THE CENTRAL BANK OF THE REPUBLIC OF TURKEY

MONETARY TRANSMISSION MECHANISM: A VIEW FROM A HIGH INFLATIONARY ENVIRONMENT

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MONETARY TRANSMISSION MECHANISM: A VIEW FROM A HIGH INFLATIONARY ENVIRONMENT

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ABSTRACT

This study examines the basic features of the monetary transmission mechanism in Turkey in the context of a small aggregate macroeconomic model. The core equations of the model consist of aggregate demand, wage-price setting, uncovered interest rate parity and a monetary policy rule, as well more unique features of the Turkish monetary transmission. The model describes how agents set wages and prices in a high inflation economy. Changes in exchange rates and interest rates are the primary references informing expectations and wage and prices adjust very quickly compared to economies such as the UK. Another idiosyncratic feature of Turkey is the importance of the high levels of government debt. Following Flood and Marion (1996) and Werner (1996), we explicitly model this relationship between fiscal and monetary policy by allowing for a currency risk premium that depends on the share of Turkish-lira-denominated government debt in GDP. The results show how if monetary and fiscal policy are not co-ordinated, the monetary transmission mechanism is weak and unstable because of the effect of interest rates on the secondary balance and the exchange rate risk premium. The results underline the importance of recent commitment by the government to achieve primary surpluses in Turkey's new disinflation programme.

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I. INTRODUCTION

Price stability has become the primary criterion for judging the success of monetary policy in recent years. It is also widely accepted that the choice of monetary policy to achieve a target path is a separate issue from other aspects of government policy such as the choice of fiscal policy. However, recent literature suggests that the case for such a policy separation is less clear.[1] Agencies responsible for inflation stabilisation need to concern themselves with fiscal policy choices while the agencies concerned with fiscal policy have a corresponding need to consider the implications of their actions for monetary stability. The linkages between fiscal and monetary policy are weaker in major industrial economies. There, fiscal policy has a weaker impact on inflation determination and monetary policy has little effect upon the government budget deficit. However, even for countries like US and the UK, there exist fiscal-monetary linkages. First, monetary policy influences the real value of outstanding government debt through its effects upon the price level and upon bond prices, and thus the cost of debt servicing. Second, contrary to the "Ricardian equivalence" proposition suggesting a neutral impact of fiscal policy on aggregate demand, fiscal shocks change the level of aggregate demand. Therefore, the fiscal policy stance affects the effectiveness of monetary policy even when the monetary policy rule has no explicit dependence upon fiscal variables. Woodford (1998) shows that a central bank charged with maintaining price stability cannot be indifferent to the determination of fiscal policy. If the government budget is not expected to adjust according to a Ricardian rule, then both the time path and the composition of the public debt have consequences for price inflation.

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[1] Woodford (1998).

The main theme of this study is to examine the consequences of the co-ordination between fiscal and monetary policies in the monetary transmission mechanism using the case study of Turkey. The aim is to show how the setting of monetary policy in Turkey against a background of persistent budget deficits demonstrates the importance of fiscal and monetary policy co-ordination.[2]

In the first half of the 1990s, public finances deteriorated markedly and political uncertainty intensified in Turkey. Combined with an open capital account, this led to the financial crisis of early 1994 that resulted in a marked devaluation, triple-digit inflation and a deep recession (Figure 1). Turkey's financial crisis of early 1994 had shaped the policies of the second half of 1990s. In the aftermath of the crisis, measures were taken to gradually reduce political influence on monetary policy and enhance its co-ordination with fiscal policy. The Central Bank along with the Treasury built up credibility through transparent, and predictable policies. Nonetheless, the fiscal deficit and inflation rate continued to increase. The high and chronic inflation and large public-sector-financing-requirements combined with a fully liberalised exchange rate regime imposed significant constraints on the Central Bank's policy options and left little room for policy manoeuvre.[3] The Central Bank aimed at maintaining real interest rate stability and a competitive exchange rate rather than more traditional goals such as price stability (Figure 2).[4]

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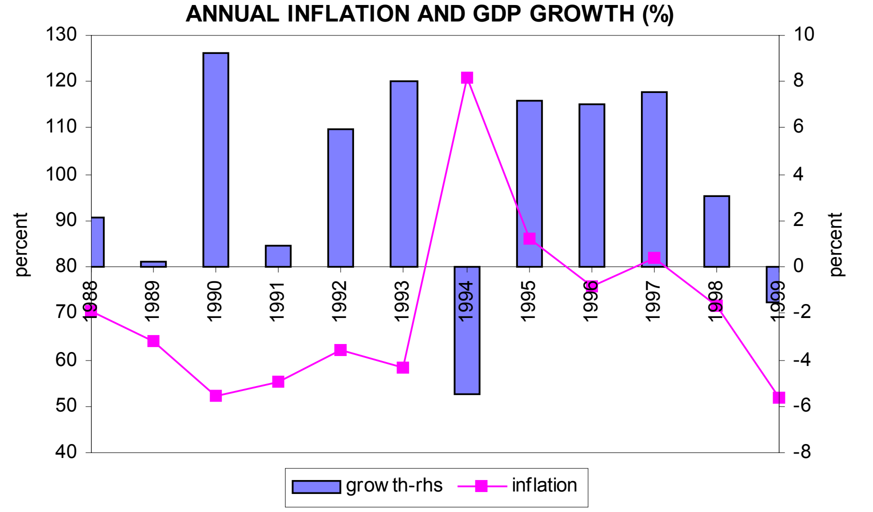
[2] Özatay (1997) analyses the importance of fiscal and monetary policy co-ordination in achieving price stability in Turkey over the period between 1977-1995.

[3] The public-sector-borrowing-requirement increased from around 5 percent in the late 1980s to 13 percent of GNP in 1999.

[4] See Daniel and Üçer (1999).

FIGURE 1
ANNUAL INFLATION AND GDP GROWTH (%)



The deterioration in the fiscal position had been the result of both substantially negative primary budget balances and high and rising interest rates. The high budget deficits had been mainly financed through domestic borrowing (Figure 3). Large public sector deficits with heavy reliance on domestic financing reduced the private sector confidence in the sustainability of fiscal stance and increased the risk premium culminating in very high real interest rates.[5] Henceforth, the ex-post uncovered interest rate parity (UIP) residual has a rising trend especially in the second half of 1990s that is proxied to the risk premium in the study (Figure 4).

[5] In the second half of 1990s, the consolidated budget expenditures increased to 36 percent of GNP from 17 percent, while revenues increased to 24 percent from 14 percent resulting in a widening budget deficit. The share of interest rate payments in GNP rose sharply over the period and by the end of 1999 interest payments consisted of almost 40 percent of the total consolidated budget expenditures. In line with the financing strategy of the government, interest payments on domestic and foreign borrowing had a share of 13 percent and 1 percent of GNP, respectively.

