INFLATION, OUTPUT, AND STABILIZATION IN A HIGH INFLATION ECONOMY: TURKEY, 1980-2000

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ABSTRACT: This paper surveys and examines the sources of fluctuations in inflation and output in Turkey. Using a dynamic open economy aggregate supply - aggregate demand model with imperfect capital mobility and structural vector-autoregressions, the authors consider real oil price, supply, balance of payments, real demand, and monetary disturbances. Empirical results indicate that inflation is driven by monetary and real demand disturbances while output is mainly driven by aggregate supply disturbances. The historical decomposition shows that a substantial portion of inflation is aggregate demand-driven core inflation. A credible disinflation program accompanied by structural reform is likely to stabilize the economy with little output costs.

Keywords:
Stabilization Policy - Turkey
Inflation- Causes and Effects; Inflation Theories
Turkey- Macroeconomic Developments
Macroeconomics- Theory of Aggregate Supply and Aggregate Demand
Time Series Models

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1. Introduction

The Turkish economy has been plagued by high and persistent inflation in the last two decades. Although the economy grew at reasonable levels, economic growth has been volatile and macroeconomic instability became the hallmark of the post-1980 period. Despite many attempts to stabilize the economy, these stabilization attempts have been unsuccessful. Common explanations of inflation since late 1970s include (1) high public sector deficits (due to, among other things, populist government expenditures before elections, military expenditures, massive infrastructure projects, bankrupt social security institutions, losses incurred by state owned enterprises), (2) monetization of public sector deficits, (3) increases in prices of major imported inputs (particularly, crude-oil prices), (4) inflationary effects of rising exchange rates via increases in prices of imported goods, (5) persistent inflationary expectations of economic agents. High and persistent inflation has been blamed for, among other things, major distortions in the economy, worsening of the income distribution, increase in directly unproductive activities, an increase in the underground economy, and curtailing of foreign direct investment.

The unprecedented hovering of inflation at levels short of hyperinflation over the last two decades in Turkey poses a challenge yet a systematic macroeconomic account of the underlying shocks has attracted scant attention in the literature. The main objective of this paper is to examine the sources of fluctuations in inflation and output in Turkey over the last two decades. To that end, we use an open economy aggregate supply aggregate demand model and structural Vector Autoregressions (VAR) to decompose inflation and output movements into those attributable to oil price, supply, balance of payments, real demand, and monetary shocks. An advantage of our model is that it does not assume perfect capital mobility, an assumption of

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dubious validity for Turkey. Moreover, following Quah and Vahey (1995), we estimate core

inflation as inflation driven by aggregate demand shocks in the broad sense. The issue is germane

in that if inflation is driven by shocks to the economic environment or oil price shocks, the

government has little leverage in attempting a successful stabilization program. Finally, it is

possible to decompose output into components driven by particular shocks. The resulting

decomposition may provide an idea on the output costs of disinflation. To preview our results,

inflation is mainly driven by real demand and monetary shocks while output is mostly driven by

supply shocks. Moreover, a substantial portion of inflation is demand-driven "core inflation" and

output costs of disinflation are limited.

Section 2 of the paper details major macroeconomic developments since 1970. Section 3

presents a selective survey on sources of Turkish inflation. In section 4, we develop a dynamic

open economy aggregate supply - aggregate demand model with imperfect capital mobility to

identify various macroeconomic shocks. Section 5 presents the empirical results based on

variance decompositions and impulse response functions and estimates of "core inflation". The

last section has the concluding remarks.

2. An Overview of Major Macroeconomic Developments in Turkey

Chronic inflation in Turkey is accompanied by volatile output growth. Year-to-year

changes in consumer prices sampled monthly from January 1970 to February 2001 and some

sub-period averages of these annual inflation rates are shown in Figure 1. As seen in the figure,

Turkey experienced major accelerations in inflation in 1970-1971, 1973, 1975-1976, 1977-1978,

1979-1980, 1984, 1987-1988, 1994 and 1997. Major events associated with these repeated jumps

in inflation rates are, a sharp devaluation of the Turkish lira in 1970, oil-price shocks both in 1973-1974 and in 1978-1979, a balance-of-payments crisis in 1977-1980, another drastic devaluation in January 1980, increasing public sector deficits and their monetization particularly in the first half of the 1980s, the Persian Gulf crisis in 1990-1991, the 1994 financial crisis following the overvaluation of the Turkish lira after the 1989 capital account liberalization, the Russian crisis in August 1998, and two major earthquakes in 1999, respectively.

(Insert **Figure 1** about here)

Figure 2 shows real growth rates for gross domestic product (GDP) of the Turkish economy. Oil-price shocks in the 1970s and related balance-of-payments problems contributed substantially to a deep economic recession and a political and social crisis in late 1970s. After the introduction of a broad stabilization and liberalization program in January 1980, the government installed by the military regime in September 1980 was able to lower inflation below 40 percent per year and accelerate economic growth in the following four years. However, after 1983, the volatility of annual GDP growth rates increased substantially. Other events such as the 1990-1991 Persian Gulf crisis, the 1994 Turkish financial crisis, the 1998 Russian crisis and two earthquakes in 1999 contributed to rising output volatility in the economy.

(Insert **Figure 2** about here)

On the institutional and policy side, Turkey embarked on far reaching structural reforms after 1979. In 1980, in response to a strong balance-of-payments crisis accompanied by a deep recession and accelerated inflation, Turkey abandoned its inward-oriented development strategy and gradually started to introduce free-market based reforms. The Government devalued the Turkish lira to eliminate its excess overvaluation, increased the prices of public sector products

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and reduced the financial depression in the economy. The first steps of external liberalization concentrated on current account transactions. The 1980 stabilization and liberalization program was aimed not only at reducing inflation and accelerating output growth but also hoped to liberalize the capital account in a reasonable future. All of these were done at the cost of an initial jump in the annual inflation rate over 100% in 1980.

In May 1981, the Government took the first step from fixed to a managed floating-exchange-rate system. In 1984, domestic citizens were allowed to open foreign exchange deposit (FED) accounts in Turkish banks.[1] In 1989, the Government took serious steps to liberalize the capital account. Following the introduction of convertibility, the overvaluation of the Turkish lira and high domestic interest rates on government bonds attracted short-term capital inflows to the country. The change in the deficit financing method of the public sector from money- to bond-finance starting in 1986, and attempts to stabilize the exchange rate to prevent the inflationary effects of rising exchange rates made this fiscal policy combination unsustainable within a short period of time. This led to an "exchange-rate" crisis in the first half of 1994 without a "balance-of-payments" crisis typical of the 1970s. In 1994, the annual inflation rate exceeded 100% as in 1980.

Turkish governments introduced new disinflation measures to stabilize the economy after the 1994 financial crisis. However, these efforts in 1995, 1998 and 2000 failed to reduce the inflation rate to levels below 25% per year, as it had been in the early 1970s. The recent three-year disinflation and economic restructuring program that was put into effect on January 1, 2000, seems to have collapsed as of the end of February 2001. This exchange-rate-based stabilization program faced two successive liquidity and interest-rate crises; first in November 2000, and then

in February 2001. The government is currently working on another program which is expected to focus on overhauling the banking system, privatization of some state owned enterprises, and exchange rate management within a band.

