foreign exchange regulations, which induced a portfolio reallocation toward foreign currency-denominated assets and a significant erosion of the base of the inflation tax. Anand and van Wijnbergen (1988, 1989), van Wijnbergen (1989) and World Bank (1991) formulate their analyses in a framework that can be used to derive inflation for a given deficit and money demand; however, multiple equilibrium inflation rates can result because the inflation rate is also a determinant of money demand. Finally, Batavia and Lash (1983) find evidence of a vicious circle between inflation and public sector deficits in the period 1950–75: they maintain that inflation increases the public sector deficit because it raises expenditure faster than revenues.

It has been argued that fiscal deficits have been affected by the political cycle and that public price policy has been used in this connection, by keeping public prices unchanged before elections and raising them after the elections (Rodrik). Thus, inflation is lower just before an election and increases afterward, both because of the direct effect of public prices in the total price index and because of the indirect effect of public prices through private prices. The link between public prices and private price dynamics has been investigated for the period 1982–1990 by Ozatay (1992b). He finds that the response of private prices to electrical energy prices, prices of refinery products, and mining sector prices—which account for almost half of the public PPI—is sizable and occurs quickly.

Metin (1995) takes into account various possible sources of inflation, including cost push factors and concludes that fiscal variables dominate the inflationary process in Turkey. In addition, she does not find significant effects of disequilibria in the labor and goods markets, while the imbalances in the money market have an effect, but only in the short run.

C. Structural and Cost-Push Explanations

Finally, a number of studies explore the role that structural and cost-push factors play in the inflationary process. These factors include: (i) the link between the exchange rate and prices; (ii) the markup on final product prices due to the oligopolistic industrial structure; and (iii) wage pressures stemming from indexation rules and entrenched inflationary expectations.

Rising inflation and continued depreciation of the Turkish lira throughout the 1980s give rise to the hypothesis of a devaluation-inflation spiral. In Turkey, this process is facilitated by the relatively high dependence of the economy on imports of capital and intermediate goods, and the predominantly oligopolistic industrial structure that allows a markup over costs by manufacturing firms. Under these circumstances, increases in the price of foreign currency or the dollar price of imported inputs are translated into higher prices of domestic products. However, the empirical evidence on the validity of this argument is mixed.

Onis and Ozmucur (1990) find evidence of a two-way causal link between exchange rates and prices. Rittenberg (1993) and Metin (1995), however, provide counter evidence. Using Granger causality tests, Rittenberg shows that causality runs from price level changes to exchange rate changes, but not vice versa. In a more recent study, Metin finds no evidence that purchasing power parity and uncovered interest parity relationships hold for the period 1948 to 1987, although she cites several structural shifts during the estimation period which may have obscured the transmission effects. Although no consensus has been reached on the causality between exchange rates and inflation, it is worthwhile noting that a key assumption of the devaluation-inflation argument was not fulfilled during the post-1980 period; that is, monetary policy was not uniformly accommodative (da Cunha, Webb, and Isaac, 1990).[2]

Few studies have tested the relative significance of oligopolistic pricing behavior in the Turkish manufacturing sector on inflation. In general, these studies indicate that markup pricing alone cannot explain the causes of persistent inflation in Turkey. Uygur (1990) finds that firms' markup, expressed as a function of changes in excess demand, statistically determines private manufacturing wholesale price inflation, but with only a relatively small impact. Instead, inflationary expectations are found to be the more relevant factor, accounting for about 75 percent of the magnitude of the price changes. In turn, these expectations are shown to be determined by: (i) inertia—higher current inflation leads to higher expected

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[2]In a slightly different vein, Bilginsoy (1993) emphasizes that, during 1965–1980, monetary growth had a purely inflationary impact in periods of foreign exchange crisis, when imports were rationed by nonmarket allocation mechanisms, but had an expansionary effect on output in the noncrisis periods. Hence, he argues that it would be incorrect to pool data from two distinct import regimes in the estimation of inflation equations, as other empirical studies have done.

inflation; (ii) public sector policy (e.g., energy prices); and (iii) uncertainty.[3] The study by da Cunha, Webb, and Isaac resembles Uygur in that a markup rule expressed as a function of changes in excess demand is estimated; they stress, however, the difficulty of determining the degree to which price markup responds positively to changes in excess demand. Estimation of the price equation indicates that the markup is positively associated to changes in excess demand; however, sectoral differences could not be identified.

Yeldan (1993) argues that the underlying sources of inertial inflation in Turkey originate from the prevailing income inequality and conflicting social claims on national output, which act to propagate cost inflation in Turkey in the 1980s. Attempts by each sector to set its price so as to maximize its share of a given output seldom lead to a change in income distribution, but result instead in inflation. However, to reach the order of magnitude of recent inflation rates, the markup implied by Yeldan's model would not only be unusually high, but would also suggest continually rising markups on the part of firms, irrespective of changes in demand conditions.

Wage pressures are not found to have a substantial impact on the inflationary process in Turkey during the 1980s (Onis and Ozmucur, 1990; da Cunha, Webb, and Isaac, 1990; Ozatay, 1992a; Yeldan, 1993; and Metin , 1995). In a model of wage and price determination, da Cunha, Webb, and Isaac, show that between 1978 and early 1982, wages were positively and significantly associated with changes in excess demand and past inflation, the latter suggesting backward-looking indexation or expectations. However, between 1982 and late 1988, when a more constrained wage policy regime was in effect, wages served to ease rather than trigger inflationary pressures in the economy.

III. A MODEL OF THE INFLATION DYNAMICS

While most studies focus on a particular cause of inflation and then try to find empirical support for their theory, we let the data determine the main explanatory factors of Turkish inflation by using a comprehensive model of the economy. The model presented in this paper offers a simple representation of an economy in which there are four sectors—goods, money, labor, and external. The goods market provides the equilibrium condition for the long-run price level. The evolution of prices in the short run is dependent not merely on conditions in the goods market, but is also influenced by conditions in the money, external, and labor markets. These influences are captured by including estimates of market disequilibria in these markets in the inflation equation, along with the standard error correction term and other short-run explanatory factors.   .

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[3]In this regard, Togan (1987) and Basci and Togan (1995) show that an adaptive expectations model characterizes inflationary expectations in Turkey better than a rational expectations model.

