Disinflation, Fiscal Sustainability, and Labor Market Adjustment in Turkey

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1 Introduction

For much of the past two decades, Turkey’s economy has suffered from persistent fiscal imbalances, high inflation, financial volatility, and sharp swings in economic activity (see Figure 1). Large budget deficits during the 1990s fueled a rapid expansion in domestic public debt and sharp increases in real interest rates, with deposit rates for instance averaging 12.8 percent during that decade. In turn, high interest rates had an adverse effect on private investment and contributed to unsustainable debt dynamics. The overall balance of the consolidated public sector rose from 5.2 percent of GNP to 13.1 percent in 1997 and 22.3 percent in 1999. The net debt of the public sector reached 61 percent in 1999. In late 1999, the government launched a 3-year disinflation program based on a pre-announced exchange rate path. Despite some progress in 2000, with inflation falling and the public sector recording a sizable primary surplus, unfavorable debt dynamics and financial sector weaknesses combined with the rigidities imposed by the exchange rate peg led to a currency collapse and a full-blown financial crisis. Between the end of 1995 and the end of 2001, Turkey’s public debt almost doubled in proportion to GNP, from 41.3 percent to 80 percent (see Figure 1) with a significant portion of the increase coming in 2001 as the cost of bank restructuring was borne by the budget. Inflation hit 68.5 percent at the end of 2001 and the nominal interest rate on treasury bills reached 99.1 percent.

Although short-lived (the economy started to recover in 2002), the crisis had severe economic and social costs. Real GNP fell by 9.5 percent in 2001 alone, whereas per capita GDP contracted by 13 percent between 1998 and 2001. The officially recorded unemployment rate rose from 6.4 percent in 1998 to 8.5 percent in 2001 and 10.6 percent during 2002 (see Figure 2). Real wages in manufacturing remained relatively constant throughout 2000 as nominal wage increases kept pace with inflation, but then declined sharply in 2001—by 20 percent in the fourth quarter of that year, compared to the

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1In 1995, foreign debt represented two thirds of total debt (or 30.7 percent of GNP), whereas in 2002 it amounted to 40 percent of the stock (or 32.1 percent of GNP). Moreover, a sizeable fraction of the domestic debt is now denominated in foreign currency or indexed on the exchange rate. In 2002 this debt amounted to 15.3 percent of GNP, with total domestic debt representing 47.7 percent. The sum of foreign debt and foreign-currency denominated domestic debt amounted therefore to 47.4 percent that same year.

2See Yilmaz and Boratav (2003) for an overview of developments leading up to the crisis.
same period of the previous year (World Bank (2003)). World Bank estimates indicate that the urban headcount poverty index rose from 6.2 percent in 1994 to 17.2 percent in 2001. Credit to the private sector (particularly in the nontradables sector) fell sharply as a share of GDP and recovered only slowly—a typical pattern in the aftermath of financial crises in developing countries, as documented for instance by Tornell and Westermann (2003) and Schneider and Tornell (2004).

The development of the public debt overhang and the consequent need for continuous refinancing of the debt has led to a very close link between financial market participants’ perceptions of credibility of the Government’s program, key macroeconomic variables such as interest rates, exchange rates and inflation, and real variables such as employment and growth. Our premise in this paper is that a proper modeling of the structure of the labor market in Turkey, and a proper account of the linkages between the financial and real sides of the Turkish economy, are essential steps to understand the impact of the disinflation program on the evolution of output and employment. Accordingly, we develop a dynamic computable general equilibrium (CGE) model with a relatively aggregated productive sector, a segmented labor market and a full-blown financial sector. By itself, this endeavour is not new; over the years, a number of CGE models have been developed for Turkey. These include Lewis (1992), Yeldan (1997, 1998), Diao, Roe, and Yeldan (1998), Karadag and Westaway (1999), De Santis (2000), Voyvoda and Yeldan (2003), and Elekdag (2003). Those of Lewis (1992), Yeldan (1998), and Elekdag (2003) include a financial sector, whereas the others are “real” models focusing on tax and trade policy issues. In all of these models, however, the treatment of the labor market is fairly rudimentary and some important channels through which the real and financial sectors interact are absent. Indeed, as far as we are aware, some of these channels have been either ignored or improperly addressed in the previous literature; our framework should therefore be of independent interest to researchers focusing on other countries with large market-financed debt overhangs.

We pay particular attention to financial sector issues such as a high degree of exchange rate flexibility, risk premia in the banking sector, dollarization of

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\footnote{The model developed in this paper is based on the IMMPA (for Integrated Macroeconomic Model for Poverty Analysis) framework developed by Agénor (2003a), Agénor, Izquierdo, and Fofack (2003), and Agénor, Fernandes, Haddad, and Jensen (2003). This class of models captures real and financial features that are common to many developing countries.}
loans and bank deposits, the link between market interest rates and official policy rates, and interactions between credibility, default risk on government debt, and inflation expectations. Understanding the link between credibility and inflation, in particular, is important to understand Turkey’s experience in the immediate aftermath of the 2001 financial crisis. For instance, to the extent that inflation inertia is due to doubts about the commitment and ability of policymakers to keep prices in check, a disinflation program may entail a large output cost.