FIGURE 2
PSBR AND REAL INTEREST RATE

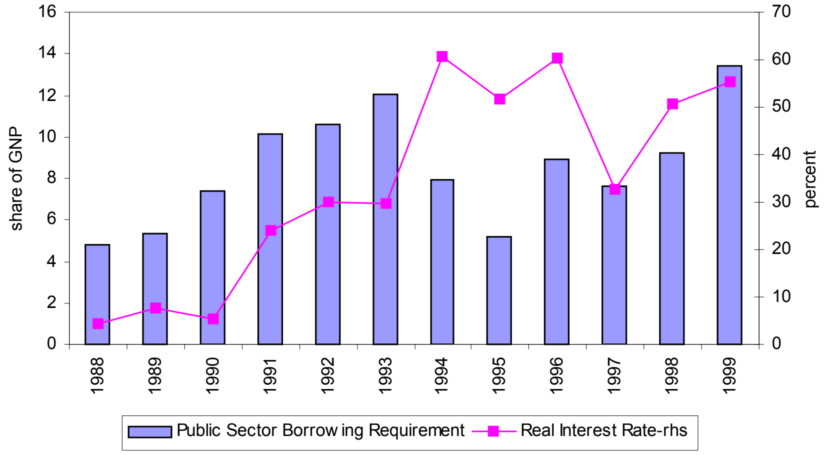
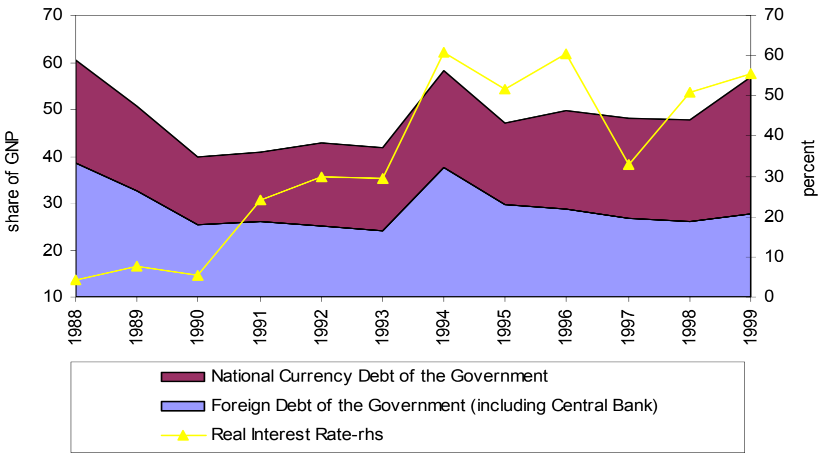
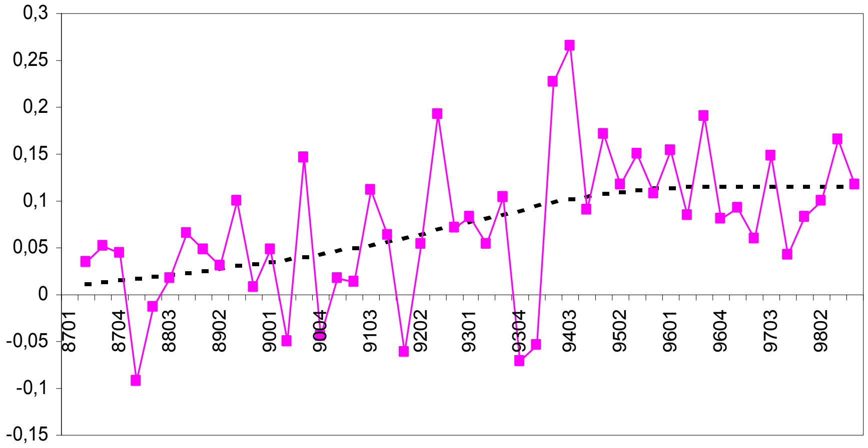


FIGURE 3
FOREIGN AND DOMESTIC DEBT/GNP AND REAL ANNUAL INTEREST RATE (%)



Controlling the underlying factors that have caused the inflationary environment, Turkey has shaped the pillars of the recent medium term disinflation programme (2000-2002). The programme aims to break the inflationary inertia partly through fiscal discipline and targets the inflation rate to decline from 65 percent at the end of 1999 to 25 percent by the end of 2000, and to single digits by the end of 2002. The most important component of the program is the nominal anchor provided by a forward-looking commitment to the exchange rate. The exchange rate has a strong impact on prices via expectations formation and imported inflation, and unlike previous programmes exchange rate has been chosen explicitly as a nominal anchor. The monetary authorities commit to a certain future depreciation path for the exchange rate thus providing a forward-looking approach by the crawling-peg regime.

FIGURE 4
EX POST UIP RESIDUAL



Meanwhile, the exchange rate commitment is set to be supported by a strong fiscal adjustment with a planned increase in the primary surplus, and privatisation proceeds as well as an incomes policy that links the increase in government sector wages and the minimum wage to targeted inflation. Fiscal discipline and real income policies are important pillars in the sustainability of the programme.

Similar to previous strategies, the guiding rule for the conduct of monetary policy is to create domestic liabilities in return for foreign exchange assets. There is a pre-announced exit strategy introducing a crawling-band regime by mid-2001.[6]

Based on the recent experience of the Turkish economy, the study examines the monetary transmission mechanism in the framework of a small-scale macroeconomic model. The key equations of the model are aggregate demand, wage and price setting, interest rate parity condition, debt dynamics and a monetary policy rule. Debt dynamics are embedded allowing them to affect the risk premium in the uncovered interest rate parity condition.

The rest of the study is organised as follows: In Section 2, after providing a theoretical perspective in the determination of real exchange rate, the relationship between debt dynamics and the risk premium is modelled. In Section 3, the key equations of the model are presented and the underlying factors determining the model dynamics are discussed. Section 4 is devoted to the simulation results and the last section concludes.

II. DEBT DYNAMICS AND REAL INTEREST RATE DETERMINATION

II.1. Real Interest Rate Determination and Domestic Debt Burden

To illustrate the theoretical concept of the real interest rate determination, consider the following three equilibrium conditions given in the system of (2.1.1)-(2.1.3). As quoted by Canzoneri and Dellas (1998), equation (2.1.1) is the standard Euler equation that

[6] For details see Erçel 1999.

determines savings and consumption decisions in a model with real interest rates:

$$u'(c_t) = \beta i_t E_t[u'(\overline{c}_{t+1})] \approx \beta i_t [u'(\overline{c}_{t+1}) + \tfrac{1}{2} u'''(c_{t+1}) \sigma^2_{c_{t+1}}] \qquad (2.1.1)$$

where $E_t(.)$ and $\sigma_t(.)$ are conditional expectation and variance operators, $u(.)$ is instantaneous utility, β is the consumer's discount factor, i_t is the risk free rate, and $\overline{c}_{t+1}=E(c_{t+1})$. Higher variance of consumption leads to a more prudent consumption behaviour by promoting precautionary savings (assuming u″>0). Therefore, either current consumption goes down or the risk free rate declines as a response to higher future consumption uncertainty.

$$m_t = f[i_t, u(c_t)] \qquad (2.1.2)$$

$$1 + i_t = \frac{ir_t \pi_t}{\pi_{t-1}} \qquad (2.1.3)$$

The second equation, equation (2.1.2), is the standard money demand equation in which the real demand for money, m, depends on the nominal rate of interest, i, and the marginal utility of consumption $u(c)$. The equation (2.1.3) is the Fisher relationship linking the nominal rate of interest to the real rate, ir_t, via price inflation, π.

Based on the illustration above and following Chadha and Dimsdale (1999), factors determining the real interest rate can be summarised under five broad headings: (i) Changes in the real rate can arise from a change in the behaviour of savings or investment owing, for example, to a demographic change in a life-cycle model of consumption or a shift in public savings arising from budget deficits or surpluses. Changes in the profitability of investment on the account of technical progress, fiscal incentives or changes in taxation of profits can result in a shift in investment behaviour; (ii) the Fisher identity, equation (2.1.3), considers the full adjustment of nominal interest rates to inflation. The adjustment takes place but the process is likely to be slow, therefore changes in monetary growth may be expected to have persistent effects on real interest rates and hence on real variables such as output and employment; (iii) An increase in the public debt relative to GDP will require agents to adjust their portfolios to hold more government securities. The real yield on government bonds should rise in order to encourage this shift in asset portfolios; (iv) Governments facing large budget deficits may attempt to reduce their cost of borrowing by imposing restrictions on other borrowers. Hence, the deregulation of capital markets will tend to raise the real interest rate towards the market level and; (v) investors' perceptions of risk have an effect on the real rate of return on a particular security via the time varying risk premium.