A. A Long-Run Model

Standard aggregate demand and supply functions are assumed to determine the long-run equilibrium level for domestic prices.[4] Aggregate demand increases if real money balances rise and/or competitiveness improves (i.e., if domestic prices in foreign currency terms decline relative to foreign prices of competing exports). Aggregate supply declines if real wages and/or imported input prices increase. Hence, the balance of aggregate demand, y^d, and supply, y^s, can be written as:

$$y^d(\frac{M}{P}, \frac{P_x^*}{PE}; \epsilon_d) = y^s(\frac{W}{P}, \frac{P_r^*}{PE}; \epsilon_s)$$

where P denotes the domestic price level, W nominal wages, E the exchange rate (defined as the price of domestic currency in foreign currency),[5] M money, P_x^* the exogenous price of exports, P_r^* exogenous imported input prices, and ϵ_d and ϵ_s are random demand and supply shocks, respectively. Solving for the price level yields the following **long-run price equation**:

$$P = \theta_0 E + \theta_1 M + \theta_2 W + \theta_3 P_x^* + \theta_4 P_r^* + \epsilon \qquad (1)$$

The expected signs of money, wages, export and import prices are positive, while the expected sign for the exchange rate is negative.

To identify pressures on prices deriving from external sector disequilibrium, the observed level of the real exchange rate is compared with a measure of the "equilibrium" real exchange rate (RER), defined to be the real exchange rate that, given estimated export and import relationships, is compatible with a financeable deficit on the goods and services account. The financeable deficit (K) is estimated by average levels of medium and long-term capital flows, current transfers, and net factor income. Note that the RER, as defined here, is not an equilibrium exchange rate in the broader sense of being sustainable over the medium term, but more narrowly the exchange rate that yields a financeable deficit on goods and services, given existing patters of capital inflows. Given standard export and import functions, with export (import) volumes depending on the real exchange rate and foreign (domestic) income, the RER can be derived as follows:

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[4]As in Bruno and Melnick (1994), the aggregate demand schedule is derived from the standard open economy IS-LM framework, where interest rates have been substituted from the model. The aggregate supply schedule is obtained from a three-factor production function.

[5]Hence, an increase in E means appreciation.

$$RER = \frac{PE}{P^*} = \frac{K + \beta y_f P_x^* - \delta y P_r^* + \xi P_x^* - \mu P_r^*}{\alpha P_x^* + \gamma P_r^*}$$ (2)

where P^* is a weighted average of foreign export and import prices, δ is the estimated coefficient of domestic income (y) in the import function, β is the estimated coefficient of foreign income (y_f) in the export function, ξ and μ are the estimated constants in the export and import function, respectively, and α and γ are the estimated coefficients of the real exchange rate in the export and import function, respectively. The difference between the actual and equilibrium real exchange rates provides a measure of disequilibrium in the external sector that impacts on price developments.

Equilibrium in the money market is obtained when the public sector deficit, as a ratio to GNP, is fully financed by long-run seigniorage—money creation—and a sustainable level of borrowing. The long-run seigniorage level is assumed to change in proportion to expected inflation and real income growth; for simplicity, a unit elasticity of real money balances demanded with respect to income is assumed. Sustainable borrowing, both domestically and externally, is defined by reference to a debt-to-output ratio that is constant or not rising. The financeable deficit, G^*, can then be written as the maximum deficit consistent with the projected demand for real money balances and a constant debt to output ratio:

$$G^* = (\dot{y}^* + \pi^*)\frac{H}{Y_{t-1}} + \frac{\dot{D}^*}{Y}$$ (3)

where $\dot{y}^*$ is the projected growth in real output, Y is nominal output, π^* is the targeted inflation rate, H base money and $\dot{D}^*$ are changes in total debt such that the debt-output ratio is constant. The difference between the actual public sector deficit and the financeable deficit, as measured in equation (3), yields the disequilibrium in the money market. If a large positive disequilibrium is obtained then upward pressures on inflation will emerge. This is referred to as the required deficit reduction consistent with the stipulated macroeconomic targets.[6]

The **long-run real wage** is determined as a weighted average of the real wage offered by firms (i.e., the real wage on the labor demand function) and the real wage demanded by workers (i.e., the real wage on the labor supply function), with weights determined by the relative bargaining power of firms and workers. Hence, the long-run real wage is given by:

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[6]See World Bank (1995) for a more detailed exposition of the concept of financeable deficit and the required deficit reduction.

$$\frac{W}{P} = \omega_0 \frac{y}{L} + \omega_1 u \tag{4}$$

where L is employment so that y/L measures productivity, and u is the unemployment rate. The disequilibrium in the labor market is then estimated by the residuals of equation (4).

B. A Short-Run Model for Inflation

The short-run inflation equation is an error correction representation of equation (1) expanded to include the disequilibrium term from the other three sectors:

$$\pi = \beta_0 + \sum_{i=1}^{n} (\beta_{1i}\pi_{t-i}) + \sum_{i=0}^{n} (\beta_{2i}\Delta E_{t-i} + \beta_{3i}\Delta M_{t-i} + \beta_{4i}\Delta W_{t-i} + \beta_{5i}\Delta P^*_{et-i} + \beta_{6i}\Delta P^*_{rt-i} + \beta_{7i}\Delta Z_{t-i})$$

$$+ \beta_8 ECM_{t-1} + \beta_9 D_{e_{t-1}} + \beta_{10} D_{m_{t-1}} + \beta_{11} D_{w_{t-1}} + \nu_t \tag{5}$$

where π is the inflation rate, ECM, the error correction term, D_i, i=e,m,w, represent the respective deviation of the actual real exchange rate, public sector deficit and real wage from their long run equilibrium, Z_t is a vector of other exogenous variables such as changes in real government expenditure, and ν_t is the residual.

The dynamic adjustment of the rate of inflation depends not only on the speed at which the disequilibrium within the goods market corrects itself, but also on the dynamic adjustment of the foreign exchange market, the money market and the labor market to their respective long-run equilibria. The expected sign of the exchange rate disequilibrium is negative: when the real exchange rate is more appreciated than its long-run level downward pressure on inflation is exerted. The disequilibrium effects originating from the money and labor markets are expected to be positively signed, as an excess supply of money and a higher-than-equilibrium real wage level raise inflation.