Accounting for default risk on public debt is another key feature of our analysis. It is well recognized that fiscal policy must be evaluated in a framework in which the government is subject to an intertemporal budget constraint (see, for instance, Uctum and Wickens (2000), Gunaydin (2003), and Salman (2003) for a discussion in Turkey’s context). If the real rate of interest is above the real growth rate of the economy, a fiscal deficit today (brought about by either an increase in expenditure or a reduction in taxes) must be accompanied at some point in the future by either a fiscal contraction or a rise in seigniorage revenue. Otherwise, the increase in public debt will feed upon itself as the government borrows to finance the interest payments on the liabilities that it previously issued. If the government cannot meet its debt service payments without further borrowing, investors may be unwilling after a certain point to continue to accumulate government bonds. As a result, the government will have to either reduce its primary deficit or engage in an outright default. Although we do not account explicitly for the government’s intertemporal budget constraint in our framework, we capture this “unwillingness” of investors to provide indefinite financing by assuming that there is a non-zero probability of default that depends on the existing stock of debt. In turn, the probability of default affects the expected rate of return on government bonds. The higher the perceived risk of default is, the higher will be the actual interest rate on these bonds, and the lower will be the degree of credibility of the fiscal stance. Lower credibility translates into higher inflation expectations and greater inflation persistence.4

4Diao, Roe, and Yeldan (1998) analyzed fiscal management issues in Turkey using an explicit intertemporal CGE framework that accounts for the existence of a risk premium associated with large public sector borrowing requirements. Specifically, the domestic real interest rate, \( r \), is taken to diverge from the world interest \( r^* \), by \( r = (1 + \theta)r^* \), with \( \theta \) being a function of the ratio of the fiscal deficit to GDP. However, the model is “real” and thus the impact of interest rate changes on portfolio decisions and the supply side (through short-term bank borrowing) are not taken into account.
Given our focus on the behavior of wages and unemployment during disinflation, the labor market plays also an important role in our analysis. Indeed, our framework captures many important features of the Turkish labor market—namely, a large informal urban economy, open unskilled urban unemployment, wage bargaining in the urban formal sector, and international migration, with remittance flows accounting for about 2 percent of GDP in 2002. In any model designed to study the response of the labor market to short-run macro shocks and structural adjustment measures, accounting for the informal sector is essential; in the case of Turkey, it is even more so. Some observers have argued that growth in that sector may explain the observed tendency for labor force participation to fall since the 1960s, that is, the growing gap between the labor force (the adult population either employed or looking for work, which was 22 million in 2001) and the adult population (of about 46 million adults in that same year).

The remainder of the paper is organized as follows. Section II describes the model. Section III considers two policy experiments and discusses the response of production, wages and unemployment, as well as the behavior of the public debt-to-GDP ratio. The first consists of a temporary increase in official interest rates. The second focuses on fiscal adjustment and involves tax reform, namely an increase in the VAT rate and a rise in the tax rate on income of profit earners. These simulations are important because the sustainability of Turkey’s public debt remains a key policy issue. It has been argued by various observers that Turkey needs to run large primary surpluses over the medium and long term to lower its public debt burden, meet its disinflation targets, and convince markets that its debt is sustainable, for the risk premium embedded in interest rates on domestic debt to fall. The adjustment program introduced in May 2001 called for Turkey to maintain a primary surplus on the order of 6.5 percent of GNP over the medium term to lower its public debt to manageable proportions and achieve the goal of single digit inflation by 2005. Although we do not assess explicitly the validity of this target, our simulations allow us to quantify the impact of fiscal adjustment not only on the budget and domestic inflation, but also on the labor market (real wages and unemployment) and standards of living. The last

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5These estimates are based on a variant of the consistency framework developed by Anand and van Wijnbergen (1989). This approach lacks a simultaneous determination of the rate of output growth, the real interest rate, fiscal variables, and the real exchange rate. Our analysis, by contrast, is cast in a general equilibrium setting, as in Voyvoda and Yeldan (2003).
section summarizes the main results of the paper and offers some concluding remarks. Appendices A and B provide a list of equations and variable definitions, whereas Appendix C discusses the structure of the financial SAM that underlies the model, our calibration procedure, and the parameter values that are used in the behavioral equations.

2 Structure of the Model

Our model of the Turkish economy captures three features that we believe are essential to analyze the impact of disinflation and fiscal reforms on labor market adjustment and public debt sustainability. First, the linkages between the financial and the real sectors; second, the structure of the labor market; and third, the channels through which fiscal variables interact with financial variables to affect the economy. In addition, particular attention is paid to modeling monetary policy and the credit market. Specifically, we assume that the central bank sets a short-term policy interest rate (such as the repurchase rate) and has a perfectly elastic supply curve of liquidity to commercial banks at that rate. Credit to firms by commercial banks is also perfectly elastic (at the given lending rate), whereas lending to households is subject to rationing. Foreign borrowing by commercial banks is exogenous and equilibrium of the credit market is obtained by domestic borrowing from the central bank, at the given policy rate.

In this section we review the various building blocks of the model. We consider in turn the production side, the labor market, external trade, aggregate supply and demand, income formation, saving and investment, the financial sector and asset allocation decisions, the balance sheets and flow budget constraints of the public sector (comprising both the government and the central bank), the balance of payments, equilibrium conditions for the currency and bond markets, price formation, and the links between default risk, credibility, and inflation expectations.