As suggested by Chadha and Dimsdale (1999) and Agenor and Montiel (1996), large budget deficits have a positive impact of on real rates of return in the short run. In countries where financial markets are relatively developed and interest rates are market determined, the reliance on domestic financing of fiscal deficits may exert a large effect on domestic real interest rates. As fiscal deficits are mainly financed through domestic sources, a rise in public debt will increase the default risk and reduce the private sector's confidence in the sustainability of fiscal stance, leading to an increase in real interest rates. The Turkish case is a good example of the positive association between fiscal deficits and real interest rates in practice. Between 1995 and 1999, the public-sector-borrowing-requirement increased more than two-fold with more than 90 percent of the deficit being financed through domestic borrowing. Meanwhile, real interest rates had been realised above 50 percent (Figure 2).

II.2. Debt Dynamics and Co-ordination Between Fiscal and Monetary Authorities

As mentioned above, debt dynamics and the interaction between fiscal and monetary policy are of particular importance in the determination of real interest rates. Following Moalla-Fetini (2000), we illustrate the relationship by the subsequent equations. Consider that the government debt at time t is determined by the identity (2.2.1):

$$\Delta D_G^{PR} + \Delta D_G^{CB} + \Delta D_G^{FX} = I_G^{PR} + I_G^{CB} + I_G^{FX} + TR_{CB}^{G} + P_G \qquad (2.2.1)$$

where Δ is the first difference operator ($\Delta x_t = x_t - x_{t-1}$), and D_G^{PR} is the stock of government bonds held by the private sector, D_G^{CB} is the stock of government bonds held by the central bank, D_G^{FX} is the stock of government bonds held by the foreign sector, I_G^{PR} is interest payments on government bonds held by the private sector, I_G^{CB} is interest payments on government bonds held by the central bank, I_G^{FX} interest payments on government bonds held by the foreign sector, TR_{GB}^{P} is transfers of profit from central bank to the government and P_G is the primary balance of the government.

The central bank's balance sheet can be written as:

$$\Delta C_{CB}^{PR} + \Delta C_{CB}^{FX} + \Delta D_G^{CB} = \Delta M + \Delta NW \qquad (2.2.2)$$

where C_{CB}^{PR} is claims on the private sector, C_{CB}^{FX} is claims on the foreign sector, M is base money and NW is the central bank's net worth, and:

$$\Delta NW = I_{CB}^{PR} + I_{CB}^{FX} + I_{G}^{CB} - TR_{CB}^{G} - OP \qquad (2.2.3)$$

where I_{CB}^{PR} is interest receipts of the central bank on private sector credits, I_{CB}^{FX} is interest receipts of the central bank on net foreign assets, OP are operating costs of the central bank. By substituting (2.2.2) and (2.2.3) into (2.2.1), we get the following expression:

$$\Delta D + \Delta M = -P + OP + IP \qquad (2.2.4)$$

where net debt of the consolidated government/ central bank is given by

$$\Delta D = \Delta D_{G}^{PR} + \Delta D_{G}^{FX} - \Delta C_{CB}^{PR} - \Delta C_{CB}^{FX}\ , \qquad (2.2.5)$$

and net interest payments on net debt are

$$IP = I_{G}^{PR} + I_{G}^{FX} - I_{CB}^{PR} - I_{CB}^{FX}\ . \qquad (2.2.6)$$

The resultant consolidated government/central bank budget constraint, equation (2.2.4), indicates that the sum of the primary deficit and interest payments to the private and foreign sectors should be financed either through bond issuance or money creation. The co-ordination of the fiscal and monetary authorities will determine the relative weights of the alternative sources of financing bearing in mind that they have a trade-off between lower debt burden against higher inflation as they shift towards money creation.

Based on the alternative sources of debt financing, Fry (1997) states three policy co-ordination frameworks. In the first, the central bank determines the change in reserve money providing a partial financing of the government's deficit, and the remaining deficit is set in the light of the other available sources. In the second, the deficit is predetermined and the central bank increases reserve money to finance the whole deficit. In the third, the change in reserve money and the deficit are set independently, leaving the change in government debt as the residual. The latter is only possible if interest rates are allowed to rise to ensure all debt is sold.

The general explanation in the literature about the relationship between inflation and government deficits views the monetization of debt as the way to finance the gap between government expenditures and tax revenues. However, substitutability of bond financing and money creation can be seen even if government finances its debt through bonds. In this case, the increase in nominal stock debt of the government is identically equal to the budget deficit that is independently set from money creation and central bank accumulates larger assets by issuing money that leads a lower level of nominal net debt of the consolidated government/central bank. With the existence of primary deficits and real interest rate levels exceeding growth rate, inflation helps to stabilise the debt to GNP ratio, and that is through the transfers of seignorage revenues to the government.[7]

As mentioned above, large public deficits as well as the heavy reliance on domestic financing have been important factors underlying the sharp increases in real interest rates in Turkey. The gradual withdrawal of central bank financing of the government debt in the second half of 1990s strengthened the association between fiscal deficits and real interest rate.[8] Debt dynamics are of particular

[7] Moalla-Fetini (2000).
[8] In 1989, the use of the short-term advance facility by the Treasury was limited to 15 percent of budgetary expenditure and the practice of using the rediscount facility as a tool of selective credit policy ended. The Central Bank Act was revised in October

concern when the real interest rate is higher than the growth rate of the economy.

Fry (1997) discusses the stability condition when real interest rate exceeds the growth rate. Following previous notation, let the government debt to follow a time path that can be expressed as:

$$TD_t = TD_{t-1} * (1 + r_t) + P_t \qquad (2.2.7)$$

where the sum of domestic debt and foreign debt is given by $TD_t = DD_t + FD_t * e_t$, and r_t denotes the approximation for foreign and domestic interest rates for simplicity. Both sides of the equation (2.2.7) can be divided by gross domestic product (GDP) which grows at a rate γ, and rearranged as follows:

$$\Delta td = p + \left[\frac{(1+r)}{(1+\gamma)} - 1 \right] td \qquad (2.2.8)$$

where *td* is the ratio of government debt to GDP and *p* is the government's primary balance as a ratio of GDP, which equals government expenditure on goods and services *g* minus tax revenue *t*, also expressed as ratios to GDP. Finally, equation (2.2.8) can be expressed in continuously compounded form:

$$dtd = p + (r - \gamma) td \qquad (2.2.9)$$

Equation (2.2.9) indicates that, when the real interest rate exceeds the real growth rate, the debt to GDP ratio rises unless the government runs a primary surplus ($p<0$). To avoid explosive expansion of debt, the government must spend less on goods and services, *g,* than its tax revenue, *t*, i.e. run a primary surplus. By

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1995. Short-term advances to the Treasury were not to exceed 12 percent of the current budget appropriations and this rate was specified as 10 and 6 percent for 1996 and 1997 respectively, and 3 percent thereafter.

setting *dtd=0* in equation (2.2.9), the required primary surplus for long-run solvency can be expressed as:

$$-p = (r-\gamma)td \qquad (2.2.10)$$

In a recent study, Moalla-Fetini (2000) analyses the required level of the primary surplus that is consistent with stabilising debt-to-GNP in Turkey. Larger primary balances need lower inflation rates to stabilize the debt-to-GDP ratio. On the other hand, for a given level of primary balance, a widening in the gap between the real interest rate and real growth rate leads to higher inflation rates.[9]

In contrast to the much past research that discusses the monetization of debt in the presence of large public deficits, we focus on the fiscal impact of debt dynamics on the exchange rate risk premium. Excess deficits do not lead automatically to monetization in our model. Since we assume that the central bank can issue more domestic currency bonds than are necessary to fund the deficit. Foreign currency demand is entirely exogenous and where foreign and domestic financing are perfect substitutes. Therefore, central bank is left with only one of four possible policy options. It can choose to control the exchange rate, interest rate, bond issues or money supply. Our base-line specification establishes a monetary policy rule that targets the interest rate as the instrument, leaving the remaining three variables to be determined by market forces.