3. Macroeconomic Determinants of Inflation in Turkey: A Selective Survey

There is a large body of literature focusing on specific aspects of post-1979 inflation in Turkey. These empirical studies differ in their sample period, methodology, and hence, their conclusions. Using monthly data from 1981-87, Onis and Ozmucur (1990) explore inflationary dynamics in Turkey. The authors reject a pure monetary explanation of inflation based on a VAR and a simultaneous equation model. Although they find devaluations of the Turkish lira to have a strong impact on domestic inflation, supply-side factors seem to have significant effects on inflation.

Using a broad data set with annual and quarterly data, Metin (1995) finds that fiscal expansion dominates Turkish inflation from 1950 to 1988. An implication is that, in order to reduce inflation successfully, governments have to eliminate public sector deficits. Moreover, devaluations have some inflationary effects. Inflationary effects of the depreciation of domestic currency are also implicated by Erol and van Wijnbergen (1997), Lim and Papi (1997) and Agenor and Hoffmaister (1997). The link between devaluations and inflation highlights the importance of stabilizing the exchange rate in order to achieve price stability in Turkey.

It is common for politicians and bureaucrats to blame oil prices and other supply-side factors (Persian Gulf crisis, earthquakes etc.) for inflation. Kibritcioglu and Kibritcioglu (1999) use the 1990 input-output table to investigate the inflationary effects of oil prices in Turkey. They

found that a hypothetical 20 percent increase in the dollar price of imported crude-oil leads to a cumulative increase in the general price level of only 1.1 percent within the time frame of six to ten months. Furthermore, a 20 percent devaluation of the Turkish lira contributes about 2.8 percent to inflation within the same time frame. These results provide preliminary evidence that increases in oil prices have had a limited effect on inflation in Turkey after 1980.

Recently, Lim and Papi (1997), Alper and Ucer (1998), and Baum et al. (1999) emphasize the increasing role of *inertia* in the process of inflation in Turkey. Erlat (2001), for example, states that consumer and wholesale price indexes in Turkey have a significant long-run memory component. This makes government stabilization attempts difficult given the unusual resistance these disinflationary measures face. One can conjecture that inflationary inertia is a combined consequence both of persistent inflationary expectations related to lack of government credibility, and backward looking expectations in contracts for wages, sales, rents etc. in the economy.

(Insert **Table 1** about here)

Table 1 presents both annual and sub-period changes in consumer price index, real GDP, exchange rate, crude-oil import price, money supply and public sector borrowing requirement in the 1979-2000 period. The figures in last two columns on the current account balance and short-term capital inflows are given at annual levels and sub-period averages in millions of US dollars. According to overall sub-period figures, the consumer price index increased 287 times in the 1990-2000 period but it increased only 53 times from 1979 to 1989. The recent acceleration of inflation in the 1990s seems to have been accompanied by a slow down in output growth. Depreciation of the Turkish lira also seems to have accelerated in the 1990s. In real terms,

however, the depreciation of the Turkish lira in the 1980s is followed by a slight appreciation in the 1990s if we ignore changes in foreign price levels in the same period. This development along with increases in real domestic interest rates after 1989 explain the rise in short-term capital inflows in the 1990s, as seen in the last column of Table 1. In contrast to the oil-price shocks of the 1970s, crude-oil price changes in the 1981-1998 period do not seem to be dramatic enough to have caused the ongoing high inflation in Turkey.

From 1979 to 2000, the broad money supply M2 has increased substantially which points to an accommodating monetary policy. In real terms, the M2 measure of the money supply rose 111 percent while the increase in real reserve-money (the IMF definition) was limited to about 48% in the same period. The borrowing requirement of the Turkish public sector (PSBR) increased in nominal as well as real terms particularly in the first half of the 1990s. The overall increase in PSBR in real terms from 1979 to 2000 is about 156 percent. There is evidence that monetization of public sector deficits decreased as a result of the availability of bond-financing since 1986 in Turkey (Alper and Ucer, 1998). Moreover, Central Bank credits to the public sector have been sharply declining since 1998. However, sustained monetary growth in the mean time, despite the diminishing role of monetization of government deficits, indicates that inflation in Turkey may still have a monetary character rather than being a fiscal one (Kizilyalli, 1999).

The foregoing discussion highlights the importance of identifying *shocks* driving inflation and output, since observed movements in the data are combinations of macroeconomic "shocks" and responses to these shocks. Did inflation arise because of negative supply shocks? What is the significance of oil price shocks in driving inflation? Do shocks to the balance of payments play a role in the inflationary process? What is the role of aggregate demand impulses, real and

monetary, in the inflation process? In the following two chapters, we address these questions using a dynamic aggregate supply aggregate demand model[2]. We also isolate components of inflation due to particular shocks based on historical realizations of the shocks. The resulting decomposition can be used to pin down the size of policy driven inflation vs. inflation due to the macroeconomic environment. It is also possible to assess the output costs of disinflation.

4. Sources of Inflation: An Illustrative AS - AD Model

In order to motivate the restrictions embedded in the structural VAR model, consider a dynamic open economy aggregate supply- aggregate demand model with finite capital mobility:

$h_t = h_{t-1} + \epsilon_t^h$	Oil price	(1)
$y_t^s = \check{y}_t - \theta\, h_t$	Aggregate supply	(2)
$\check{y}_t = \check{y}_{t-1} + \epsilon_t^s$	Evolution of capacity output	(3)
$k\,[i_t - i_t^* + (E_t s_{t+1} - s_t) - \rho_t] + \eta_1(s_t - p_t) - \eta_2 y_t + b_t = 0$	Balance of Payments (BOP)	(4)
$i_t = (E_t s_{t+1} - s_t) - (\eta_1/k)\,(s_t - p_t) + (\eta_2/k)\, y_t + [i_t^* + \rho_t - (1/k) b_t]$		(4')
$z_t = [i_t^* + \rho_t - (1/k) b_t]$		(5')
$z_t = z_{t-1} + \epsilon_t^z$	"BOP" shock	(5)
$y_t^d = d_t - \gamma[i_t - E_t(p_{t+1} - p_t)] + \eta_1(s_t - p_t) - \eta_2 y_t$	Aggregate demand/IS	(6)
$d_t = d_{t-1} + \epsilon_t^d$	Aggregate demand shock	(7)
$m_t^d = p_t + y_t - \lambda\, i_t - \mu z_t$	Money demand	(8)
$m_t^s = m_{t-1}^s + \epsilon_t^m$	Money supply	(9)
$y_t^s = y_t^d = y_t$	Goods market equilibrium	(10)
$m_t^s = m_t^d = m_t$	Money market equilibrium	(11)

where h is the real world oil price, y is domestic output, ў is capacity output, i is domestic

nominal interest rate, i* is the foreign interest rate, s is the exchange rate expressed as the

domestic currency price of foreign currency, p is the domestic price level, m is the money stock,

d is autonomous aggregate demand, ρ is a risk premium on domestic currency, b represents an

exogenous shift in net exports due to e.g., a change in competitiveness, z represents exogenous

elements in the balance of payments equation, E_t is the expectations operator conditional on

information available at time t, all variables except interest rates are in logarithms, and all

parameters are assumed positive.

Equation (1) is the evolution of the world oil price, which is assumed to be exogenous.

Equation (2) is an aggregate supply equation, where aggregate supply depends on capacity output

and real world oil price. Capacity output in equation (3) is a function of the productive capacity

of the economy (e.g., capital stock and employment), and for simplicity, is assumed to be a

random walk process.