2.1 Production

Given our focus on macroeconomic aspects, the production structure is kept fairly aggregate. The economy is divided between rural and urban sectors. The rural sector produces a homogeneous good, which is sold domestically and abroad. The urban sector consists of both formal and informal compo-
ments; furthermore, the formal urban economy is separated between a private sector (which also produces a good sold on both domestic and foreign markets) and a public sector, which produces a single nontraded good.

2.1.1 Rural Sector

Gross output in the rural sector, \( X_A \), is given by the sum of value added, \( V_A \), and intermediate consumption:

\[
X_A = V_A + X_A \sum a_{ij}, \tag{1}
\]

where the \( a_{ij} \) are input-output coefficients measuring sales from sector \( i \) to sector \( j \). We also have \( i, j = A, I, P, G \) where \( A, I, P, G \) are used in what follows to refer, unless otherwise indicated, to the rural sector, the urban informal sector, the private urban formal sector, and the public sector, respectively.

Value added is produced with land, \( LAND \) (available in fixed supply), unskilled labor, \( U_A \) (the only category of labor in the rural sector), and the economy-wide stock of public capital in infrastructure, \( K_{INF} \), which is treated as a pure public good and consists not only of roads and public transportation that may increase access to markets, but also power plants, hospitals, and other public goods that may contribute to an increase in the productivity of factors in private production. A two-level production structure is assumed. Specifically, \( U_A \) and \( K_{INF} \) combine through a constant elasticity of substitution (CES) function to form a composite factor, which is then combined with land through a Cobb-Douglas technology:

\[
V_A = LAND^{1-\eta_{XA}} \left[ \alpha_{XA} \left( \beta_{XA} U_A^{-\rho_{XA}} + (1 - \beta_{XA}) K_{INF}^{-\rho_{XA}} \right)^{-\frac{1}{\rho_{XA}}} \right]^{-1-\eta_{XA}}, \tag{2}
\]

Thus, given the Cobb-Douglas specification, rural production exhibits decreasing returns to scale in the composite input. In what follows, the quantity of land is normalized to unity.

In standard fashion, output of the rural sector is allocated to domestic sales, \( D_A \), and exports, \( E_A \), through a constant elasticity of transformation (CET) function:

\[
X_A = \alpha_{EDA} \left[ \beta_{EDA} E_A^{-\rho_{EDA}} + (1 - \beta_{EDA}) D_A^{-\rho_{EDA}} \right]^{-\frac{1}{\rho_{EDA}}}, \tag{3}
\]

where, as discussed later, the ratio \( E_A/D_A \) depends on relative prices.
2.1.2 **Urban Informal Sector**

The second component of the production structure is the informal sector, whose share increased significantly in Turkey since the 1980s. The OECD (1996) estimated the size of the non-agricultural informal sector (defined as unpaid family workers, half of the self-employed, employers with fewer than four employees, and unregistered wage earners) to be 21 percent for 1993. Another study (cited by Onaran (2002)) using the same definition found 23 percent for 1997. The private formal sector was estimated at 19 percent of total employment, the public sector at 12 percent, with the rest (about 46 percent of total employment) being employed in the agricultural sector. Thus, the informal non-agricultural sector exceeded the size of the private formal sector. More recently, Taymaz and Ozler (2003) estimated that the informal sector accounts for more than 30 percent of output and 40 percent of employment in the manufacturing sector. Similar estimates are cited in Tunali (2003).

Gross production in the informal sector, $X_I$, is given as the sum of value added, $V_I$, and intermediate consumption:

$$X_I = V_I + X_I \sum a_{iI}. \quad (4)$$

There is no physical capital in the informal sector, and value added is generated using only unskilled labor, $U_I$, with a decreasing returns to scale technology:

$$V_I = \alpha_{XI} U_I^{\beta_{XI}}, \quad \alpha_{XI} > 0, \quad 0 < \beta_{XI} < 1, \quad (5)$$

from which the demand for labor can be derived as

$$U_I^d = \beta_{XI} (PV_I V_I W_I), \quad (6)$$

with $W_I$ denoting the nominal wage and $PV_I$ the price of value added.

2.1.3 **Urban Formal Private Sector**

Gross production in the private urban formal sector, $X_P$, is again given by the sum of value added, $V_P$, and intermediate consumption:

$$X_P = V_P + X_P \sum a_{iP}. \quad (7)$$
Value added is generated by combining both skilled and unskilled labor, as well as public and private physical capital, through a multi-level CES production structure. At the lowest level of factor combination, skilled labor, $S_P$, and private physical capital, $K_P$, are combined to form the composite input $J_1$, with a relatively low elasticity of substitution (as measured by $\sigma_{X_1} = 1/(1 + \rho_{X_3})$) between them:

$$J_1(S_P, K_P) = \alpha_X [B_X S_P^{1 - \rho_{X_1}} + (1 - B_X) K_P^{1 - \rho_{X_1}}]^{1/(1 - \rho_{X_2})}.$$