II.3. Interest Rate Parity Condition and the Risk Premium

As discussed in the previous section, the deteriorating fiscal position and the heavy reliance on domestic borrowing in financing the public debt has been the main reason behind the high and rising real interest rates in Turkey in recent years. Following Flood and Marion (1996) and Werner (1996), we explicitly model the impact of increasing debt burden on real interest rates by allowing for a currency risk premium that depends on the share of Turkish-lira-denominated debt in GDP. The uncovered interest rate parity condition indicates that the domestic nominal interest rate, i_t, deviates from the foreign nominal interest rate level, if_t, by the expected rate of change of the exchange rate, $E_t(e_{t+1}-e_t)$, plus a time varying risk premium, q.

$$e_t = if_t - i_t + E_t e_{t+1} + q \qquad (2.3.1)$$

As suggested in Flood and Marion (1996), the risk premium, q, depends on many factors such as the relative private holdings of domestic and foreign securities, agents' attitudes toward risk and uncertainty about the future exchange rate. The assumption that the risk premium depends on the currency composition of government debt is tested by Werner (1996) for Mexico and found that such a risk premium works well there during the 1992-1994 period.

Following the notation of Werner (1996), the interest parity condition can be modelled depending on the expected utility maximisation of an individual faced with three securities; domestic currency denominated government bonds, foreign currency denominated government bonds and bonds indexed to the domestic price level. The portfolio composition can be expressed in terms of the parameters of the model and the structure of returns:

[9] The analysis suggests that an additional 1 percent primary surplus is required for 2 percentage of points higher interest rate and an additional 0.6 percent of GNP primary surplus is required for each 1 percentage point of lower inflation.

$$\overline{w} = \alpha_1 w(1+i-\tau-\pi) + \alpha_2 w(1+if+e-\tau-\pi) + (1-\alpha_1-\alpha_2)w(1+i_p-\tau) \quad (2.3.2)$$

where w denotes total wealth and $\overline{w}$ denotes the expectation for the level of real wealth at the end of the period, i, if, and i_p are the interest rates on domestic currency denominated bonds, on foreign currency denominated bonds and on price indexed bonds. α_1, α_2 and α_3 give the portfolio composition in terms of respective fractions of wealth. The term τ is the capital levy rate that gives rise to political risk premium, e is the expected rate of depreciation and π is the expected inflation rate. The political levy is assumed to be independent, where the depreciation rate and the inflation can be correlated. Based on the assumptions, the variance of end-of-period wealth is given by:

$$\sigma_w^2 = \alpha_1^2 w^2 \sigma_\pi^2 + \alpha_2^2 w^2 (\sigma_e^2 + \sigma_\pi^2) - 2w^2(\alpha_2^2 \sigma_{\pi e}^2 - \alpha_1\alpha_2\sigma_\pi^2 + \alpha_1\alpha_2\sigma_{\pi e}^2) \quad (2.3.3)$$

The investor's utility represented by the function $U(w, \sigma_w^2)$ will be positively related to expected wealth and negatively related to the variance of the end of period wealth. After some manipulation of the first order conditions, the following expression is obtained:

$$U_w / 2wU_\sigma (i - if - e) = -(\alpha_2(\sigma_e^2 - \sigma_{\pi e}^2) - \alpha_1 \sigma_{\pi e}^2) \quad (2.3.4)$$

where e denotes the expected rate of depreciation. To simplify the notation, the risk aversion parameter is renamed by equalizing θ *to* $(U_w/2wU_\sigma)^{-1}$, then equation (2.3.4) can be rewritten:

$$i - if = e + \theta(\sigma_{\pi e}^2 \alpha_1 - \alpha_2(\sigma_e^2 - \sigma_{\pi e}^2)) \quad (2.3.5)$$

According to equation (2.3.5), the currency risk premium on domestic currency denominated government bonds is proportional to the covariance between the rate of devaluation and the rate of inflation, $\sigma_{\pi e}$. On the other hand, the risk premium on the foreign currency denominated government bonds is proportional to the difference between the variance of the devaluation rate and the covariance between the rate of devaluation and the rate of inflation. The interest rate differential depends on the relative shares of domestic currency and foreign currency denominated government bonds in total debt stock, expected rate of devaluation and the variance-covariance structure mentioned above.

The equation is reduced to the following by assuming that purchasing parity holds continuously implying that the covariance between the rate of devaluation and the rate of inflation is equal to the variance of the rate of devaluation:

$$i - if = e + \theta\sigma_e^2\alpha_1 \quad (2.3.6)$$

The reduced form of equation (2.3.5) suggests that the uncovered interest rate parity condition equalises the differential between domestic and foreign interest rate to the expected rate of change of the exchange rate plus a time varying risk premium which is a function of domestic currency denominated debt to GDP ratio.

Based on equations (2.2.5) and (2.3.5), we include the government debt identity in the equations system of the model and have a link to interest rate determination by allowing a time varying risk premium as a function of domestic debt to GDP ratio in interest rate parity condition.

III. MODEL DYNAMICS AND STYLISED FACTS

The small macroeconomic model developed in this study is an aggregate model consisting of core equations of aggregate demand, wage and price setting, debt dynamics, uncovered interest rate parity and a monetary policy rule. In this section, these key equations of the empirical model are presented and the underlying factors determining the dynamics are discussed. Fiscal fundamentals, monetary policy reaction and expectations formation are the main topics in the discussion.

III.1. The Model

The framework of the model is given by the following system of equations (3.1.1)-(3.1.8). Each equation is motivated in the sections that follow:

Aggregate demand:

$$y_t = \alpha_1 ir_t + \alpha_2 (er_t - er_{t-1}) + \alpha_3 y_{t-1} + \alpha_4 y_{t-2} + \varepsilon_{1t} \qquad (3.1.1)$$

Wage-price setting:

$$\Delta w_t = \beta_1 (yt_{t-1} - l_{t-1} + pc_{t-1}) + \beta_2 w_{t-1} + \varepsilon_{2t} \qquad (3.1.2)$$

$$\pi_t = \chi_1 pc_{t-1} + \chi_2 \Delta e_t + \chi_3 e_{t-1} + \chi_4 (w_{t-1} - yt_{t-1} + l_{t-1}) + \chi_5 E\pi_{t+1} + \varepsilon_{3t} \qquad (3.1.3)$$

Government debt identity:

$$d_t = -fd_t \exp(e_t) + p_t + ((1+i_t)d_{t-1} + (1+if_t)\, fd_{t-1}\exp(e_{t-1}))\, 1/(1+y_t - y_{t-1}) 1/(1+\pi_t) \qquad (3.1.4)$$

Interest rate parity condition:

$$er_t = irf_t - ir_t + er_{t+1} + q_t \tag{3.1.5}$$

Risk premium:

$$q_t = \phi_1 d_{t+4} + \phi_2 q_{t-1} \tag{3.1.6}$$

Fiscal policy rule:

$$p_t = \varsigma_1 d_t + \varsigma_2 p_{t-1} \tag{3.1.7}$$

Monetary policy rule:

$$i_t = \pi_{t+1} + q + ir_{ft} + \delta_0(\pi_t - \pi^*) + (1-\delta_0) y_t + \varepsilon_{8t} \tag{3.1.8}$$

where all variables, except interest rates and the shares in GNP, are expressed in logs. The variable *y* is the output gap defined as the difference between aggregate demand and the natural output level. *yt*, *w* and *l* denote total production, nominal wage rate and employment, respectively. *i, ir* are nominal and real domestic interest rates where *irf* stands for real foreign interest rate. The inflation rate and price level are represented by π and *pc* respectively, where π^* denotes the inflation target. *er* and *e* denote the levels of the real and nominal rate of exchange rate respectively. In debt identity, *d* and *fd* denote the shares of domestic currency and foreign currency denominated bonds in GDP, respectively, where *p* represents the primary balance. *q* is the time varying risk premium. *E* is the mathematical expectations operator, and Δ is the first difference operator. *Exp* points to the exponential form of the variables.