IV. EMPIRICAL ANALYSIS

A. Data

The model is estimated with quarterly time series data from 1970 to 1995; see Appendix I for a description of data sources. The choice of the sample period is dictated by the desire to take a long-term view; the rationale for quarterly as opposed to annual frequency, is to capture short-term inflation dynamics. For some series, quarterly data had to be interpolated from annual data.

Prices are measured by the wholesale price index for the private manufacturing sector, thereby excluding administratively influenced state enterprise prices and agricultural prices. However,

because the private manufacturing index was not available prior to 1981, the total wholesale price index is used in the earlier period. Wages are estimated from the annual payments made to employees in the private manufacturing sector as well as from survey data of the Turkish Confederation of Employers' Association. The monetary aggregate used is broad money inclusive of foreign exchange deposits, M2X, and the exchange rate variable is the nominal effective exchange rate as provided by the IMF Information Notice System.

B. Estimates for the Long-Run Model

Prices

The long-run price equation is estimated over the period 1970 to 1995 (Table 1). Both likelihood ratio tests of the Johansen procedure point to multiple cointegrating relationships. The choice of the cointegrating vector to be included in the short-run inflation equation is determined by the vector that has the right signs as expected from economic theory and is shown below:

$$P = -0.57E + 0.22M + 0.08W + 0.52P_x + 0.01P_r$$

The residuals from this estimation are included as the error correction term ECM in equation (5). The expected sign is negative because when prices are above their equilibrium level, due for instance to a shock, downward pressure on prices is exerted, thus "correcting" the error and driving prices back toward equilibrium.

The real exchange rate

All variables in the export and import equations—with the exception of the sum of capital inflows, transfers and income—were transformed by an eight-quarter moving average, in an effort to capture long-term trends. The financeable deficit for the goods and services balance was calculated as a four-quarter moving average of the sum of medium- and long-term capital inflows, transfers, and net factor income. No cointegrating relationships were identified for both the export and import functions when estimated over the period 1970 to 1995, which is not surprising given the significant structural break that occurred in the trade regime with the shift from an inward-looking import substitution strategy in the 1970s to an export-oriented growth strategy in the 1980s. To account for this shift in the trade regime, the estimation period was divided into two subsample periods: (i) from 1970 to 1983 and (ii) from 1984 to 1995.[7] A cointegrating relationship was obtained for both the export and import functions in each of the subsample periods (Tables 2a and 2b). The cointegrating vector for exports includes exports of goods and services (deflated by the export price index), the real effective exchange rate, and an index of world imports, which proxies the level of demand in partner

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[7]Most of the trade liberalization measures became effective from 1984 onward.

countries. On imports, the cointegrating vector includes imports of goods and services (deflated by the import price index), the real effective exchange rate and real domestic income. All the variables have the expected sign in both periods.

Figure 3 plots the actual and estimated equilibrium real exchange rates; the difference between the actual and equilibrium exchange rates is included as D_e in the inflation equation (5) (Figure 4, top panel). It would appear that the real exchange rate was overvalued during most of the 1970s but this was reversed in the 1980s when the authorities actively pursued a real depreciation policy. The appreciation of the equilibrium exchange rate in the early 1990s reflects the improving terms of trade and the increased availability of external financing, a trend reversed in 1994 with the cutoff in access to capital markets.[8]

The financeable public sector deficit

The financeable deficit is computed according to equation (3), where π is taken to be zero to imply seignorage consistent with noninflationary financing, and D grows at the rate of nominal GNP to maintain a constant debt to GNP ratio.[9] Real GNP growth is assumed to average 4 percent a year, representing the trend growth over the sample period. The difference between the actual PSBR and the financeable deficit measure constitutes the required deficit reduction, included in the inflation equation (5) as D_m (Figure 4, bottom panel). The required deficit reduction has been mostly positive over the entire sample period. In 1994, for instance, the required deficit reduction necessary to obtain noninflationary financing and sustainable debt growth amounts to over 6 percent of GNP.

The real wage

Although a cointegrating vector was obtained for the wage equation, it was not satisfactory in that the coefficient for the unemployment rate was incorrectly signed (Table 3). Failure to obtain a satisfactory result may partly reflect data deficiencies, but may also be due to heavy regulation of labor markets, notably during the 1980s. The residuals from the cointegrating vector, D_w, were included in the inflation equation (5) in an attempt to capture the inflationary impact of the disequilibrium in the labor market, but did not prove to be significant.

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[8]It should be recalled that the concept of "equilibrium" exchange rate used is not defined in RMS terms of a sustainable balance of payments over the medium term.

[9]For simplicity, we assume a constant level based on the debt to GNP ratio in 1970 (25 percent).