A distinguishing feature of the model is that, due to risk premiums and fads, uncovered

interest parity does not hold. The capital account in the balance of payments is a function of the

net domestic rate of return adjusted for a risk premium. Note that the parameter *k* represents the

degree of capital mobility and large values of *k* indicate higher levels of capital mobility. The

trade balance is a function of the real exchange rate[3] $(s_t - p_t)$ and domestic output. Moreover, due

to exogenous changes in terms of trade, b_t represents exogenous increases in net exports.

Although, equation (4) may seem to impose a zero balance of payments, the existence of the shift

term b_t provides a more general specification. For example, one can view b_t as an exogenous

level for the balance of payments. Equation (4') rewrites equation (4) in terms of the domestic

nominal interest rate while equation (5') pools all the exogenous elements in the balance of payments equation to define z_t. Equation (5) specifies the evolution of z_t as a non-stationary stochastic process[4].

Equation (6) is an aggregate demand (IS) equation where aggregate spending depends on the expected real interest rate, plus the trade balance. The autonomous portion of aggregate demand, d_t, is assumed to follow a random walk in equation (7). Equation (8) is a conventional money demand equation with a unitary income elasticity. Money demand is also a function of the exogenous elements in the balance of payments. This specification allows for reductions in money demand when there are exogenous shifts in the balance of payments which necessitate a depreciation of domestic currency. The exogenous BOP shock in money demand is meant to allow for currency substitution. It is known that currency substitution is prevalent in inflationary environments. Moreover, when there is a risk premium associated with domestic currency or self-fulfilling fads in exchange rate expectations, z_t will be positive. In such cases, money demand is reduced by μz_t.

Equation (9) is the evolution of money supply, which for simplicity, is assumed to follow a random walk. Finally we close the model by postulating goods and money market equilibrium relationships (equations 10 and 11) and proceed to solve the model for the rational expectations equilibrium.

In order to solve the model for the rational expectations equilibrium, we eliminate the interest rate from equations (6) and (8) using equation (4') to obtain the following system:

$$
\begin{vmatrix} \lambda(1+\dfrac{\eta_1}{k}) & 1-\dfrac{\lambda\eta_1}{k} \\[2ex] \gamma(1+\dfrac{\eta_1}{k})+\eta_1 & -\gamma(1+\dfrac{\eta_1}{k})-\eta_1 \end{vmatrix} \begin{vmatrix} s_t \\[2ex] p_t \end{vmatrix} = \begin{vmatrix} \lambda & 0 \\[2ex] \gamma & -\gamma \end{vmatrix} \begin{vmatrix} E_t\, s_{t+1} \\[2ex] E_t\, p_{t+1} \end{vmatrix} + \begin{vmatrix} m_t - (\dfrac{\lambda\eta_2}{k}-1)y_t \; + \; (\mu-\lambda)z_t \\[2ex] (1+\eta_2+\dfrac{\eta_2\gamma}{k})y_t - d_t - \gamma z_t \end{vmatrix}
\tag{12}
$$

The system can be written compactly as $AY_t = B\,E_t\,Y_{t+1} + W_t$, or $Y_t = \Pi\,E_t\,Y_{t+1} + CW_t$ where $C = A^{-1}$ and $\Pi = A^{-1}B$. The eigenvalues of the matrix Π are $\{1/(1+\lambda);\ \gamma k / (\gamma k + \gamma\,\eta_1 + \eta_1 k)\}$. The eigenvalues are both within the unit circle for finite values of the parameters, hence the forward-looking solution is convergent. The forward-looking solution to the system in (12) is

$$
E_t Y_{t+1} \;=\; C \sum_{i=1}^{\infty} \Pi^i\, E_t\, W_{t+i+1}
\tag{13}
$$

Given the stochastic processes for the exogenous variables, it is evident that $E_t\,W_{t+i} = W_t$ for $i = 1, 2, \dots$ Then the solutions for the real exchange rate, real money balances, and the price level in terms of the exogenous variables are:

$$
s_t - p_t \;=\; [\,\frac{k}{\eta_1(\gamma+k)} + \frac{\eta_2}{\eta_1}\,]\, y_t \;-\; \frac{\gamma k}{\eta_1(\gamma+k)}\, z_t \;-\; \frac{k}{\eta_1(\gamma+k)}\, d_t
\tag{14}
$$

$$
m_t - p_t = c_1 y_t + c_2 z_t + c_3 d_t
$$
$$
c_1 \equiv \frac{2\lambda\eta_2 + \lambda k}{k(\gamma+k)} - 1 \;;\quad c_2 \equiv \frac{\lambda k}{\gamma+k} - \mu \;;\quad c_3 \equiv -\frac{\lambda}{\gamma+k} \;;
\tag{15}
$$

$$
p_t \;=\; m_t - c_1 y_t - c_2 z_t - c_3 d_t
\tag{16}
$$

The observed movements in the vector of variables $\mathbf{X_t} = [h_t\ y_t\ (m_t\text{-}p_t)\ (s_t\text{-}p_t)\ p_t]'$ are due to five

mutually uncorrelated "structural" shocks with finite variances, $\epsilon_t = [\epsilon_t^h \, \epsilon_t^s \, \epsilon_t^z \, \epsilon_t^d \, \epsilon_t^m]$. These are

oil price shocks, ϵ_t^h, aggregate supply shocks, ϵ_t^s, BOP shocks, ϵ_t^z, real demand shocks, ϵ_t^d, and

money supply shocks[5], ϵ_t^m.

It can be shown that the long run impact of the structural shocks on the endogenous

variables has a peculiar structure. In order to show the long run effect of structural shocks, ϵ_t, on

X_t we express the solution to the model in first differences:

$$\Delta h_t = \epsilon_t^h \tag{17}$$

$$\Delta y_t = -\theta \, \epsilon_t^h + \epsilon_t^s \tag{18}$$

$$\Delta(m_t - p_t) = c_1 \, (\epsilon_t^s - \theta \, \epsilon_t^h) + c_2 \, \epsilon_t^z + c_3 \, \epsilon_t^d \tag{19}$$

$$\Delta(s_t - p_t) = [\frac{k}{\eta_1(\gamma + k)} + \frac{\eta_2}{\eta_1}](\epsilon_t^s - \theta \epsilon_t^h) - \frac{\gamma k}{\eta_1(\gamma + k)}\epsilon_t^z - \frac{k}{\eta_1(\gamma + k)}\epsilon_t^d \tag{20}$$

$$\Delta p_t = c_1 \, \theta \, \epsilon_t^h - c_1 \, \epsilon_t^s - c_2 \, \epsilon_t^z - c_3 \, \epsilon_t^d + \epsilon_t^m \tag{21}$$

Note from equations (15) and (21) that the long run effect of a BOP shock on the price

level depends on the degree of capital mobility, and the relative magnitude of the semi-interest

elasticity of money λ vs. the elasticity of money demand with respect to a BOP deterioration, μ.

Assuming k is sufficiently large, the coefficient c_2 in equation (21) reduces to $\lambda - \mu$. When $\mu < \lambda$

($\mu > \lambda$), the predicted effect of a BOP shock on the price level is positive (negative).

Consequently, the long run effect of a BOP shock on the price level is an empirical question.

Similarly, the long run effect of a supply shock on the price level can be of either sign.

As has been emphasized, the degree of capital mobility plays a crucial role in determining the dynamic effects of the shocks. Consider the effect of a real demand shock under perfect capital mobility. With perfect capital mobility, uncovered interest parity holds up to an error term. In this case, the real demand shock cannot alter the real interest rate. In order to clear the goods market, the domestic currency appreciates in nominal terms, domestic prices stay put, and the real exchange rate appreciates. This decreases competitiveness and hence net exports and brings back aggregate demand to its original level. Consequently, under perfect capital mobility, real demand shocks have no long run effect on the price level or domestic real money balances.