III.2. Aggregate Demand - IS Equation

Aggregate demand equation (3.1.1) explains the dynamic relationship between real output, real interest rate and the real exchange rate. The equation suggests that the current level of real interest and real exchange rate affect the current level of output. The real interest rate should have a negative impact, $\alpha_1<0$, since a rise in real interest rates reduces investment spending due to higher cost of capital and encourages savings. A quicker depreciation of domestic currency that is denoted by an increase of *er* makes domestic goods cheaper than foreign goods, thereby causing an increase in net exports and hence also in aggregate output suggesting a positive coefficient, $\alpha_2>0$. Output also depends on its lagged values. The significance of lagged variables indicates that output is predetermined and the current monetary policy actions are ineffective on current level of output.[10]

Estimation results of equation (3.1.1) with the Turkish data reveal that the current levels of the real exchange rate and real interest rate are significant in explaining the output gap.[11] The coefficients can be considered to be low, α_1=-0.12, α_2=0.10, for both variables, although they have the expected signs.[12] The weak impact of real exchange rate on output reflects the inelasticities of real trade flows to change in prices. As suggested by Ghosh (2000), Turkish trade activity elasticities are higher than price elasticities. Long-run

[10] Batini and Haldane (1999) includes a forward-looking term of $E_t y_{t+1}$. A positive and significant term indicates that monetary policy can affect output today by affecting future expectations of output.

[11] Output gap measures are based on Yalçın (2000). He derives two output gap measures for Turkey based on potential output estimations and HP filtering method. Both measures give similar results in the aggregate demand equation.

[12] Batini and Haldane (1999) set the real interest rate and real exchange rate elasticities to 0.5 and 0.2, respectively.

export price elasticity ranges between 0.5 to 1.3 whereas the short-run price elasticity is estimated to be around 0.4. Şahinbeyoğlu and Ulaşan (1999) also show that export demand is price inelastic in Turkey. For the import demand equation, the estimation results indicate a long-run price elasticity ranging from 0.05 to 0.5 where the short-run price elasticity is estimated to be 0.7.

TABLE 1
MODEL PARAMETERS

	Equation / Values	
	IS curve	
α_1	-0.12	Real interest rate response
α_2	0.10	Real exchange rate response
α_3	1.38	Autoregressive element
α_4	-0.66	Autoregressive element
	Wage-setting	
β_1	0.21	Unit labour productivity
β_2	-0.24	Autoregressive element
	Price-setting	
χ_1	-0.18	Autoregressive element
χ_2	0.23	Nominal exchange rate response
χ_3	0.09	Nominal exchange rate response
χ_4	0.11	Unit labour cost
χ_5	1.00*	Inflation expectations response
	Risk premium	
ϕ_1	0.10*	Response to domestic currency debt/GDP ratio
ϕ_2	0.60*	Autoregressive element
	Monetary Policy Rule	
δ_0	0.50*	Feedback parameter
	Fiscal Policy Rule	
ζ_1	-0.10*	Feedback parameter
ζ_2	0.30*	Autoregressive element

(*)Calibrated parameters.

The relatively low response of output to the changes in real exchange rate and in the real interest rate points to a weak power of monetary policy actions on the current level of output. The first and the second lags of the output are highly significant with estimated coefficients of α_3=1.38 and α_2=-0.66, respectively, suggesting a predetermined structure of the output (Appendix, Table 1).

III.3. Wage-Price Setting

The wage-price mechanism estimated in the model consists of two equations, equations (3.1.2) and (3.1.3), a wage equation and a price or mark-up equation, respectively. The mark-up equation gives the behaviour of prices or the implicit supply curve of firms where the prices are defined as a mark-up over unit labour costs. The wage equation gives the behaviour of nominal wages as a function of unit labour productivity and past inflation.

Estimation results of equation (3.1.2) reveal that nominal unit labour productivity and past inflation are the main determinants of wage setting behaviour in Turkey and wages are quick to adjust to changes in the price level as expected in a high inflationary environment. The higher the price level compared to nominal wages in the previous period, the higher the adjustment in current level of nominal wages. The strong and quick pass through is caused by the indexed structure of wages and the frequent wage settings in Turkey that enhances the inflationary inertia.[13]

According to equation (3.1.3), the pricing behaviour is defined as a mark-up over unit labour costs. Output gap measures are estimated to be insignificant in the Phillips curve. Along with the dynamic homegeneity property, the restriction on the coefficient of the inflation expectations that equalizes to unity is not rejected.[14]

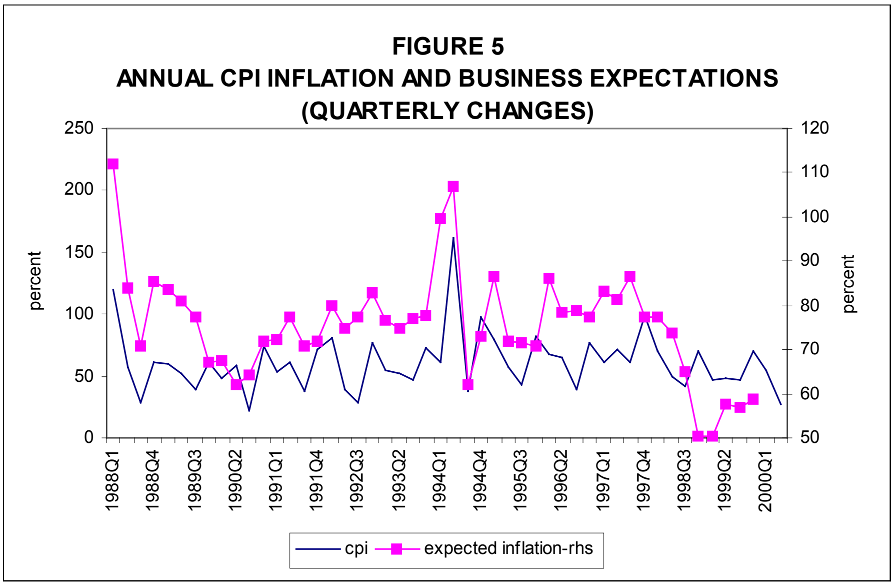
[13] In recent years, public sector wages have been set bi-annually while minimum wage is set set on an annual basis.

[14] Following Lyziak (2000), direct measures of expected inflation appear in the Phillips curve. Taking into account the need to correct long-run bias resulting both from the survey and from the quantification method exploited, the series are adjusted in order to impose that the long-run actual inflation is equal to expected inflation (see Appendix, Table 2).

Therefore, changes in the exchange rate and adjusted inflation expectations occur to be significant in affecting price setting behaviour in Turkey. Foreign exchange rate changes are important either in affecting the cost of production and/or changing the relative prices of final goods in the inflation basket. Turkey has a relatively open economy with a trade volume of almost 45 percent of GNP, of which 60 percent of total imports are intermediary goods and 12 percent are consumer goods. Meanwhile, almost 50 percent of the goods in the basket of consumer price index are tradable goods (Appendix, Table 2).

III.4. Expectations Formation

The long history of high inflation in Turkey with the lack of credibility of the disinflationary programmes led agents to form their expectations based on timely data such as changes in interest rates and the exchange rate. Additionally, the Central Bank's actions allowing a continuous depreciation of the domestic currency have stimulated this process.



Inflationary expectations data derived by the quantification of the business tendency survey exhibit a close pattern to both consumer and wholesale price inflation.[15] In a chronic inflationary environment, agents respond more rapidly to the available information in the market. The pattern of rising and volatile real interest rates may reflect inflationary expectations rather than contractionary monetary policy (Kalkan *et al.,*1998).[16]

In the case of Turkey with a chronic inflationary environment, rising real interest rates have become both the cause and the consequence of high inflation. With persistently high levels of public debt where real interest rate exceeds the growth rate, markets are skeptical about the ability of the monetary authorities to pursue a non-inflationary monetary policy. A contraction in monetary policy worsens the debt dynamics as higher interest rates increase the debt stock and raises the possibility of future monetisation of debt. As agents anticipate this outcome and incorporate it in their expectations of inflation and interest rates, disinflationary policy leads to higher real interest rates, slower growth and higher inflation.