At the second level, this composite input is used together with unskilled labor, $U_P$, to form the composite input $J_2$:

$$J_2(J_1, U_P) = \alpha_X [B_X J_1^{1 - \rho_{X_2}} + (1 - B_X) U_P^{1 - \rho_{X_2}}]^{1/(1 - \rho_{X_2})}.$$

In line with the evidence for middle-income developing countries (see Agénor (1996, 2003)), the elasticity of substitution between $J_1$ and unskilled labor, measured by $\sigma_{X_2} = 1/(1 + \rho_{X_2})$, is taken to be higher than the elasticity between $S_P$ and $K_P$, that is

$$\sigma_{X_2} > \sigma_{X_1}.$$

The final layer combines $J_2$ and $K_{INF}$ (the stock of government capital in infrastructure) as production inputs:

$$V_P(J_2, K_{INF}) = \alpha_X [B_X J_2^{1 - \rho_{X_2}} + (1 - B_X) K_{INF}^{1 - \rho_{X_2}}]^{1/(1 - \rho_{X_2})}.$$

As in the rural sector, firms in the private urban formal sector allocate their output to exports, $E_P$, or the domestic market, $D_P$, according to a CET function:

$$X_P = \alpha_{ED} [B_{ED} E_P^{1 - \rho_{ED}} + (1 - B_{ED}) D_P^{1 - \rho_{ED}}]^{1/(1 - \rho_{ED})}.$$

This specification also implies, as shown later, that the ratio $E_P/D_P$ depends on relative prices.

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6 An alternative approach would be to follow Stokey (1996) and assume that physical capital (possibly defined as a composite of both public and private capital) and unskilled labor are substitutes, whereas both are complementary to skilled labor.
2.1.4 Public Production

Gross production of public services, \( X_G \), is given by the sum of value added, \( V_G \), and intermediate consumption:

\[
X_G = V_G + X_G \sum a_{iG}.
\]  

Value added is generated by combining both categories of labor and public capital in infrastructure. Again, a two-level CES production structure is assumed. At the first level, skilled labor, \( S_G \), and public capital in infrastructure, \( K_{INF} \), combine to produce a composite input, \( J_G \), with a relatively low elasticity of substitution between them:

\[
J_G(S_G, K_{INF}) = \alpha X_G \beta_X G^{-\rho X G} + (1 - \beta_X G) K_{INF}^{-\rho X G} \left[1 - \rho X_G\right].
\]  

At the second level, \( J_G \) is combined with unskilled labor, \( U_G \), to produce net output:

\[
V_G(J_G, U_G) = \alpha X_G \beta_X G^{-\rho X G} + (1 - \beta_X G) U_G^{-\rho X G} \left[1 - \rho X_G\right].
\]  

We assume that the elasticity of substitution between \( S_G \) and \( K_{INF} \), \( \sigma_{XG} = 1/(1 + \rho_{XG}) \), is lower than the elasticity of substitution between the composite input \( J_G \) and \( U_G \), \( \sigma_{XG} = 1/(1 + \rho_{XG}) \), in order to capture the fact that there is a greater degree of complementarity between physical capital and skilled labor (as in the private sector), and a greater substitutability between these two factors and unskilled labor:

\[
\sigma_{XG} > \sigma_{XG} J.
\]

2.2 The Labor Market

As noted earlier, modeling the main features of the labor market in Turkey is one of the key objectives of our model. Accounting for labor regulations and government-induced sources of labor market segmentation are thus important. Turkey’s labor laws are the strictest in the OECD in terms of employment protection; the country’s severance pay requirements are higher than in any other country (except Portugal) and restrictions on the use of
temporary workers are severe. In principle, employment protection rules are meant to enhance job security by making dismissals costly to the employer. They should therefore help to stabilize employment levels, all else being equal, reducing layoffs in downturns. But they also reduce hiring as the economy recovers. The evidence for Turkey (see Tunali (2003)) suggests that employment protection laws may have increased the insecurity faced by workers, as employers avoid paying severance altogether and hire short-term workers illegally, and may have shifted activity to the informal sector—with adverse effects on tax revenue.

Turkey has implemented a minimum wage law nationwide since 1974. The minimum wage has been adjusted twice a year since 1999 to inflation. During the period 2000-2001, it represented only about 25 percent of the average daily wage in manufacturing (see Tunali (2003)). The extent to which it is enforced, even in the urban formal sector, remains a matter of debate. However, even if it is not “binding” per se, changes in the minimum wage may well play an important signaling role for wage setters in general, including trade unions. Similarly, it is widely believed that public sector wages have a strong signaling effect on wage setting in the private sector (see Tunali (2003)). Collective agreements between the government and the major trade unions—almost all civil servants and employees of state-owned enterprises are unionized—serve as a model for unions and workers in the formal private sector.

In modeling the labor market we attempt to capture in a stylized way several of these features. Given that the model integrates an informal urban sector, we account for the fact that labor market regulations and other “distortions” in the formal economy may not be binding for a large segment of the labor market. Wages may therefore exhibit a high degree of flexibility. In light of the evidence suggesting that the power of trade unions has eroded significantly during the past two decades (see Onaran (2002)), we focus on the case where workers in the private formal sector negotiate wages directly

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7 As demonstrated formally by Saint-Paul (2002), employment protection is more likely to arise in economies with greater worker bargaining power.