Notice that although all endogenous variables are unit root stochastic processes, the vector $\mathbf{X_t}$ is difference stationary. Finally, the long run impact of the structural shocks on the endogenous variables is "near-triangular", which we show in the next section.

4.1. Identification of the Shocks

If the vector $\mathbf{\Delta X_t}$ is covariance stationary, it can be written as an infinite moving average process in the structural shocks:

$$\Delta X_t = \sum A_i \epsilon_{t-i} = A(L)\epsilon_t \qquad\qquad (22)$$

where $\mathbf{A(L)}$ is a matrix whose elements are polynomials in the lag operator L. Denote the elements of $\mathbf{A(L)}$ by $\mathbf{a_{ij}(L)}$. The time path of the effects of a shock in ϵ_j on variable i after k periods can be denoted $\omega_{ij}(k)$. We also adopt the notation such that $\mathbf{A(1)}$ is the matrix of long run effects whose elements are denoted $a_{ij}(1)$; each element gives the cumulative effect of a shock in ϵ_j on variable i over time. Similarly, $\mathbf{A_0}$ is the matrix of the contemporaneous impact effects and

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consists of $\partial_{ij}(0)$. The objective of identification is to discern the 25 elements of $\mathbf{A_0}$. Given the model structure above, the long run effects of the shocks on the endogenous variables are given by

$$
\begin{vmatrix} \Delta h_t \\ \Delta y_t \\ \Delta(m_t - p_t) \\ \Delta(s_t - p_t) \\ \Delta p_t \end{vmatrix}
=
\begin{vmatrix} a_{11}(1) & 0 & 0 & 0 & 0 \\ a_{21}(1) & a_{22}(1) & 0 & 0 & 0 \\ a_{31}(1) & a_{32}(1) & a_{33}(1) & a_{34}(1) & 0 \\ a_{41}(1) & a_{42}(1) & a_{43}(1) & a_{44}(1) & 0 \\ a_{51}(1) & a_{52}(1) & a_{53}(1) & a_{54}(1) & a_{55}(1) \end{vmatrix}
\begin{vmatrix} \epsilon_t^h \\ \epsilon_t^s \\ \epsilon_t^z \\ \epsilon_t^d \\ \epsilon_t^m \end{vmatrix}
\tag{23}
$$

Note that the matrix of long run effects is lower triangular except that $a_{34}(1)$ is not zero. The system in (23) provides 9 restrictions toward identification. Given the 15 restrictions embedded in the variance covariance matrix, an additional restriction is needed to identify the shocks. The degree of capital mobility can be used to derive the remaining restriction. When capital mobility is sufficiently high, the parameter k is large, and the long run effect of real aggregate demand shocks on real money balances is minimal. This can be seen by the inspection of $c_3 = -\lambda/(\gamma + k)$ in equations (15) and (19). Empirical estimates of the semi-interest elasticity of money demand, λ, are small, usually less than one. This implies that for high capital mobility, $a_{34}(1)$ in equation (23) will be close to zero. As a limiting case, perfect capital mobility implies $a_{34}(1) = 0$ and is sufficient to recover the orthogonal shocks. In the empirical model, it is fairly straightforward to re-estimate the model for non-zero values of $a_{34}(1)$ corresponding to low capital mobility. This enables us to assess the sensitivity of the results to varying degrees of capital mobility.

5. Empirical Results

Our benchmark model consists of the system in (23) with "high capital mobility" where $a_{34}(1) = 0$. After estimating the model, we perform variance decompositions and impulse response analysis typical of VARs. We also use simulations based on historical realizations of the orthogonal shocks to construct estimates of "core" inflation. The data are quarterly from 1980Q1 through 2000Q2. The measures of the variables are: h_t = real domestic price of crude oil (West Texas crude oil converted to domestic currency using period average exchange rate of the US dollar and deflated by the wholesale price index), y_t = GDP, q_t = SDR exchange rate deflated by the CPI, p_t = consumer price index, and m_t = M1. Data sources are as follows: M1, CPI, and SDR exchange rate are from the CD ROM edition of the *International Financial Statistics*; GDP is from the State Institute of Statistics for 1980-1986 and from the Central Bank of the Republic of Turkey thereafter. West Texas crude oil price is from the Federal Reserve Bank of St Louis FRED® database, the wholesale price index is from Central Bank of the Republic of Turkey, and so is the nominal, period average exchange rate of the US dollar. All data are seasonally adjusted using the Census X-11 additive method.

In order to properly specify the VAR, variables ought to be tested for unit roots. We use the KPSS test, which tests stationarity as the null hypothesis, and the Augmented Dickey-Fuller (ADF) test with a unit root null hypothesis. The maximum lag in the ADF test is determined by pairing down the model starting with a maximum lag of 8, depending on whether the maximum lag coefficient is significant at the 10% significance level. The test results for all variables in levels and first differences are given in Table 2.

(Insert **Table 2** about here)

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Statistical evidence in the table points to nonstationary variables in levels. The KPSS test

rejects the null hypothesis of stationarity for all variables at the 5 percent significance level and

the ADF test concurs that a unit root cannot be rejected for all variables in levels. As for first

differences of the variables, all seem stationary except the inflation rate. Although the ADF test

indicates that the inflation rate is on the borderline of a unit root process, the KPSS test clearly

points to a non-stationary inflation rate. For the empirical model, we proceed with the

assumption that all variables are difference stationary except for the inflation rate, which is a unit

root process, hence the vector $\Delta \mathbf{X_t} = [\Delta h_t \ \Delta y_t \ \Delta(m_t\text{-}p_t) \ \Delta q_t \ \Delta^2 p_t]$ is stationary.

We then estimate the VAR with 4 lags (likelihood ratio tests indicate that the model can

be paired down to 4 lags) and implement the identification strategy outlined above. In order to

assess the dynamic effect of each shock, we present impulse response functions and variance

decompositions.

5.1. Impulse Response Functions

Figure 3 presents responses of inflation and output to each shock (real oil price, supply,

balance of payments, real demand, and monetary). We present both point estimates and a 90

percent confidence band based on bootstrapping with 1000 draws for the impulse response

functions. Figure 3a indicates that in response to an oil price shock, inflation rises and output

falls although the effect on inflation does not seem significant. The inflation rate falls in response

to a supply shock; again the response is not statistically significant. The BOP shock seems to

have a negative and significant impact on inflation but the rest of the response is insignificant.

The impact effect of a real demand shock on inflation is negative but insignificant. As expected,

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the long run effect of the real demand shock on inflation is positive and significant. Finally, inflation responds positively and significantly to a monetary shock. Except for the first three quarters, the inflation response to a real demand shock and a monetary shock is similar. Notice that demand side shocks, real and monetary, have everlasting effects on inflation. This points to inflation inertia which may be due to forward looking inflationary expectations which may result from the lack of credibility of governments, and the existence of backward looking expectations in contracts for wages, sales, rents etc. in the economy.