Figure 3. Turkey: Real Effective Exchange Rate, 1973-95
(1990=100)
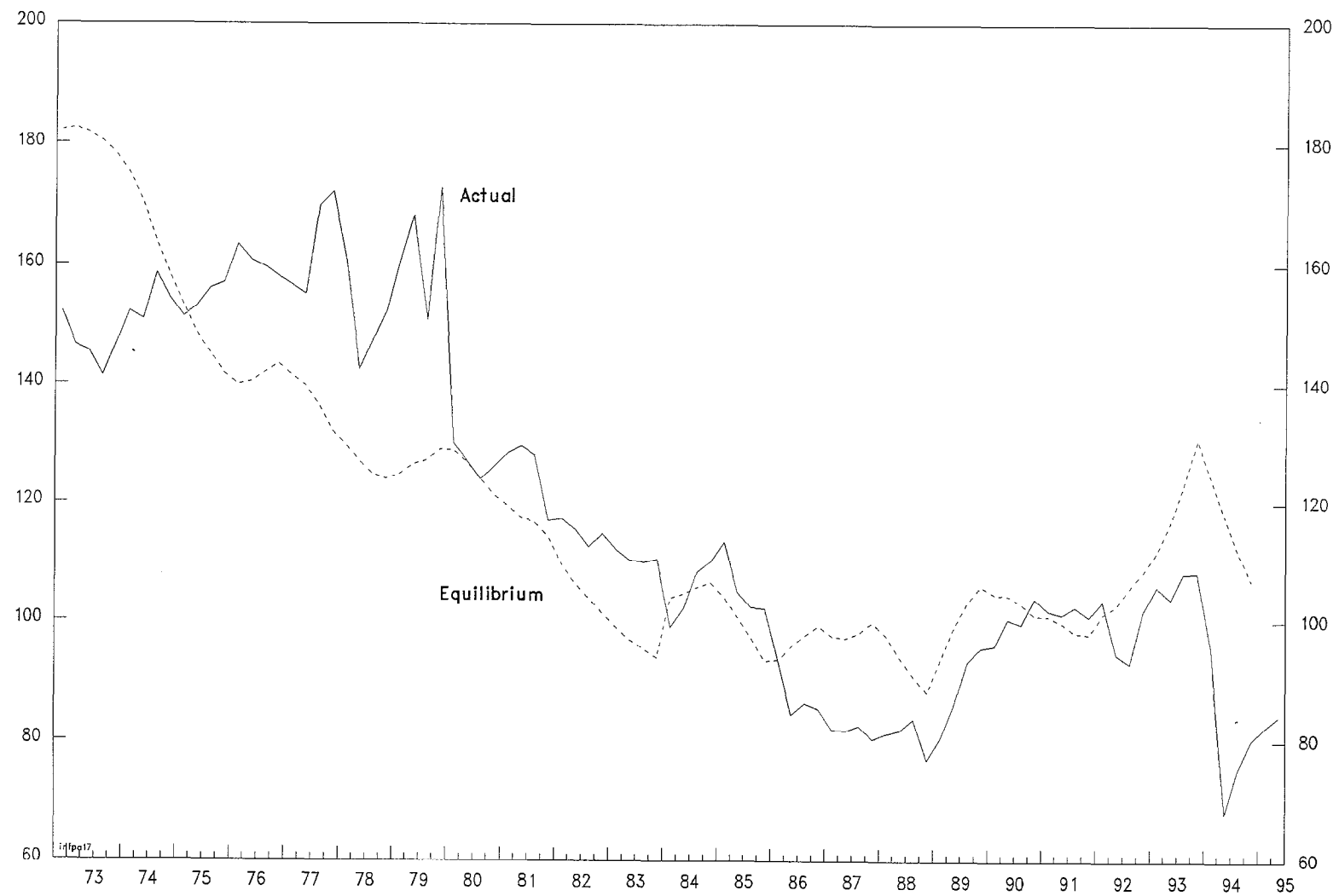
Source: IMF, Information Notice System. Equilibrium real effective exchange rates are as calculated from equation (2).

Figure 4. Turkey: Market Disequilibria, 1972-94

REAL EXCHANGE RATE DISEQUILIBRIUM 1/
(In percent)

REQUIRED DEFICIT REDUCTION 1/
(In percent of GNP)
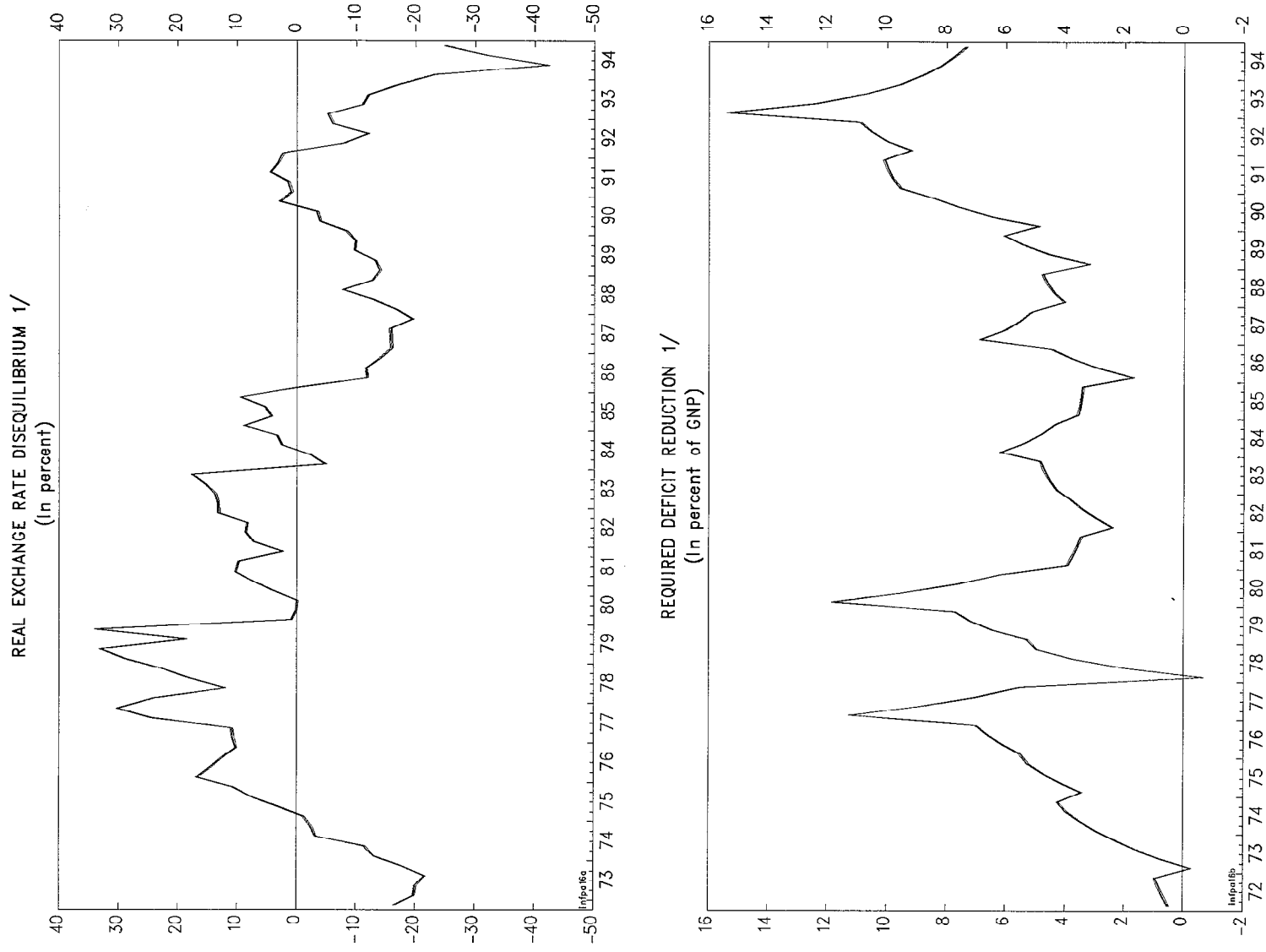
Source: As estimated from the model.