8 Tunali (2003) reports that the pair-wise correlation between average wages in the public sector and the private manufacturing sector was 0.46 in the first period and 0.78 in the second period. Note that Granger causality tests or impulse response functions from simple VAR models (involving, for instance, the rates of growth of public and private sector wages, inflation, and the cyclical component of output) could provide some useful additional information.
with firms. We also assume that workers’ reservation wage depends on wages in the public sector. We thus capture the “signaling” effect alluded to above.\footnote{As noted earlier, severance payments have long been a major source of frictions between unions and employers in Turkey. We do not explicitly introduce firing costs given the focus of our simulations in this paper; but this could be done along the lines suggested by Agénor (2003).}

### 2.2.1 Rural Wages, Employment, and Migration

Unskilled workers in the economy may be employed either in the rural sector or in the urban sector, whereas skilled workers are employed only in the urban economy. We also assume that skilled workers who are unable to find a job in the formal sector do not opt to work in the informal economy, either because of a high perceived disutility of work there, or because they fear an adverse signaling effect on future employers.

Assuming profit maximization, and using the production function \( (2) \), the demand for labor in the rural sector is

\[
U_A^d = U_A^d(V_A, \frac{W_A}{PV_A}) = (1 - \eta_{XA})V_A^{1+\frac{\alpha_{XA}}{1-\eta_{XA}}} \cdot \frac{(1-\eta_{XA})PV_A}{W_A} \cdot \frac{\beta_{XA}}{\alpha_{XA}}^{1+\frac{\alpha_{XA}}{1-\eta_{XA}}}, \tag{15}
\]

where \( W_A \) denotes the nominal wage and \( PV_A \) the net output price in the rural sector.

Wages in the rural sector adjust to clear the labor market. Let \( U_{RUR}^s \) denote labor supply in rural areas; the equilibrium condition is thus given by

\[
U_{RUR}^s = U_A^d(V_A, \frac{W_A}{PV_A}). \tag{16}
\]

Over time, labor supply in the rural sector grows at an exogenous rate, \( g_{RUR} \), net of worker migration to urban areas, \( MIG \):

\[
U_{RUR}^s = U_{RUR, t-1}(1 + g_{RUR}) - MIG. \tag{17}
\]

In the tradition of Harris and Todaro (1970), we assume that the incentives to migrate depend negatively on the ratio of the average expected wage in the rural sector to that prevailing in the urban sector. Unskilled workers in the urban economy may be employed either in the private formal sector, in which case they are paid a wage \( W_{UP} \), or they can enter the informal...
economy and receive the going wage in that sector, \( W_I \).\(^{10}\) Assuming that unskilled workers in the private formal sector pay a social security tax at the rate \( s_{\text{tax}}^{U} \), the expected unskilled urban wage, \( EW_{\text{URB}} \), is thus a weighted average of \( (1 - s_{\text{tax}}^{U})W_{UP} \) and \( W_I \):

\[
EW_{\text{URB}} = \theta_U (1 - s_{\text{tax}}^{U})W_{UP} + (1 - \theta_U)W_{I,-1},
\]

(18)

where \( \theta_U \) is the probability of finding a job in the private urban formal sector, which is approximated by the proportion of unskilled workers actually employed in the private formal sector, \( U_P \), relative to the total number of unskilled urban workers looking for a job, \( U_s^{U} \), minus those employed in government, \( U_G \). Assuming a one-period lag yields

\[
\theta_U = \frac{U_{P,-1}}{U_s^{U,-1} - U_{G,-1}}.
\]

(19)

In the rural sector, the employment probability is equal to unity, because workers can always find a job at the going wage. Assuming a one-period lag, the expected rural wage is thus \( W_{A,-1} \).

The migration function can therefore be specified as

\[
MIG = U_{\text{RUR},-1}\lambda_M \left[ \sigma_M \ln \left( \frac{EW_{\text{URB}}}{W_{A,-1}} \right) \right] + (1 - \lambda_M)\frac{U_{\text{RUR},-1}}{U_{\text{RUR},-2}}MIG_{-1},
\]

(20)

where \( 0 < \lambda_M < 1 \) measures the speed of adjustment and \( \sigma_M > 0 \) measures the elasticity of migration flows with respect to expected wages. This specification assumes that costs associated with migration or other frictions may delay the migration process, introducing persistence in migration flows. Of course, other factors can be relevant in explaining these flows in Turkey. It has been argued, for instance, that the dramatic reductions in government subsidies to farming that started in the mid-1990s have made agriculture and the rural sector less and less attractive, encouraging rural-to-urban migration (see Tunali (2003)).\(^{11}\) This could be captured by defining subsidies as negative production taxes—which would raise value added prices (as discussed later) and affect rural wages, through the labor demand function (15) and the market equilibrium condition (16)).

\(^{10}\)As noted later, there is no job turnover for either category of workers in the public sector; the employment probability in that sector is therefore zero. Public sector wages therefore do not affect the expected urban wage.