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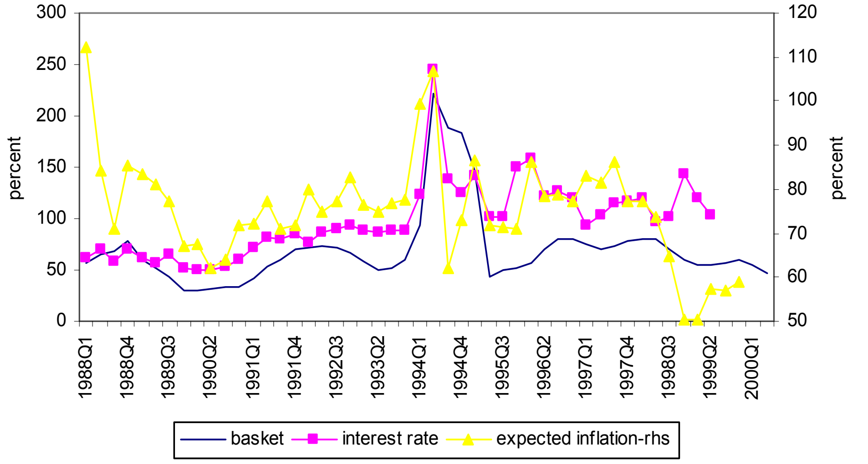
[15] Kıpıcı (2000) quantifies the qualitative information on price expectations obtained from the quarterly tendency surveys in Turkish manufacturing industry.

[16] They analyse the leading indicators of inflation by investigating the macroeconomic variables that perform best in predicting inflation in Turkey. By employing time series techniques and robustness criterion, the study identifies the inter-bank interest rate and the exchange rate basket as the two key leading indicators that survive the robustness criteria. The Granger causality running from inflation to various interest rates rules out any cost-push or wealth effect type of inflation. The authors point out the existence of the expectations channel formed by the interest rates as being timely information. The positive relationship might therefore simply reflect inflationary expectations rather than contractionary monetary policy.

FIGURE 6
INFLATION EXPECTATIONS AND REFERENCES
(QUARTERLY CHANGES)



In addition to the underlying fiscal fundamentals in the inflationary process, the Central Bank's policy aiming at a constant real value for an exchange basket contributed to the inflationary inertia. Therefore, the continous nominal depreciation of the Turkish lira brought its own inflationary dynamics and exchange rate changes had become one of the primary references informing price expectations. Consequently, agents follow closely recent trends in financial data in particular change in the foreign exchange rate and interest rate which are available at a high frequency and set in their anticipation of future inflation. In the framework of the model, inflationary expectations are assumed to be rational allowing a forward-looking approach.

III.5. The Monetary Policy Rule

The common theme of monetary policy implementation in the second half of 1990s can be generalised as providing stability in financial markets, especially in the foreign exchange market. The policy strategy was set as controlling the growth in net domestic assets and creating domestic liabilities in return for increases in foreign assets. The Central Bank announced that it would control the depreciation of the Turkish lira in line with the targeted inflation rate. The policy aimed at a smooth pattern in the real value for the exchange basket was named as the "real exchange rate rule".[17] ollowing a price targeting strategy, that is the real exchange rate, Central Bank had to adjust its purchases and sales of foreign exchange that led to a depreciation rate in line with the inflation rate. The trade-off was to lose control over the money supply and the Central Bank attempted to control reserve money via the sterilised intervention that offset the liquidity implications of the foreign exchange operations.

In line with the Central Bank's recent experience of targeting an exchange rate path consistent with the inflation rate, the monetary policy rule equation (3.1.8) sets the real exchange rate consistent with the divergence of the actual inflation rate from the targeted level and the change in output gap.[18] The feedback parameter is set as δ_0=0.50 initially as suggested by the Taylor rule. Alternative values for feedback parameter are used for experimenting the influence of monetary policy under various concerns of price stability. Experiment results are reported in section IV.

III.6. Uncovered Interest Rate Parity Condition

Debt dynamics and the relationship between risk premium and domestic currency denominated debt to GDP ratio are discussed in section 2. In the framework of the model, equation (3.1.4) determines

[17] The basket exchange rate comprises of 1 US dollar and 1.5 DM (0.77 Euro).

[18] In the framework of the model, real exchange rate is determined by uncovered interest rate parity (UIP) condition. In order to avoid double specification of the real exchange rate, we insert the UIP identity in monetary policy rule equation. Due to this notation, nominal interest rate changes are treated as monetary policy shocks.

the debt accumulation at time t, as a percentage of GDP. Equation (3.1.5) is the uncovered interest rate parity condition that determines the real exchange rate as a function of domestic and foreign real interest rate differential and time varying risk premium where the risk premium is linked to domestic currency denominated debt by equation (3.1.6). The response of risk premium to domestic currency debt to GDP ratio, ϕ_1, is set 0.1 and autoregressive component, ϕ_2, is set to 0.6.

IV. SIMULATIONS

Using baseline parameterisation and the model, we analyse the transmission mechanism under two basic experiments of fiscal and monetary shocks. As a third case, we compare three alternative models under different monetary policy rules.[19] In this section, the impulse responses are presented and discussed.

IVI.1. Experiment 1- An increase in government spending

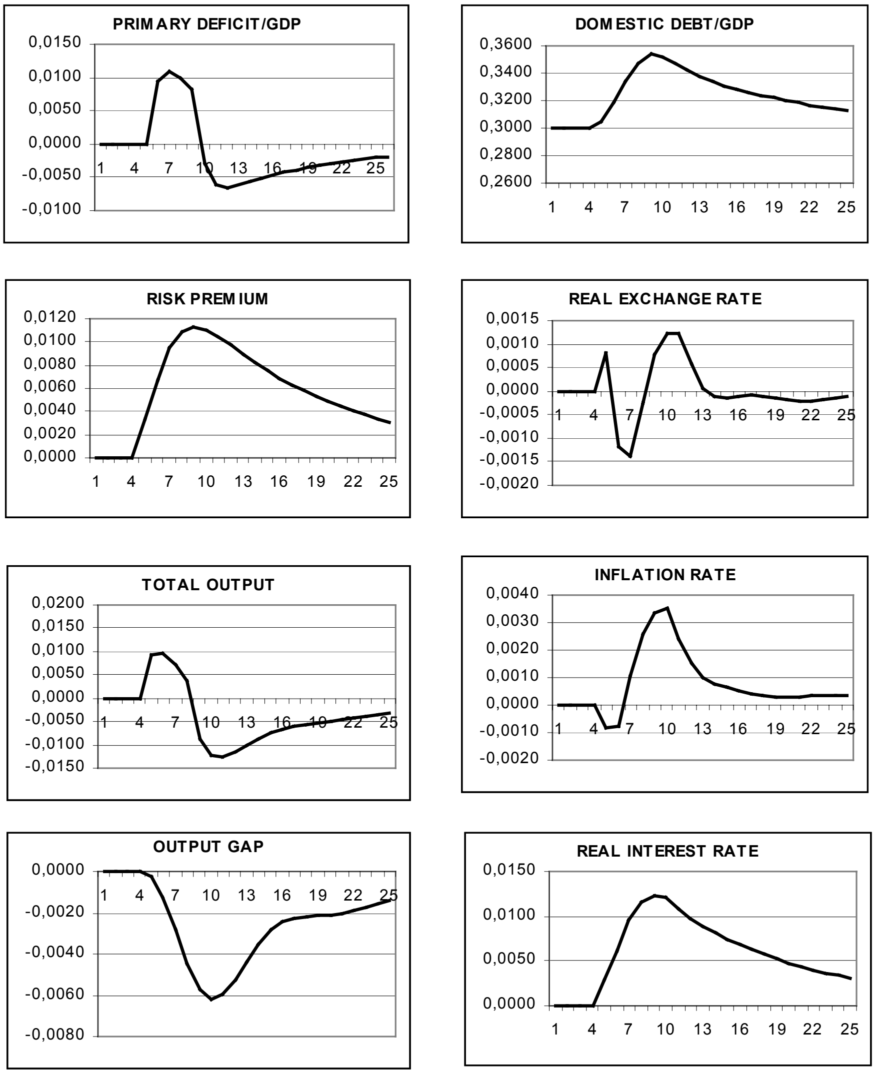
The first experiment is an unanticipated one-percentage increase in government spending as proxied by an increase of one percent in the primary deficit to GDP ratio through quarters 5-8. An expansion in the primary deficit will be financed through domestic debt which in turn results in an upward pressure on real interest rates via increasing the risk premium.