(Insert **Figure 3** about here **)**

Output responses to various shocks are given in Figure 3b. The output response to an oil price shock for the first three quarters is a pronounced and significant reduction in output; the rest of the response is not statistically significant. Output responds positively and significantly to a supply shock and reaches its long-run level within the second year. Both inflation and output fall in response to a balance of payments deterioration; the response is not significant except for the impact effects. It is apparent from the figure that a balance of payments deterioration has a demand deflationary effect on inflation and output. Although output responds to a demand shock by alternating between contraction and expansion, the response is not significant. Similarly the output response to a monetary shock is not significant. This is in contrast with Agenor and Hoffmaister (1997) who found that a monetary shock has significant expansionary short term effect on output. Overall, the responses of inflation and output conform to the predictions of a conventional aggregate supply - aggregate demand framework.

5.2. Variance Decompositions

Table 3 presents the decomposition of the forecast error variance of inflation and output for forecast horizons up to six years. The upper portion of the table is for the base model with perfect capital mobility. It is evident from Table 3 that inflation in Turkey is a demand driven phenomenon for the period under study. Our work differs from Onis and Ozmucur (1990) in that supply-side factors seem to have negligible effects on inflation. Notice also that our results conform to Kibritcioglu and Kibritcioglu (1999) regarding the limited inflationary role of oil price shocks in Turkey. Although balance of payments shocks play a moderate effect at a one-quarter forecasting horizon, 58.5 percent of the variation in inflation is explicable in terms of monetary shocks and about 17 percent is due to real demand shocks. In the long-run, real demand and monetary shocks account for nearly 90 percent of the forecast error variance in inflation. One can conjecture that real demand shocks resulted from high public sector deficits which fueled inflationary finance and raised inflationary expectations. Moreover, devaluation of domestic currency translated into real depreciation and increases in net exports thereby increasing real aggregate demand. Since inflation seems to be demand driven, it is important to focus on disciplining devices and commitment mechanisms in stabilizing the economy.

(Insert **Table 3** about here)

The right hand side of Table 3 gives the variance decomposition of output. For forecast horizons up to one year, output is influenced by real oil prices and to some extent, balance of payments disturbances. At medium to long term forecasting horizons, output is mainly driven by supply side shocks. Notice the absence of any explanatory power of aggregate demand impulses in driving output. In a sustained inflationary environment short of hyperinflation, the element of

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surprise associated with efficacious aggregate demand policies is absent. Moreover, inflationary

expectations limit rigidities that normally are credited with expansionary aggregate demand

effects. The lack of any significant effect of aggregate demand shocks on output provides

preliminary evidence that a disinflationary program may not involve significant output losses. It

seems that these aggregate demand impulses did little but increase the volatility of output (cf.

Figure 2).

5.3. The Role of Capital Mobility

The identification scheme pursued above assumes perfect capital mobility, which may not

be reasonable for a developing country like Turkey. In this section, we estimate the model with

limited capital mobility corresponding to non-zero values of the coefficient c_3. Recall that $c_3 = -\lambda/(\gamma+k)$ determines the long-run effect of aggregate demand impulses on the demand for real

money balances. We gauge the effect of limited capital mobility by estimating the model for a

finite k. We set the long-run effect of aggregate demand shocks on the demand for real money

balances at $a_{34}(1) = -0.02$ standard deviations[6]. The results of this model are summarized at the

lower portion of Table 3.

Limited capital mobility evidently has no bearing on the relative importance of real oil

price, supply, or monetary shocks in explaining inflation or output. The only visible effect of

limited capital mobility is the diminished importance of real demand shocks and the increased

role of balance of payments shocks in explaining inflation. This pattern is reversed for output:

under limited capital mobility, real demand shocks explain a higher proportion of the forecast

error variance of output and balance of payments shocks explain a lower proportion, albeit at

only one quarter forecast horizon. For longer forecast horizons, capital mobility seems to have no effect on the variance decomposition of output.

5.4. Core Inflation

Following Quah and Vahey (1995), we construct "core inflation" by eliminating supply side influences (oil price shocks and supply shocks). The remaining "aggregate demand driven inflation" based on historical realizations of balance-of-payments shocks, real demand shocks, and monetary shocks gives an idea about the extent of policy-induced inflation.[7] As the original inflation series is in differences, the simulations are accumulated including the mean (deterministic part) to obtain the total simulated inflation. The deterministic part of the simulated inflation is included in the core estimate. If a substantial portion of actual inflation is demand-driven or "core inflation", there is room for a successful stabilization program to bring down inflation.

(Insert **Figure 4** about here **)**

A decomposition of inflation based on historical realizations of the shocks is given in Figure 4. This figure reveals several interesting features of the high inflation period in Turkey. First, there is a moderating effect of favorable supply side shocks on total inflation between 1982-1987, and 1994-1997. These can partially be attributed to favorable oil price shocks. For example, oil prices fell from $35/barrel at the end of 1981 to $15/barrel at the end of 1986. Similarly, we observe dampening effects of oil prices in 1990s. Second, and most important, core inflation was never far below total inflation during the entire sample period. Finally, the spike in the inflation rate in 1994 seems to have been mostly driven by a "core" impulse.

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Given the negligible non-core inflation and oftentimes moderating supply side influences on inflation, the historical decomposition of inflation has important policy implications. Since Turkey imports a substantial portion of its oil, there is a tendency for policymakers to partially blame "oil prices" for the high sustained inflation. If we assume that core inflation is mostly induced by discretionary demand policies, Figure 4 tells a different story. On the bright side, the close association of core inflation with actual total inflation implies that a credible commitment mechanism that restraints policymakers from resorting to discretionary demand policies has a good chance of stabilizing the economy.

6. Conclusions

Inflation has been a major destabilizing force in the Turkish economy in more than two decades. It has been blamed for major distortions in the economy and lack of foreign direct investment not to mention the social ills associated with worsening of the income distribution. Our empirical analysis on causes of Turkish inflation in this paper differs from existing studies in the literature in methodology and the sample period. We attempt to provide evidence on the sources of inflation and output fluctuations in the high-inflation period in Turkey in the last two decades. Using a dynamic aggregate supply and aggregate demand model with limited capital mobility and structural VARs, we decompose inflation and output movements into those attributable to real oil price, supply, balance-of-payments, real demand, and monetary shocks.

Empirical results lend support to the view that a major component of inflation has been aggregate demand-driven or "core" inflation. Moreover, demand shocks fail to explain output movements; output is mainly driven by supply shocks. It seems that aggregate demand impulses

had little output expansionary effects but contributed significantly to the volatility of output. Our results show that after a monetary shock, inflation has no tendency to go down in the long-run which may point to inflation inertia. It is possible that inflationary inertia is a combination of forward-looking inflationary expectations which may result from the lack of credibility of governments, and backward-looking expectations in the formation of contracts for wages, sales, rents etc. in the economy. Without explicit structure, it is impossible to discern the sources of inertia in inflation.

One can conjecture that the main driving force behind aggregate demand impulses is a combination of of high public sector deficits and devaluations that translate into changes in the real exchange rate, and hence, changes in real aggregate demand. The former fueled inflationary finance, and combined with a lack of political determination to undertake the necessary structural reforms, fed inflationary expectations. It can be said that Turkish macroeconomic policies in the 1980s and 1990s reflected a preference toward expansionary policies at the expense of price stability. When governments in Turkey faced a choice between responding to the immediate needs of their constituents and reforms necessary for sustainable long-run growth, they opted for the first, and quite predictably, Turkey became one of few countries in history to have a high sustained inflation short of hyperinflation for more than two decades. The lack of any significant effect of aggregate demand shocks on output provides preliminary evidence that a credible disinflation program will have little or no output costs.

The fact that a major component of inflation is demand driven highlights the importance of structural reforms and credible commitment mechanisms that restrain discretionary polices. To the extent that recent government programs resolve the credible commitment problem and are accompanied by structural reforms, they can bring the high inflation era to an end, and stabilize the economy.