\(^{11}\)Further reductions in subsidies to farming in agriculture may therefore continue to induce migration. Although this issue is beyond the scope of this paper, it has important implications for the design of fiscal adjustment.
2.2.2 The Urban Labor Market

In the urban sector, as noted earlier, both public and private production require skilled and unskilled labor, whereas production in the informal urban sector requires only unskilled labor. We consider, in turn, the determination of wages and employment for both categories of labor, and then the determination of wages through bargaining.

Public Employment and Wage Formation  Both skilled and unskilled employment in the public sector, $U_G$ and $S^*_G$, respectively, are considered exogenous.\textsuperscript{12} Wages of both categories or workers, $W_{UG}$ and $W_{SG}$, are assumed to be fully indexed on the urban consumption price index, $P_{URB}$:

\[
W_{jG} = \omega_{jG}P_{URB}, \quad j = U, S, \tag{21}
\]

where $\omega_{jG}$ is an exogenous real base wage.\textsuperscript{13}

Private Sector Wage Formation  To determine the skilled and unskilled wage rates in the private formal sector, $W_{UP}$ and $W_{SP}$, we assume direct bargaining between workers and employers over the nominal wage, as in Agénor (2003). Consider first the case of skilled workers. If a bargain is reached, each worker receives $W_{SP}$, whereas the producer receives $P_J m_S - W_{SP}$, where $W_{SP}^E$ is the effective cost of labor, defined as

\[
W_{SP}^E = (1 + IL)(1 + paytax_s)W_{SP},
\]

where $IL$ is the bank lending rate on domestic-currency loans, $paytax_s$ the payroll tax rate on skilled labor, and $m_s = \partial J_1(S_P, K_P)/\partial S_P$ the physical marginal product of the worker, given by (from equation (8)):

\[
m_S = \left(\frac{B_X P_1}{D_X P_1}\right)\left(\frac{J_1}{S_P}\right)^{1+\rho_X P_1}. \tag{22}
\]

\textsuperscript{12}A good theory of what determines the share of public employment in Turkey (as in many other developing countries) would involve considerations that are well beyond the scope of this paper.

\textsuperscript{13}To avoid a corner solution in which no worker wants to seek employment in the public sector, we assume that working for the government provides a nonpecuniary benefit (perhaps in terms of higher job security or reduced volatility of earnings) that is sufficiently large to ensure that the differential between $W_{jG}$ and $W_{jP}$, with $j = U, S$, is positive.
The Nash bargaining problem can be formulated as
\[
\max_{W_{SP}} (W_{SP} - \Omega_S)^{\nu_S} (PJ_1 m_S - W_{SP}^E)^{1-\nu_S}, \quad 0 < \nu_S < 1,
\]
where $\Omega_S$ is the worker’s reservation wage and $PJ_1 m_S - W_{SP}^E$ the firm’s bargaining surplus. $\nu_S$ measures the bargaining strength of a skilled worker relative to the firm. The first-order condition is given by
\[
\nu_S \frac{PJ_1 m_S - W_{SP}^E}{W_{SP} - \Omega_S} = \frac{(1 - \nu_S)(1 + IL)}{(1 + \text{paytax}_S)^{-1}} \left( \frac{PJ_1 m_S - W_{SP}^E}{W_{SP} - \Omega_S} \right)^{-\nu_S} - (1 - \nu_S)(1 + IL)(1 + \text{paytax}_S) = 0,
\]
that is,
\[
\nu_S \frac{PJ_1 m_S - W_{SP}^E}{W_{SP} - \Omega_S} - (1 - \nu_S)(1 + IL)(1 + \text{paytax}_S) = 0.
\]
From this equation, and given the definition of $W_{SP}^E$, the (equilibrium) negotiated wage can be derived as
\[
W_{SP} = (1 - \nu_S)\Omega_S + \frac{\nu_S PJ_1 m_S}{(1 + IL)(1 + \text{paytax}_S)}.
\]
which shows that the product wage is a weighted average of the reservation wage, $\Omega_S$, and the marginal product of labor adjusted for the cost of borrowing and payroll taxes. An increase in the cost of borrowing, or in the payroll tax rate, lowers the equilibrium wage.

We also assume that the worker’s reservation wage, $\Omega_S$, is related positively to wages in the public sector, $W_{SG}$, and the expected level of prices in the urban sector, (measured by the quantity $P_{URB,-1}(1 + EINFL)$, where $EINFL$ is the expected inflation rate), and negatively to the skilled unemployment rate, $UNEMP_S$.\(^\text{14}\) Wage-setting in the public sector is thus assumed to play a signaling role to wage setters in the rest of the economy, as discussed earlier. Given the exogeneity of public sector employment (which therefore cannot represent a job opportunity for those seeking employment),

\(^{14}\)Note that the reservation wage could be made a function of the unemployment benefit rate as well. However, an unemployment insurance scheme was introduced in Turkey only in August 1999; premium collections started in June 2000 and the first payments were made in March 2002. There is no evidence so far that these benefits have started to affect wage formation.
this signaling role may be the result of “fairness” considerations, rather than the perception of broader employment options.