The expansion in government spending increases total output at the time of the shock, however, it is contractionary in the following periods due to its positive impact on real interest rates. A one percentage increase in the primary deficit increases the domestic debt to GDP ratio from its baseline level of 0.30 percent to 0.35 and

[19] The model is solved using the Winsolve package and uses Fair-Taylor expectations algorithm with Newton's solution method.

leads to a higher risk premium due to higher reliance on domestic financing. In the long-run, higher real interest rates result in crowding-out reflected as a contraction in output and the output gap.

FIGURE 7



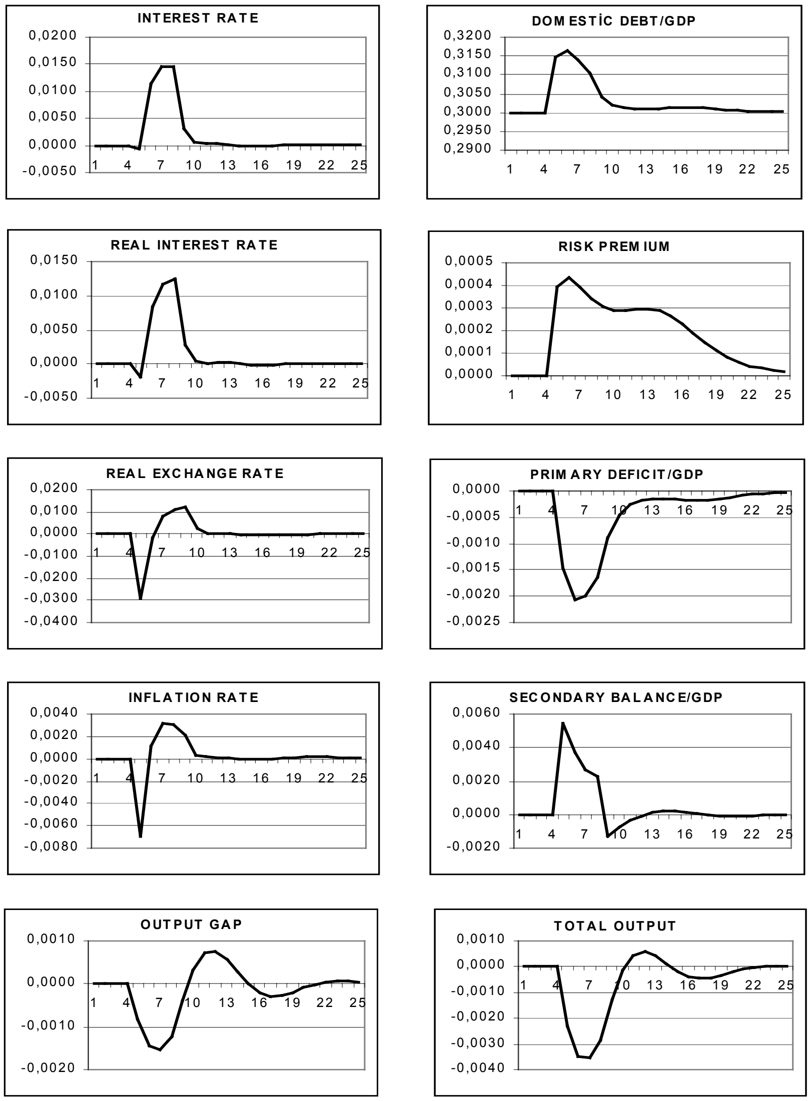
Expansionary fiscal policy experimented involves a one percentage point increase in the primary deficit and leads to a higher inflation rate after a slight decrease in the first two quarters. The increase in the inflation rate is above 0.3 percent on quarterly basis in the following quarters of the shock. The monetary policy rule affects the trend in real exchange rate based on the changes in output gap and inflation rate. Initially, the unanticipated increase in primary deficit first leads to a slight depreciation of the domestic currency, however after three quarters, monetary policy affects the real exchange rate path in line with the inflation rate. As a result, the real exchange rate appreciates at a level of 0.1 percent and then depreciates at the same level (Figure 7).

IV.2. Experiment 2- An increase in interest rates

The second experiment is an unanticipated monetary policy shock of one percentage increase in nominal interest rate through quarters 5-8. The impulse responses based on the model dynamics reveal that the increase in nominal interest rates will lead to a parallel increase in real interest rates. The change in real interest rate results in an initial appreciation of the domestic currency of above 3 percent through UIP and a decline in inflation rates by almost 0.8 percent on quarterly basis. As the inflation rate declines and the output gap decreases, the exchange rate starts to depreciate as a response to the monetary policy rule. The response of the inflation change to the contractionary monetary policy is relatively low and short-lived.

On the fiscal side, the increase in nominal interest rate leads to an expansion of domestic debt to GDP ratio through increasing the burden of interest rate payments. The domestic debt to GDP ratio increases to 0.32 from the baseline level of 0.30. The expanding domestic debt rises risk premium of almost 0.3 percent that further feeds into real interest rate that has a peak at 1.3 percentage level. Higher interest rates lead to a tightening in output gap and total output. The secondary balance defined as the burden of interest rate payments in government deficit rises as a response to increasing interest rate trend (Figure 8).

FIGURE 8



IV.3. Experiment 3- The monetary policy rule

As a third experiment, we evaluate the simulation results under different monetary policy rules by solving the alternative models that set the feedback parameter, δ_0, as 0.2, 0.5 and 0.9, respectively. The fiscal shock that is analysed in the first experiment stated as an unanticipated one-percentage increase in government spending proxied by an increase of one percent in primary deficit through quarters 5-8, is the case in comparison.

The simulation results reveal that, as the central bank has stronger ambition for disinflation, the volatility of the inflation rate and of the exchange rate increases. If the monetary authority is more active in the disinflationary process by raising interest rate relatively higher levels, δ_0=0.9, the rate of disinflation is almost three-fold. However, the cost is a more volatile exchange rate pattern as the response of the real exchange rate will be similar to the case in inflation rate. Consequently, in the absence of the co-ordination between monetary and fiscal policies, monetary authority has to face the trade-off between market stability and price stability. Unless fiscal policy is set in line with the monetary policy, or vice versa, any contractionary attempt of the monetary authority will feed into government debt through an expansion in secondary deficit and result in higher real interest rates, higher appreciation of domestic currency and also more volatile price changes (Figure 9 and Figure 10).