1/ A positive value implies that the actual value is higher than its equilibrium value.

C. The Inflation Equation

A general specification of the short-run inflation equation (5) is estimated using ordinary least squares (OLS) and instrumental variables (IV) for the sample period 1972 to 1995.[10] Table 4 reports the estimated equation obtained after eliminating variables with t-ratios less than one. The inflation equation includes (i) the first and third lags of inflation; (ii) the contemporaneous and one-period lagged change in the nominal effective exchange rate; (iii) the second lag of the change in money; (iv) the first lag of wage inflation; (v) the fourth lag of the change in export prices; and (vi) all the market disequilibrium terms, except that for the labor market.[11] The estimated equation explains 77 percent of the variation in inflation and tracks the actual inflation developments quite well (Figure 5, top panel). The results obtained using IV estimation do not differ significantly from those obtained using OLS, and all diagnostic tests from both estimation procedures are generally satisfactory. However, Chow tests indicate significant structural breaks in the inflation equation between 1980 and 1983, in line with the substantial structural changes that the Turkish economy underwent in that period.

To allow for these structural shifts, the inflation equation was re-estimated for the period 1970–1980 and 1981–1995.[12] The final results obtained are reported in Table 5 and described below; the estimated inflation equations account for up to 74 percent of the variation in inflation in the 1970s, and as much as 86 percent during the 1980s and 1990s (Figure 5, middle and bottom panels). All diagnostic tests are satisfactory. Figure 6 plots the actual and dynamic forecasts of inflation for both periods.

For the 1970s, the results indicate strong influences on prices from wages, money, and the exchange rate. The independent role for wage growth presumably reflects the sizable influence of trade union activity on wage growth during this period; real wages are estimated to have increased by some 100 percent between 1970 and 1979. Both the third lag of inflation and the error correction term are also significant and correctly signed, suggesting that inflation inertia was already of significance during the 1970s; the estimated coefficient on the error correction term implies an adjustment period to equilibrium of four quarters. The terms representing real exchange rate disequilibrium and the public sector deficit are not statistically significant,

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[10]The contemporaneous exchange rate is instrumented with past values of the exchange rate itself and other exogenous variables of the model. This was done to take account of the possible endogeneity of the nominal exchange rate variable given past policy of depreciating the nominal exchange rate in order to offset the impact of inflation on external competitiveness.

[11]Other exogenous variables, such as real government expenditure, were not significant when included in the inflation equation.

[12]1980 was chosen as the point of the structural break on the basis that both the Turkish economy and the political system underwent significant changes. Furthermore, the F-test rejects the null hypothesis that the coefficients are stable at more than 1 percent significance level.

Figure 5. Turkey: Actual and Fitted Inflation, 1972-94
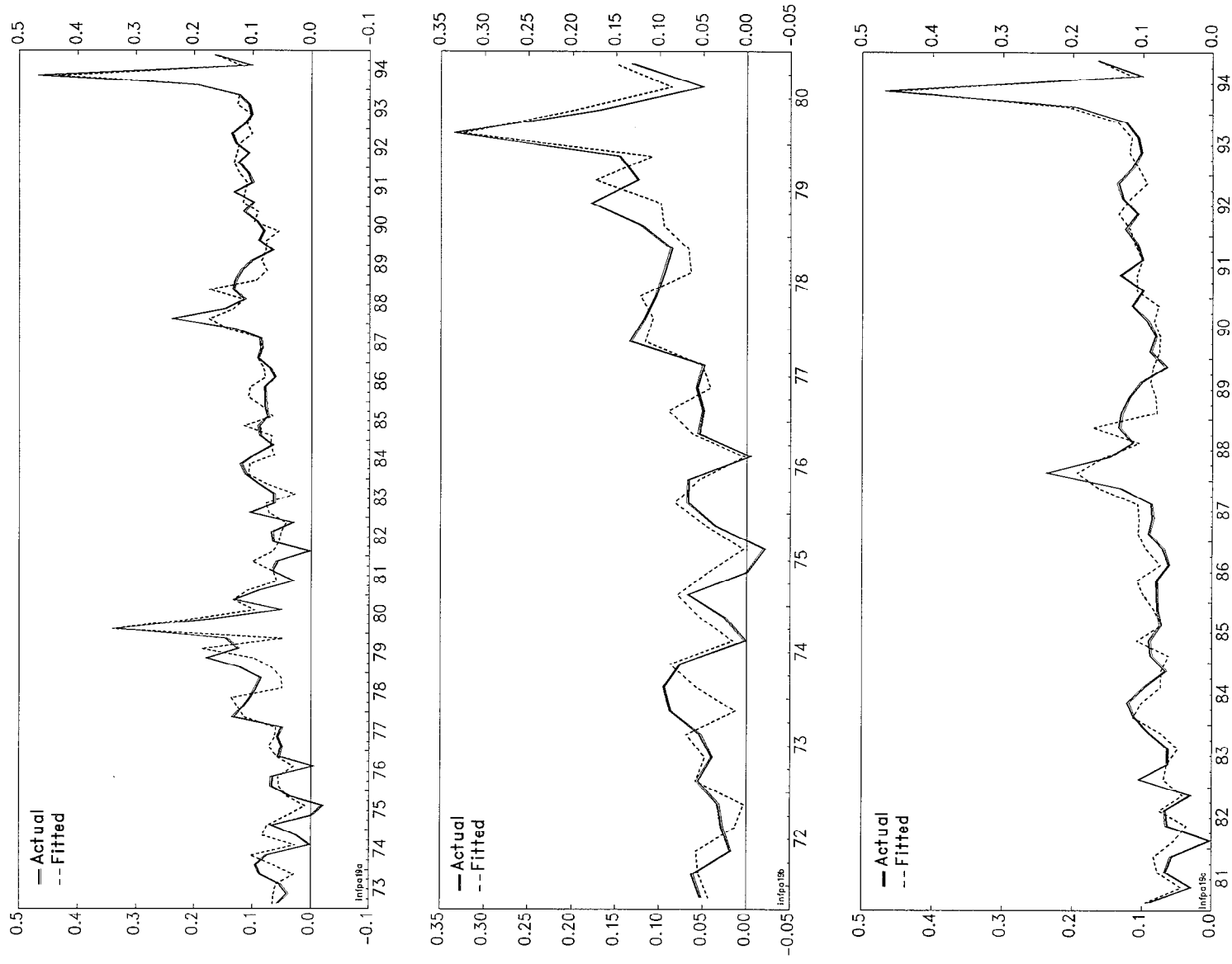
Source: As estimated from equation (5).