Tables and Figures

Table 1: Selected Macroeconomic Indicators for Turkey (1979-2000)

	Consumer Price Inflation (%)	Real GDP Growth (%)	Change in Nominal TL/US$ Exchange Rate (%)	Change in CPI-deflated TL/US$ Exchange Rate (%)	Change in Average Crude Oil Import Price in US$ (%)	Change in Nominal Money Supply M2 (%)	Change in Real Money Supply M2 (%)	Nominal Change in Public Sector Borrowing Requirement (%)***	Real Change in Public Sector Borrowing Requirement (%)	Current Account Balance (millions of US$)	Short-Term Capital Inflow (millions of US$)
1980	110.2	-2.4	128.0	8.5	76.6	74.5	-17.0	125.0	7.1	-3408	-2
1981	36.6	4.9	61.2	18.0	19.2	85.0	35.4	-31.4	-49.8	-1936	121
1982	30.8	3.6	37.1	4.8	-9.2	56.7	19.8	17.2	-10.4	-952	98
1983	31.4	5.0	38.7	5.6	-11.2	29.8	-1.2	84.1	40.1	-1923	798
1984	48.4	6.7	62.5	9.5	-4.0	58.0	6.5	73.4	16.9	-1439	-652
1985	45.0	4.2	42.1	-2.0	-1.6	55.5	7.3	6.0	-26.8	-1013	1479
1986	34.6	7.0	29.5	-3.8	-48.5	42.5	5.9	47.6	9.6	-1465	958
1987	30.0	9.5	27.2	-2.1	24.8	45.0	11.5	144.1	87.8	-806	332
1988	77.7	2.1	66.8	-6.1	-18.7	54.1	-13.3	36.6	-23.1	1596	-1103
1989	63.3	0.3	48.1	-9.3	19.1	73.3	6.2	97.0	20.7	961	802
1990	60.3	9.3	22.8	-23.4	30.5	51.8	-5.3	139.6	49.5	-2625	3547
1991	66.0	0.9	60.2	-3.5	-19.7	63.6	-1.4	119.1	32.0	250	-2397
1992	70.1	6.0	64.6	-3.2	-1.7	62.9	-4.2	81.0	6.4	-974	3807
1993	66.1	8.0	60.5	-3.3	-14.2	48.1	-10.8	105.5	23.7	-6433	6971
1994	106.3	-5.5	169.9	30.9	-2.7	123.2	8.2	28.0	-37.9	2631	-3969
1995	93.6	7.2	53.7	-20.6	8.1	99.4	3.0	33.0	-31.3	-2339	3950
1996	79.4	7.0	78.0	-0.8	21.4	132.8	29.7	228.4	83.1	-2437	6515
1997	85.0	7.5	86.8	1.0	-9.0	93.5	4.6	67.6	-9.4	-2638	3395
1998	83.6	3.1	71.7	-6.5	-35.3	101.9	9.9	114.5	16.8	1984	-4110
1999	63.5	-4.7	60.9	-1.6	41.6	92.5	17.8	148.9	52.2	-1364	4188
2000	54.3	7.0	48.5	-3.7	54.6	26.5	-18.0	9.4	-29.0	-9765	5057
1979-1989	5 288	48	6 464	22	-0.2	8 798	65	5 843	10	- 1 073	166
1990-2000	28 675	42	23 864	- 17	11.3	38 782	35	44 508	55	- 2 155	2 450
1979-1988	3 200	48	4 332	34	- 16	5 033	56	2 917	- 9	- 1 276	103
1988-1994*	2 431	20	1 979	- 18	2	2 218	- 8	4 823	94	- 1 032	1 460
1994-2000**	2 876	30	1 997	- 30	69	4 315	48	4 177	44	- 2 760	3 166
1979-2000	2 485 462	130	1 932 008	- 22	45	5 252 752	111	6 351 824	156	- 1 614	1 308

Source: State Institute of Statistics, Central Bank of Turkey and State Planing Organization; our calculations.

* Current account balance and short term capital inflow figures are calculated for 1989-1994.

** Current account balance and short term capital inflow figures are calculated for 1995-2000.

*** The figure for 2000 bases on an official estimation.

Table 2. KPSS and ADF Statistics
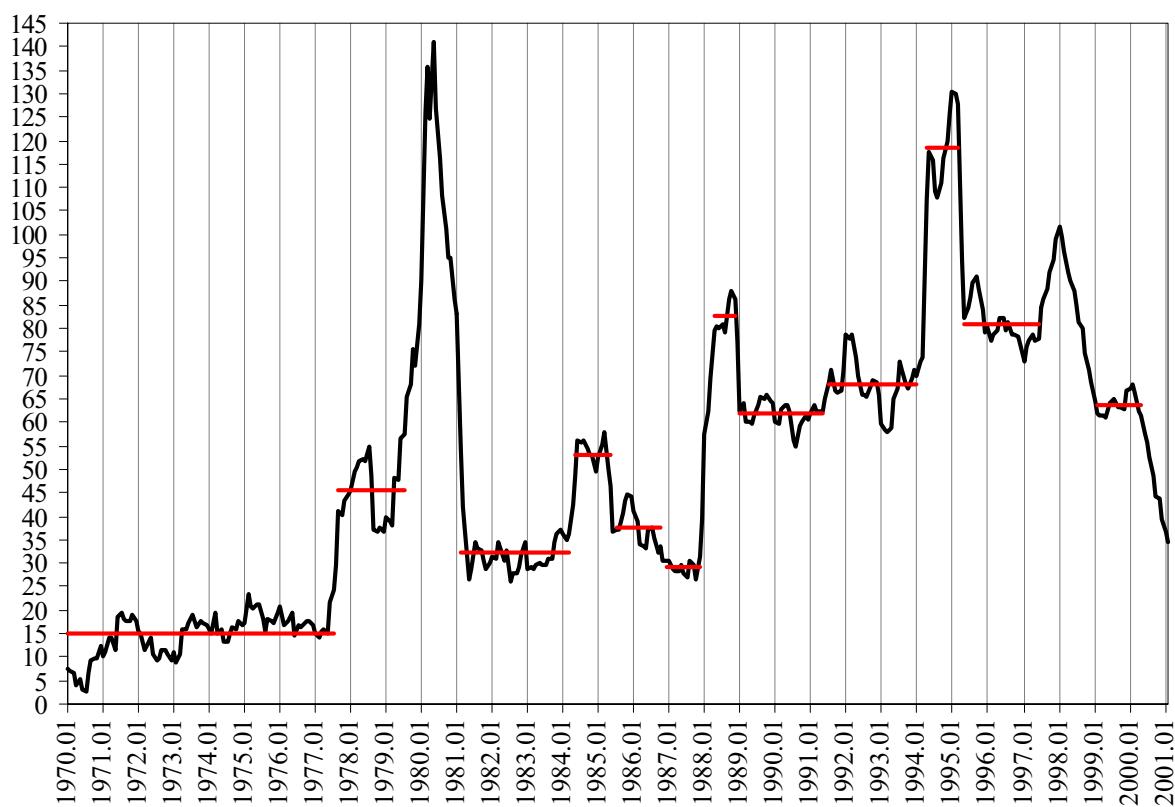
	q_t	p_t	$m_t\text{-}p_t$	y_t	h_t
			KPSS η_μ Statistic		
Levels	0.94	1.70	1.46	1.69	1.17
First Differences	0.12	0.92	0.04	0.05	0.16
			ADF τ_μ Statistic		
Levels	-1.23 (4)	1.76 (3)	-0.74 (7)	-1.15 (4)	-1.63 (8)
First Differences	-3.83 (3)	-2.79 (2)	-5.50 (6)	-5.77 (3)	-3.66 (7)