The introduction of expected prices in the urban sector measures the extent to which the worker’s reservation wage is driven by the desire to maintain its real purchasing power. To the extent that expectations of inflation display persistence (as a result of low credibility, itself resulting perhaps from a higher risk of default on public debt, as discussed later), real wage inertia may result. When unemployment is high, the probability of finding a job (at any given wage) is low. Consequently, the higher the unemployment rate, the greater the incentive for the worker to moderate his or her wage demands. Thus

\[
\Omega_S = \Omega_{S0} \frac{W_{SG}^1[P_{URB} - 1(1 + E|N|FL)]^2}{UNEMP_S^3},
\]

where \( \Omega_{S0} > 0 \) and the \( \phi_k^S \) coefficients, with \( k = 1, 2, 3 \), are all positive. Equations (23) and (24) indicate that lower unemployment, higher public sector wages, and higher expected inflation raise the level of skilled wages in the private sector. The link between the levels of unemployment and private sector wages is consistent with the “wage curve” predicted by various efficiency wage models, and has received partial support in the empirical literature on labor markets in Turkey (see Ilkcaracan and Selim (2002)). This specification differs significantly from Phillips-curve type of wage equations, in which unemployment affects the rate of growth of nominal wages. To the extent that the expected inflation rate depends on past inflation (as documented in various studies on Turkey, such as Agénor (2002), Agénor and Bayraktar (2003), and Lim and Papi (1997)), our specification may generate some significant degree of real wage rigidity. And depending on the structure of the coefficients \( \phi_k^S \), a variety of alternative specifications of the behavior of skilled and unskilled wages can be obtained. For instance, to impose the assumption that the target wage for skilled workers is fully indexed on expected inflation and does not depend on any other variable would require setting \( \phi_1^S = \phi_3^S = 0 \) and \( \phi_2^S = 1 \).

To determine unskilled wages in the private formal sector, we also assume that workers are engaged in individual bargaining with firms. Following the same reasoning as above, the wage-setting equation is thus

\[
W_{UP} = (1 - \nu_U)\Omega_U + \frac{\nu_U PJ_{2mU}}{(1 + IL)(1 + paytax_U)}.
\]
where $paytax_U$ is the payroll tax rate on unskilled labor, $0 < \nu_U < 1$ measures the bargaining strength of unskilled workers and, from equation (9),

$$m_U = \left( \frac{\beta_{X_P^2}}{\alpha_{X_P^2}} \right) \left( \frac{J_2}{U_P} \right)^{1 + \rho_{X_P^2}}. \quad (26)$$

The reservation wage is now given by

$$\Omega_U = \Omega_{U0} \frac{W_{UG}^{\phi_U^1}[P_{URB,-1}(1 + EINFL)]^{\phi_U^2} W_M^{\phi_U^3}}{UNEMP_U^{\phi_U^4}}. \quad (27)$$

Equation (27) has the same structure as (24), with UNEMP$_U$ denoting the unskilled open unemployment rate, except for an additional term in $W_M$, the legally-set unskilled minimum wage. This specification aims to capture the signaling role that changes in the minimum wage may have on wage-setting in the private sector. Thus, the minimum wage is implicitly assumed to be non-binding; it could be made so by setting $\phi_U^k = 0$, for $k = 1, 2, 3$ $\phi_U^4 = \Omega_{U0} = 1$, and $\nu_U = 0$.

**Private Sector Employment, Labor Supply, and Skills Formation**

The demand for unskilled labor by firms in the formal private sector is determined by firms’ profit maximization subject to the wage set through bargaining with workers, $W_{UP}$, as determined above. These firms have access only to bank credit to finance their working capital needs. Specifically, they borrow to finance their wage bill (inclusive of payroll taxes) prior to the sale of output. Moreover, we assume that banks can borrow only in domestic currency to finance working capital needs, unlike borrowing for capital accumulation, which (as discussed later) can be done in either domestic or foreign currency. As a result, the effective price of labor includes the bank lending rate on domestic-currency loans, $IL$.

We assume also that firms pay a payroll tax, at the rate $0 < paytax_U < 1$ for unskilled workers, which is proportional to the wage bill, $W_{UP}$. The demand for unskilled labor by (and actual unskilled employment in) the private formal sector is thus given by

$$U_P^d = J_2 \left\{ \frac{P J_2}{(1 + IL)(1 + paytax_U)W_{UP}} \left( \frac{\beta_{X_P^2}}{\alpha_{X_P^2}} \right) \right\}^{\sigma_{X_P^2}}. \quad (28)$$

$^{15}$In Turkey, payroll taxes are paid both by employees (in the form of social security contributions) and employers; see Tunali (2003). We capture employee contributions in our definition of “take home” pay.
As in Agénor (2005a), mobility of the unskilled labor force between the formal and informal sectors is imperfect. Implicit in this assumption is the idea that the labor market in Turkey is characterized by the absence (or poor functioning) of institutions capable of processing and providing in a timely manner relevant information on job opportunities to potential applicants—particularly those with low levels of qualifications. As a result, low-skilled workers employed in the informal sector are unable to engage in on-the-job search. Looking for a job in the formal sector for that category of workers requires, literally, being physically present at the doors of potential employers.