Figure 6. Turkey: Actual Inflation and Dynamic Forecasts, 1971–94
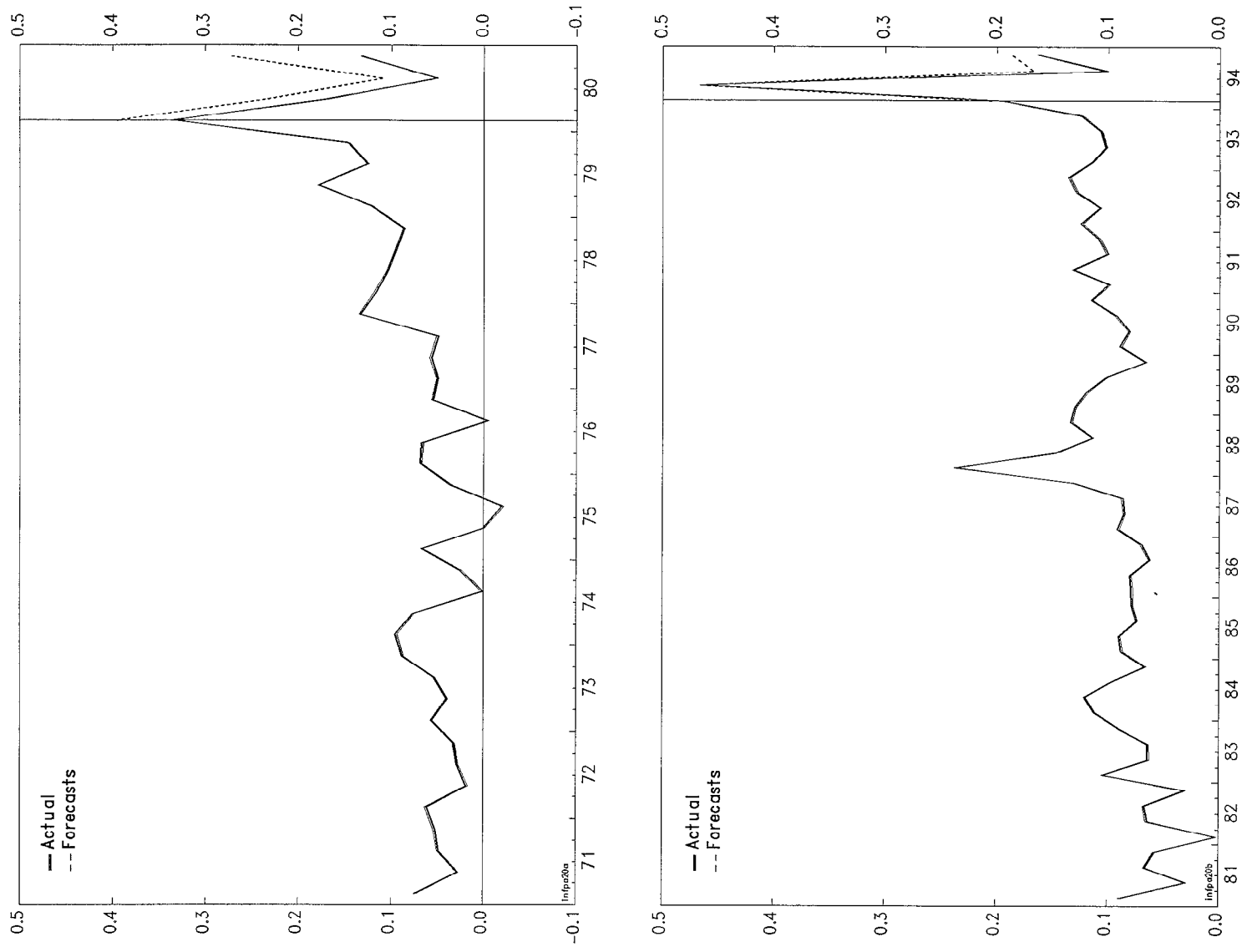
Source: As estimated from equation (5).

implying that these variables did not have an influence on inflation separate from variables that were statistically significant (i.e., money, wages, and the nominal exchange rate).

For the post-1980 period, the results indicate strong influences on price growth from the exchange rate and lagged inflation. Interestingly, the independent role for wage and money growth observed during the 1970s disappears. This likely reflects the more restrictive environment for trade unions (at least through the late 1980s) and the liberalization of external trade and financial relationships, which would have expanded both the direct role of the exchange rate in price determination and the importance of the exchange rate as a channel through which monetary policy influences prices. Up to three lags of inflation are positively signed with both the first and third lag statistically significant at the 5 percent level. Moreover, the estimated coefficient of the error correction term implies an even longer return to equilibrium—almost seven quarters—for the price level compared to the 1970s. In other words, the inflationary process exhibited greater inertia during this later period as inflationary expectations became more entrenched.[13]

The terms representing the exchange rate disequilibrium and the pressure of the public sector deficit are both significant for this period. The significance of the former likely captures the effects of the policy of real exchange rate depreciation pursued by the authorities during much of the 1980s as an export promotion tool, and supports the view that at times the exchange rate has been a key factor in generating, as distinct from merely accommodating, inflation.[14] The significance of the deficit measure supports the public finance view of the inflationary process in Turkey. The fact that money growth does not have a significant separate influence on inflation in this latter period reflects a change in the link between fiscal deficits and inflation because of the increased importance of debt financing over monetary financing.

V. CONCLUDING REMARKS

The econometric analysis supports an interpretation of Turkish inflation in which monetary variables (initially money, more recently the exchange rate) play a central role in the inflationary process; inertial factors are quantitatively important; and public sector deficits are found to have an important direct effect on inflation. Policymakers' commitment to active exchange rate depreciation on several occasions in the past 15 years has also contributed to the inflationary process. These conclusions are broadly in line with the results from other

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[13]It would be important to examine the role of expectations in inflation formation more thoroughly and incorporate it explicitly into the model.