Notes: Critical values for the KPSS η_μ test at the 5 % significance level is 0.463. The critical value of the ADF τ_μ test at the 5 % significance level is -2.89. Lag truncation for the KPSS test is set at $l = 4$. The maximum lag for the ADF test is given in parenthesis.
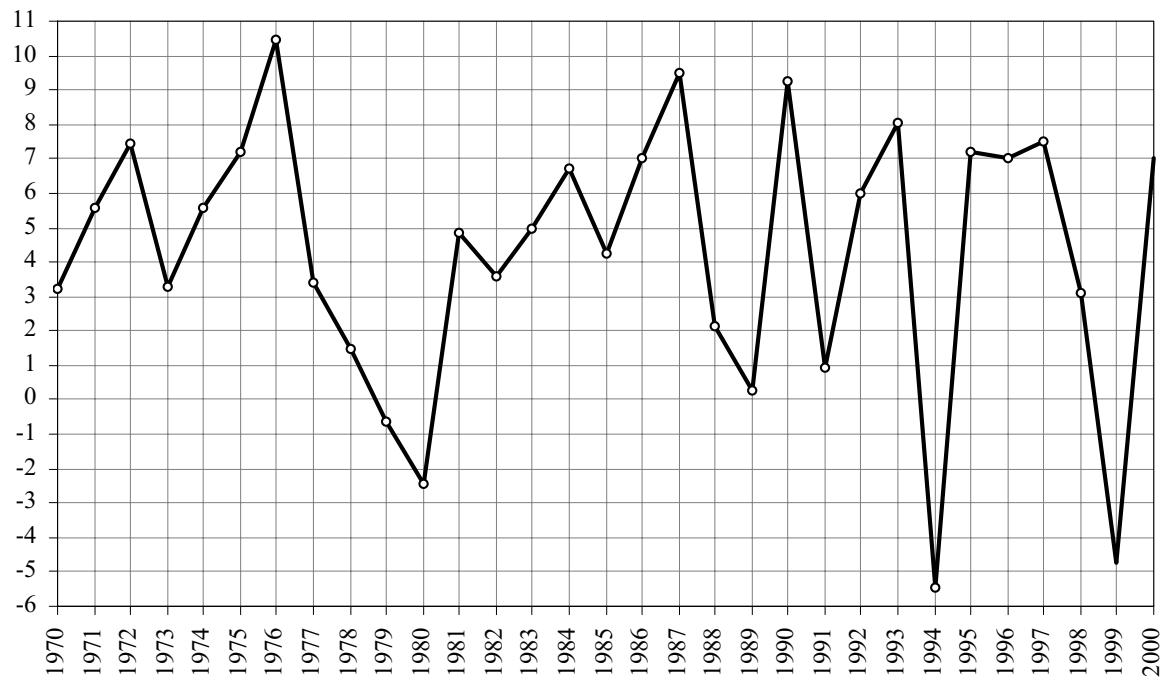
Table 3. Variance Decomposition of Inflation and Output

	Inflation					Output				
	ϵ^h	ϵ^s	ϵ^z	ϵ^d	ϵ^m	ϵ^h	ϵ^s	ϵ^z	ϵ^d	ϵ^m
k	*High Capital Mobility*									
1	5.5	4.9	16.4	14.7	58.5	28.9	47.6	21.9	1.6	0.1
4	3.7	3.6	9.4	42.3	41.0	17.4	75.3	4.9	1.6	0.8
8	4.1	4.8	7.4	40.2	43.5	11.8	82.8	3.7	1.1	0.7
12	4.2	3.9	6.1	40.8	45.1	11.7	84.2	2.8	0.8	0.5
24	3.9	3.2	3.8	41.4	47.7	9.6	88.2	1.5	0.4	0.3
k	*Low Capital Mobility*									
1	5.5	4.9	30.1	1.0	58.4	29.0	47.5	10.4	13.0	0.1
4	3.7	3.6	23.7	28.0	41.0	17.5	75.2	3.8	2.6	0.8
8	4.1	4.8	21.7	25.9	43.5	11.8	82.7	2.9	1.8	0.7
12	4.1	3.9	20.3	26.6	45.1	11.7	84.1	2.2	1.4	0.5
24	3.9	3.2	18.1	27.2	47.7	9.6	88.1	1.2	0.8	0.3

Figure 1: CPI Inflation in Turkey (in %, Jan. 1970 - Feb. 2001)

Data Source: State Institute of Statistics; our calculations.
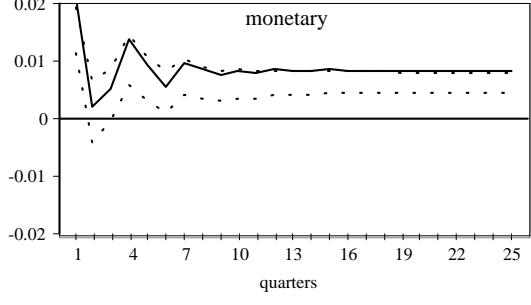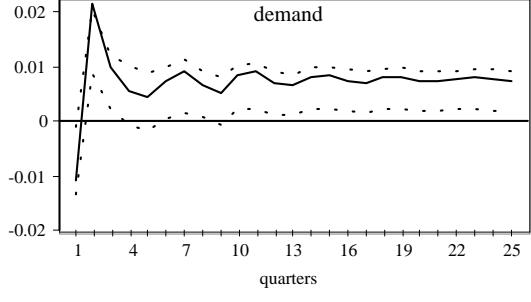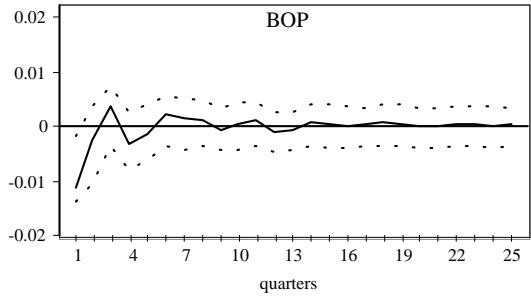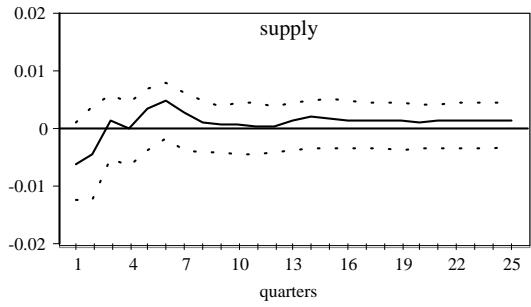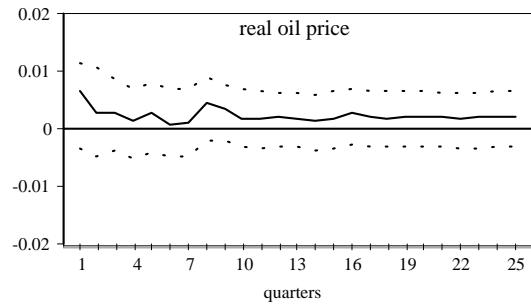
Figure 2: Real GDP Growth Rates in Turkey (in %, 1970-2000)
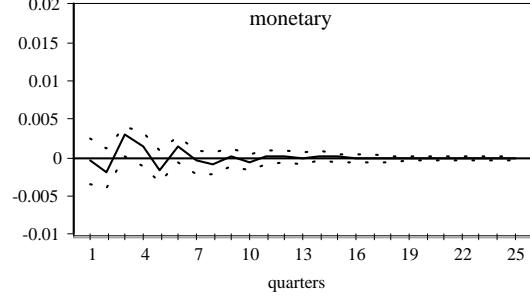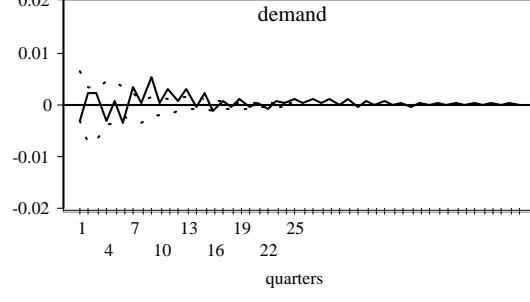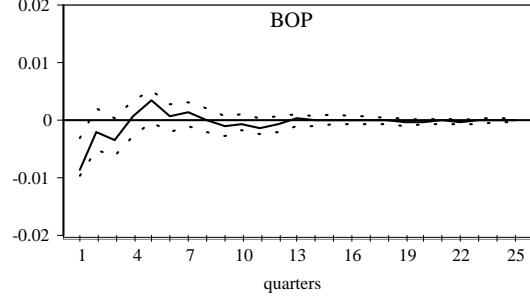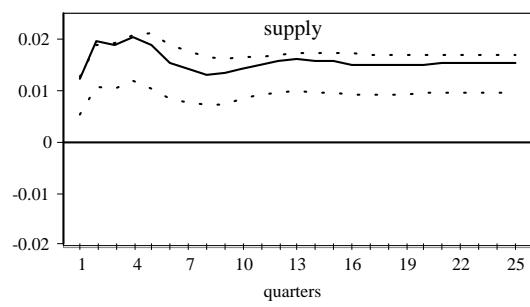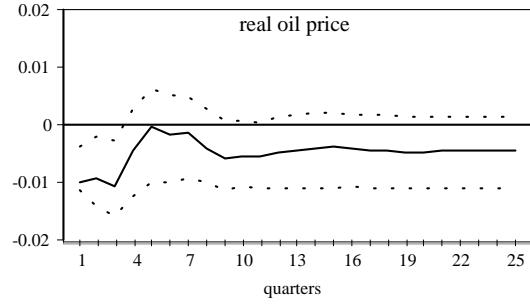