FIGURE 9
INFLATION RATES

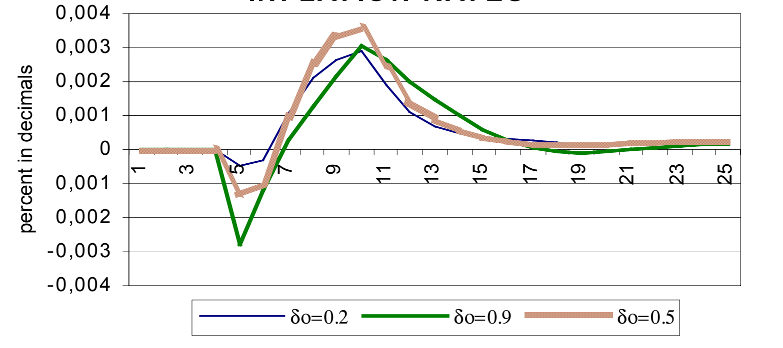
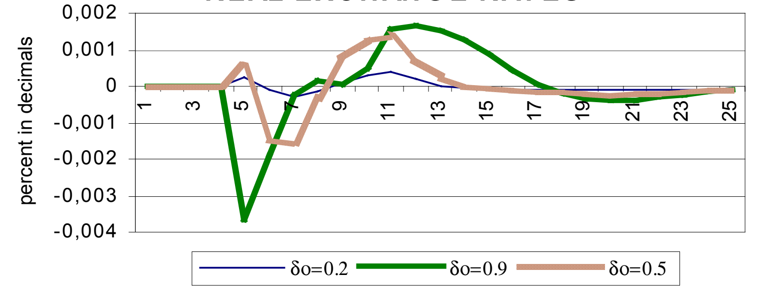


FIGURE 10
REAL EXCHANGE RATES



V. CONCLUSION

The paper shows that authorities responsible for inflation stabilisation need to concern themselves with the stance of fiscal policy while the agencies concerned with fiscal policy have a corresponding need to co-ordinate their actions with those of the monetary policy. The Turkish experience under persistent budget deficits provides a good example for the consequence of the co-ordination of fiscal and monetary policies in achieving the goal of price stability. The long history of high and chronic inflation and large public-sector-financing- requirements with a fully liberalised exchange rate regime had been the major constraints for the Central Bank of

Turkey that aimed at maintaining market stability and a competitive exchange rate rather than more traditional goals such as price stability.

The aim of this study is to analyse the basic features of the monetary transmission mechanism in Turkey in the context of a small aggregate macroeconomic model that provides a broad and stylised representation of the whole economy. The estimation results of the core equations of the model suggest that wages and prices are very quick to adjust and inflationary expectations are more important in the price setting behaviour in a high inflationary environment compared to more stable economies such as the UK. Large and persistent deficits and heavy reliance on domestic financing exert a large fiscal effect on real interest rates. In consequence, the high levels of real interest rates have become both the cause and the result of high inflation and have weakened the monetary policy transmission mechanism. In the absence of policy co-ordination between the monetary and fiscal authorities, any contractionary attempt of the monetary authority will feed into government debt through raising the exchange rate risk premium and increasing the debt servicing costs, which will also exert a more volatile exchange rate pattern. Monetary policy has to face the trade-off between market stability (exchange rate) and price stability.

The results from this study highlight the importance of recent commitment by the Turkish government to achieve primary surpluses in the new disinflation program. The most important component of the program is the nominal anchor provided by a forward-looking commitment to the exchange rate aimed at breaking the inflationary inertia. However, the exchange rate commitment is set to be supported by a strong fiscal discipline that is posited by the estimation and simulation results of this study.

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APPENDIX

TABLE 1: ESTIMATION RESULTS OF AGGREGATE DEMAND EQUATION

Dependent Variable:y				
Equation 3.1.1.				
Method: Least Squares				
Sample(adjusted): 1987:3 1999:2				
Included observations: 48 after adjusting endpoints				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	**0,00**	**0,11**	**-0,01**	**1,00**
ir	**-0,12**	**0,03**	**-3,72**	**0,00**
er	**0,10**	**0,03**	**3,40**	**0,00**
y(-1)	**1,37**	**0,10**	**13,47**	**0,00**
y(-2)	**-0,66**	**0,10**	**-6,77**	**0,00**
R-squared	0,89	Mean dependent var		0,19
Adjusted R-squared	0,89	S.D. dependent var		2,28
S.E. of regression	0,77	Akaike info criterion		2,42
Sum squared resid	25,58	Schwarz criterion		2,61
Log likelihood	-53,01	F-statistic		91,54
Durbin-Watson stat	2,19	Prob(F-statistic)		0,00
Breusch-Godfrey Serial Correlation LM Test: (1 lag included)				
F-statistic	2,14	Probability		0,15
Obs*R-squared	2,33	Probability		0,13
Breusch-Godfrey Serial Correlation LM Test: (2 lags included)				
F-statistic	1,68	Probability		0,20
Obs*R-squared	3,63	Probability		0,16
Breusch-Godfrey Serial Correlation LM Test: (3 lags included)				
F-statistic	1,11	Probability		0,36
Obs*R-squared	3,68	Probability		0,30
Breusch-Godfrey Serial Correlation LM Test: (4 lags included)				
F-statistic	0,95	Probability		0,44
Obs*R-squared	4,27	Probability		0,37
Ramsey RESET Test: (number of fitted terms=1)				
F-statistic	0,01	Probability		0,91
Log likelihood ratio	0,02	Probability		0,90
Ramsey RESET Test: (number of fitted terms=2)				
F-statistic	0,52	Probability		0,60
Log likelihood ratio	1,21	Probability		0,55
Ramsey RESET Test: (number of fitted terms=3)				
F-statistic	0,50	Probability		0,69
Log likelihood ratio	1,75	Probability		0,63
Ramsey RESET Test: (number of fitted terms=4)				
F-statistic	1,16	Probability		0,34
Log likelihood ratio	5,38	Probability		0,25
Jarque-Bera	0,60			

TABLE 2:
ESTIMATION RESULTS OF WAGE-PRICE SYSTEM

System: Wage-Price Setting				
Equations 3.1.2, 3.1.3 and corrections to inflation expectations.				
Estimation Method: Iterative Three-Stage Least Squares				
Sample: 1990:1 2000:2				
Instruments: LW(-1) LY(-1)-LL(-1) LCPI(-1) LIMP D(LIMP) LY-LL C				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0,91	0,39	-2,32	0,02
C(2)	-0,23	0,08	-2,79	0,01
C(3)	0,21	0,08	2,74	0,01
C(11)	-0,22	0,26	-0,84	0,41
C(12)	-0,20	0,08	-2,40	0,02
C(13)	0,23	0,06	4,14	0,00
C(14)	0,10	0,04	2,30	0,02
C(15)	0,13	0,06	2,15	0,03
C(24)	0,57	0,23	2,47	0,02
C(25)	0,64	0,34	1,89	0,06
C(26)	-0,01	0,03	-0,44	0,66
Determinant residual covariance		2,47E-09		
Equation: D(LW)=C(1)+C(2)*LW(-1)+C(3)*(LY(-1)-LL(-1)+LCPI(-1))				
Observations: 40				
R-squared	0,17	Mean dependent var		0,15
Adjusted R-squared	0,13	S.D. dependent var		0,06
S.E. of regression	0,06	Sum squared resid		0,12
Durbin-Watson stat	2,18			
Equation: D(LCPI)=C(11)+C(12)*LCPI(-1)+C(13)*D(LIMP)+C(14)*LIMP(-1)				
+C(15)*(LW(-1)+LL(-1)-LY(-1))+(1-C(24))*EXPINF/(C(25))				
Observations: 40				
R-squared	0,55	Mean dependent var		0,14
Adjusted R-squared	0,47	S.D. dependent var		0,05
S.E. of regression	0,04	Sum squared resid		0,04
Durbin-Watson stat	2,51			
Equation: EXPINF(+1)=C(26)+C(25)*D(LCPI(+1))+C(24)*EXPINF				
Observations: 39				
R-squared	-0,10	Mean dependent var		0,19
Adjusted R-squared	-0,16	S.D. dependent var		0,03
S.E. of regression	0,03	Sum squared resid		0,03
Durbin-Watson stat	2,31			
Wald Test:				
Null Hypothesis:	(1-C(24)/C(25))=1			
Chi-square	0,69		Probability	0,41