[14]Calvo, Reinhart, and Vegh (1994) also find that policies of targeting the real exchange rate to enhance external competitiveness in developing countries have typically led to an undervalued real exchange rate. Their results show that depreciating the real exchange rate beyond its equilibrium level is likely to result in higher inflation as evidenced in Brazil and Columbia between 1979 and 1992.

developing countries, [15] albeit perhaps with the exchange rate having a stronger role in the inflationary process than is the case in several other countries.

Further refinement of the analysis developed here, notably by sharpening the measures of the equilibrium exchange rate and the financeable public sector deficit, could yield stronger empirical results. Additional analysis is also needed to clarify the robustness of the results to changes in model specification, and to establish whether the results obtained are heavily influenced by the experience in crisis periods (e.g., the 1994 crisis). Perhaps the most important area for further work is in reviewing why the monetary authorities opted for accommodative monetary and exchange rate policies at various key points during the last decade—an issue which will likely focus further attention on the problems of excessive fiscal deficits and, perhaps, an excessive bias among policymakers in favor of real exchange rate depreciation.

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[15]See Chapter VI of the *World Economic Outlook*, "The Rise and Fall of Inflation—Lessons from the Post-War Experience", October 1996.

Table 1

Long-Run Price Equation 1/

Johansen Maximum Likelihood Procedure: lag in VAR = 6

94 Observations from 1971-Q3 to 1994-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix				
r = 0	r = 1	61.8627	39.3720	36.7620
r< = 1	r = 2	38.6308	33.4610	30.9000
r< = 2	r = 3	23.8397	27.0670	24.7340
r< = 3	r = 4	14.3923	20.9670	18.5980
Cointegration LR Test Based on Trace of the Stochastic Matrix				
r = 0	r> = 1	148.6835	94.1550	89.4830
r< = 1	r> = 2	86.8208	68.5240	64.8430
r< = 2	r> = 3	48.1900	47.2100	43.9490
r< = 3	r> = 4	24.3503	29.6800	26.7850

Estimated Cointegrated Vectors

	Vector 1	Vector 2*	Vector 3	OLS (t-ratio)
P	-1.0000	-1.0000	-1.0000	
E	-0.4515	-0.5722	-0.4840	-0.612 (16.2)
M	0.3832	0.2230	0.2640	0.158 (4.0)
W	0.1286	0.0750	0.1155	0.150 (7.2)
P_x	-1.8061	0.5193	1.3952	0.287 (2.7)
P_r	1.5766	0.0064	-0.4768	0.226 (3.2)
Intercept				-0.307 (0.5)

* Denotes the vector chosen to represent the long run relationship.

1/ All variables are in logarithm.
2/ r indicates the number of cointegrating vectors.

Table 2a

Exports of Goods and Services 1/

Johansen Maximum Likelihood Procedure: lag in Var = 4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

1972-Q4 to 1983-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	39.6016	20.9670	18.5980
r<= 1	r = 2	9.0659	14.0690	12.0710

1984-Q1 to 1994-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	43.2854	20.9670	18.5980
r<= 1	r = 2	13.4363	14.0690	12.0710

Cointegration LR Test Based on Trace of the Stochastic Matrix

1972-Q4 to 1983-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
r = 0	r> = 1	51.7204	29.6800	26.7850
r<= 1	r> = 2	12.1188	15.4100	13.3250

1984-Q1 to 1994-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
r = 0	r> = 1	60.1443	29.6800	26.7850
r<= 1	r> = 2	16.8589	15.4100	13.3250

Estimated Cointegrated Vectors

	Vector 1	1972-Q4 - 1983-Q4 OLS (t-ratio)	Vector 1*	1984-Q1 - 1994-Q4 OLS (t-ratio)
X	-1.000		-1.000	
RER	-0.274	-0.196 (9.5)	-0.133	-0.195 (9.9)
y_f	0.312	0.080 (2.2)	0.820	0.834 (75.2)
Intercept		37.528 (8.4)		-9.493 (4.2)

* Denotes vector chosen.
1/ All variables are transformed by an eight-quarter moving average.
2/ See footnote 2 in Table 1.

Table 2b

Imports of Goods and Services 1/

Johansen Maximum Likelihood Procedure: lag in Var = 4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

1972-Q4 to 1983-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	26.1287	20.9670	18.5980
r<= 1	r = 2	11.0492	14.0690	12.0710

1984-Q1 to 1994-Q4

| r = 0 | r = 1 | 49.0748 | 20.9670 | 18.5980 |
| r<= 1 | r = 2 | 12.5883 | 14.0690 | 12.0710 |

Cointegration LR Test Based on Trace of the Stochastic Matrix

1972-Q4 to 1983-Q4

| r = 0 | r> = 1 | 38.5671 | 29.6800 | 26.7850 |
| r<= 1 | r> = 2 | 12.4384 | 15.4100 | 13.3250 |

1984-Q1 to 1994-Q4

| r =0 | r> = 1 | 66.8997 | 29.6800 | 26.7850 |
| r<= 1 | r> = 2 | 17.8249 | 15.4100 | 13.3250 |

Estimated Cointegrated Vectors

		1972-Q4 - 1983-Q4		1984-Q1 - 1994-Q4
-	Vector 1	OLS (t-ratio)	Vector 1*	OLS (t-ratio)
X	-1.000	,	-1.000	
RER	0.059	0.069 (2.7)	0.141	0.235 (4.5)
y_f	0.003	0.002 (5.2)	0.005	0.006 (36.7)
Intercept		-5.061 (8.4)		-80.940 (12.7)

* Denotes vector chosen.
1/ All variables are transformed by an eight-quarter moving average.
2/ See footnote 2 in Table 1.

Table 3

Long Run Real Wage Equation 1/

Johansen Maximum Likelihood Procedure: lag in VAR = 8

92 Observations from 1972-Q1 to 1994-Q4

Null 2/	Alternative 2/	Statistic	95% Critical Value	90% Critical Value
		Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix		
r = 0	r = 1	30.2914	27.0670	24.7340
r<= 1	r = 2	13.1140	20.9670	18.5980
		Cointegration LR Test Based on Trace of the Stochastic Matrix		
r = 0	r > = 1	52.7715	47.2100	43.9490
r<= 1	r > = 2	22.4800	29.6800	26.7850

Estimated Cointegrated Vectors

	Vector 1	OLS (t-ratio)
RW	-1.000	
RPP	0.139	-0.029 (0.24)
UNR	0.241	0.098 (2.7)
DUM1	0.745	0.561 (7.4)
Intercept		11.122 (7.6)

1/ All variables are in logarithm except for the unemployment rate, UNR, and the dummy variable, DUM1 (1970-1987=0; 1988-1994=1).