Data Source: State Institute of Statistics; our calculations.

**Figure 3: Responses of Inflation and Output to Various Shocks**
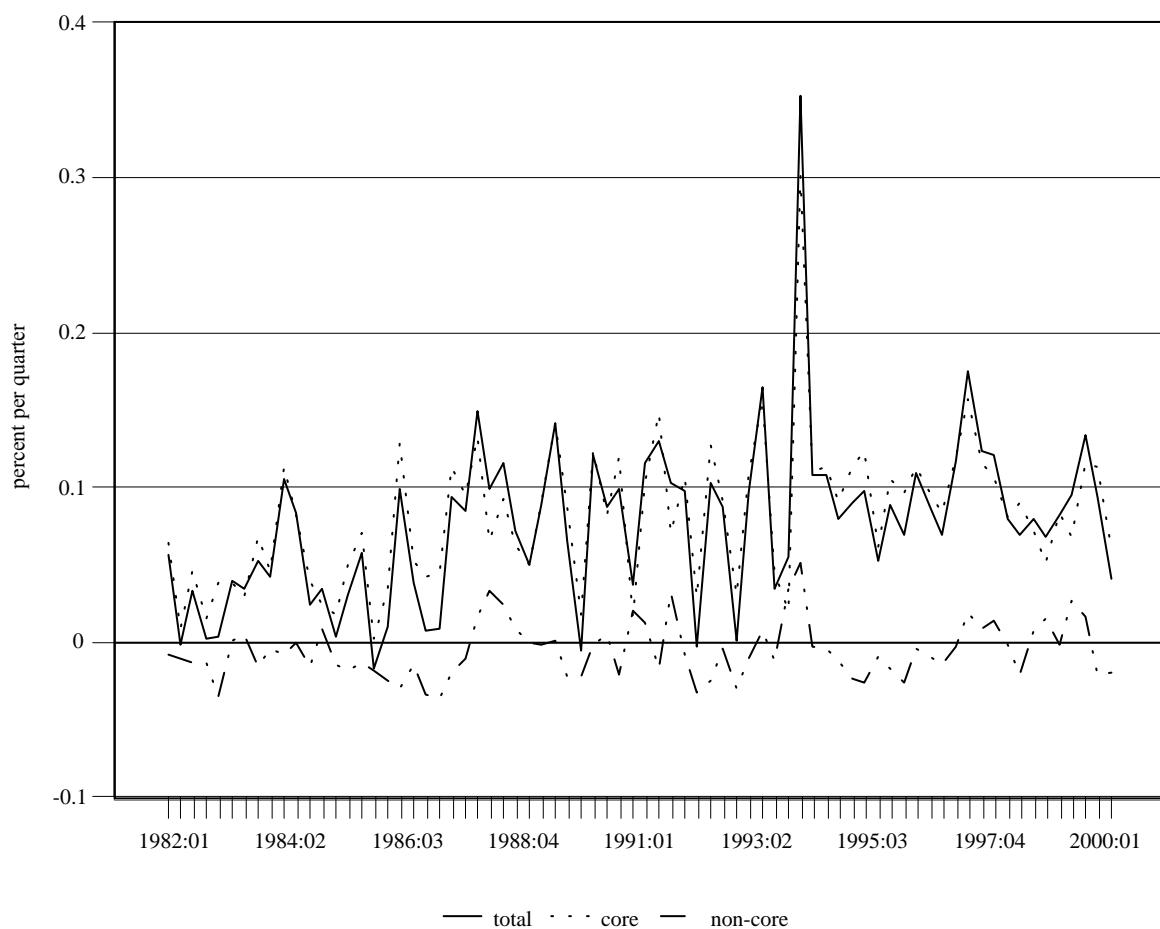
a) Response of Inflation

b) Output Responses

Figure 4: Core and Non-Core Inflation

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ENDNOTES

1. The subsequent increase in FED may be interpreted as a gross indication of rising currency substitution in Turkey.

2. Similar models have been employed by Weber (1997) and Wehinger (2000).

3. For simplicity, foreign prices are normalized to unity. Given the high inflation in Turkey relative to her trading partners, most of the variation in the real exchange rate is due to changes in nominal exchange rates and domestic prices.

4. Although ϵ_t^z is labeled a "balance of payments shock", it is evident that it captures foreign interest rate shocks, risk premium shocks, and exogenous competitiveness shocks. Without a more detailed structure, it is impossible to disentangle ϵ_t^z into its constituent parts. To keep the dimensions of the VAR tractable, ϵ_t^z will be a composite "BOP shock".

5. Since we are assuming a stable money demand function, ϵ_t^m is interpreted as a money supply shock. However, if money demand is not stable, ϵ_t^m will capture money supply shocks *net of* money demand shocks.

6. This is higher in absolute value than any long-run effect of a shock presented in Figure 3.

7. Demand-driven inflation is only an approximation to policy induced inflation as not all broadly defined demand shocks are policy related.