2/ See footnote 2 in Table 1.

Table 4

Inflation Equation

Dependent variable is ΔP

Regressor	Ordinary least squares (OLS) 1973-94 Coefficient	Instrumental variables (IV) 1973-94 Coefficient
Intercept	-0.09 (2.5)	-0.11 (2.7)
$\Delta P(-1)$	0.32 (3.2)	0.31 (3.1)
$\Delta P(-3)$	0.20 (2.9)	0.19 (2.8)
ΔE	-0.52 (13.2)	-0.55 (10.4)
$\Delta E(-1)$	0.14 (2.2)	0.14 (2.2)
$\Delta M(-2)$	0.12 (2.1)	0.12 (2.1)
$\Delta W(-1)$	0.05 (1.8)	0.05 (1.7)
ECM(-1)	-0.13 (2.9)	-0.15 (3.1)
$D_e(-1)$	-0.03 (1.4)	-0.04 (1.6)
$D_f(-3)$	0.20 (1.4)	0.31 (1.5)
$\Delta P_x(-4)$	0.08 (1.6)	0.09 (1.7)
$\overline{R}^2$	0.77	0.77
S.E. regression	0.03	0.03
Sargan's $\chi^2(4)$		0.63

	Diagnostic tests	
Serial Correlation, $\chi^2(4)$	3.05	2.93
Normality, $\chi^2(2)$	5.90	8.76
Heteroscedasticity, $\chi^2(1)$	0.78	0.02
Chow Test	$\chi^2(11)=34.33$	$F(11,67)=3.12$

t-ratios in parenthesis.

Table 5

Inflation Equation

Dependent variable is ΔP

Regressor	Ordinary least squares (OLS) 1971 to 1980 1981 to 1994		Instrumental variables (IV) 1971 to 1980 1981 to 1994	
	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	-0.15	-0.09	-0.20	-0.09
	(1.8)	(2.1)	(2.1)	(2.2)
$\Delta P(-1)$		0.33		0.35
		(2.8)		(2.8)
$\Delta P(-3)$	0.33	0.12	0.34	0.12
	(2.8)	(1.9)	(2.9)	(1.9)
ΔE	-0.46	-0.57	-0.54	-0.59
	(13.4)	(14.9)	(5.3)	(11.8)
$\Delta E(-1)$		0.20		0.22
		(2.7)		(2.8)
$\Delta M(-2)$	0.51		0.52	
	(4.1)		(4.1)	
$\Delta W(-1)$	0.29		0.32	
	(2.4)		(2.5)	
ECM(-1)	-0.16	-0.15	-0.23	-0.15
	(1.7)	(2.7)	(2.0)	(2.7)
$D_e(-1)$		-0.11		-0.11
		(3.5)		(3.4)
$D_f(-3)$		0.32		0.30
		(2.2)		(2.0)
$\bar{R}^2$	0.75	0.86	0.74	0.86
S.E. regression	0.03	0.02	0.03	0.02
Sargan's statistic			$\chi^2(6)=2.9$	$\chi^2(8)=2.8$
Diagnostic tests				
Serial Correlation, $\chi^2(4)$	1.65	3.92	0.75	4.30
Normality, $\chi^2(2)$	3.00	1.21	5.32	1.24
Heteroscedasticity, $\chi^2(1)$	0.24	0.00	0.08	0.32

t-ratios in parenthesis

Data Issues

● Wholesale price index, quarterly, 1990=100. Between 1970 and 1981, the index is based on prices of all items. From 1982, the index is based on prices in the private manufacturing industry. Source: State Institute of Statistics (SIS).

● Broad money (M2X), quarterly, in billions of Turkish liras. From 1987, the series includes foreign exchange deposits. Source: IMF, International Financial Statistics (IFS).

● Reserve money, quarterly, in billions of Turkish liras. Source: IMF, IFS.

● Nominal and real effective exchange rate indices, quarterly, 1990=100. Real effective exchange rates are based on consumer prices. Source: IMF, Information Notice System (INS).

● Wages, annual, in millions of Turkish liras. Estimated as annual payments per employee in the private manufacturing industry. From 1983, the series was updated with survey data from the Turkish Confederation of Employers' Association. Quarterly series are obtained from linear interpolation. Source: SIS and staff estimates.

● Public sector borrowing requirement, annual, in billions of Turkish liras. Quarterly series are obtained from linear interpolation. Source: State Planning Organization.

● Export price index, quarterly, 1990=100. Source: SIS

● Import price index, quarterly, 1990=100. Source: SIS.

● Consumer price index, quarterly, 1990=100. Source: IMF, IFS.

● Average productivity, annual, in Turkish liras. Estimated as the value added per worker in the private manufacturing industry. Quarterly series obtained from linear interpolation. Source: SIS.

● Unemployment rate, quarterly. Data for 1993 and 1994 are derived from annual averages. Source: OECD Analytical Base (1970-1992) and SIS (1993 and 1994).

● Index of world imports, annual, 1990=100. Based on the volume of world imports of goods and services. Quarterly series are obtained from linear interpolation. Source: IMF, World Economic Outlook Database.

● Nominal and real GNP, annual, in billions of Turkish liras. Quarterly series are obtained from linear interpolation. From 1987 both series are available in quarterly frequency. Source: SIS.

● 3-month deposit rates, quarterly. Source: IMF, IFS.

- U.S. 3-month deposit rates - London offer, quarterly. Source: IMF, IFS.

- U.S. Consumer price index, quarterly, 1990=100. Source: IMF, IFS.

- Exports of goods, quarterly, in millions of U.S. dollars. Services credit are interpolated from annual data. Source: IMF, IFS.

- Imports of goods, quarterly, in millions of U.S. dollars. Services debit are interpolated from annual data. Imports are FOB. Source: IMF, IFS.

- Current transfers and income, annual, millions of U.S. dollars. Source: IMF, IFS.

- Medium and long-term capital, annual, millions of U.S. dollars. Source: IMF, IFS and Recent Economic Developments (various issues).

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