Formally, migration flows between the formal and informal sectors are assumed to be determined (as for rural-urban migration) by expected income opportunities. Following a similar reasoning as before, the supply of unskilled workers in the formal sector thus evolves over time according to

\[
\frac{\Delta U^s_F}{U_I,-1} = \beta_F \left[ \sigma_F \ln \left\{ \frac{U^d_P,-1}{U^d_P,-1 - U^d_G,-1} \cdot \frac{1 - sstax_U}{W_{UP,-1}} \right\} \right] + (1 - \beta_F) \frac{\Delta U^s_F,-1}{U_I,-2},
\]

where \( \beta_F > 0 \) denotes the speed of adjustment and \( U^d_P,-1/(U^d_P,-1 - U^d_G,-1) \) measures the probability of being hired in the private sector, approximated by the ratio of employed workers to those seeking employment (with a one-period lag). Note that expected income in the private formal sector is measured net of social security taxes, as in (18)).

The rate of unskilled unemployment in the formal sector, \( UNEMP_U \), is thus given by

\[
UNEMP_U = 1 - \frac{(U_G + U^d_P)}{U^s_F}. \tag{30}
\]

The supply of labor in the informal economy, \( U^s_I \), is obtained by subtracting from the urban unskilled labor force, \( U_U \), the quantity \( U^s_F \):

\[
U^s_I = U^s_U - U^s_F. \tag{31}
\]

The informal labor market clears continuously, so that \( U^d_I = U^s_I \). From equations (6) and (31), the equilibrium wage is thus given by\(^{16}\)

\[
W_I = \beta_{X1} \left( \frac{PV_I \cdot V_I}{U^s_I} \right). \tag{32}
\]

\(^{16}\)To ensure that unskilled urban workers will always seek employment in the private formal sector first, we assume throughout that \( W_I < W_{UP} \).
The urban unskilled labor supply, \( U^e_{URB} \), increases as a result of exogenous growth (at the rate \( g_{URB} \)), and rural-to-urban migration, net of “outflows” due to skills acquisition, \( SKL \):
\[
U^e_{URB} = U^e_{URB,-1}(1 + g_{URB}) + MIG - SKL - IMIG. \tag{33}
\]

As noted earlier, private urban firms pay a payroll tax, at the rate \( 0 < paytax_S < 1 \), on their skilled wage bill, \( W_{SP} \). From (8), the demand for skilled labor in the private formal sector is therefore given by
\[
S^d_P = J_1 \left\{ \frac{PJ_1}{(1 + IL)(1 + paytax_S)W_{SP}} \left( \frac{\beta_{X_P^1}}{\alpha_{X_P^1}} \right)^{X_{P^1}} \right\}. \tag{34}
\]

As noted earlier, skilled workers who are unable to find a job in the formal economy opt to remain openly unemployed, instead of entering the informal economy. The rate of skilled unemployment, \( UNEMP_S \), is thus given by the ratio of skilled workers who are not employed either by the private or the public sector, divided by the total population of skilled workers:
\[
UNEMP_S = 1 - \frac{(S^T_G + S^d_P)}{S}, \tag{35}
\]
where \( S^T_G \) is total skilled employment in the public sector, defined as
\[
S^T_G = S_G + S^E_G, \tag{36}
\]
with \( S^E_G \) denoting the exogenous number of skilled workers involved in providing education.

The acquisition of skills by unskilled workers takes place through an education system operated (free of charge) by the public sector.\(^{17}\) Specifically, the flow of unskilled workers who become skilled, \( SKL \), is taken to be a CES function of the number of skilled workers (teachers) in the public sector engaged in providing education, \( S^E_G \), and the government stock of capital in education, \( K_{EDU} \):
\[
SKL = [\beta_E S^E_G^{-\rho_E} + (1 - \beta_E)K_{EDU}^{-\rho_E}]^{-\frac{1}{\rho_E}}. \tag{37}
\]
\(^{17}\)Note that we abstract from the cost of acquiring skills (as measured by the number of years of schooling multiplied by the average cost of education per year), which should also affect the propensity to invest in skills acquisition. We also do not account from privately-provided education. During the 1980s and 1990s, several new private universities were founded in Turkey. However, they still account for only a small fraction of the graduates produced by the higher education system as a whole.
The evolution of the skilled labor force depends on the rate at which unskilled workers acquire skills:

\[ S = (1 - \delta_S)S_{-1} + SKL, \]  

(38)

where \( 0 < \delta_S < 1 \) is the rate of “depreciation” of the skilled labor force.

### 2.2.3 International Labor Migration

In line with the evidence on international migration flows in Turkey, we assume that migrants are essentially unskilled workers, and that all potential migrants are in the urban sector (as captured in (33)). Moreover, international migration flows are taken to be determined by the expected urban wage for unskilled labor, \( EW_{URB} \), given by (18), relative to the foreign wage measured in domestic-currency terms, \( EW_F \). Assuming a one-period lag, we have

\[ EW_F = ER_{-1} \cdot W_{F,-1}, \]

with \( W_F \) denoting the foreign wage measured in foreign-currency terms, which is assumed exogenous. Adopting a specification similar to (20), the migration function is specified as

\[ IMIG = U_{URB,-1}\lambda_{IM} \left[ \sigma_{IM} \ln \left( \frac{ER_{-1} \cdot W_{F,-1}}{EW_{URB}} \right) \right] + (1 - \lambda_{IM}) \frac{U_{URB,-1}}{U_{URB,-2}} IMIG_{-1}, \]  

(39)

where \( 0 < \lambda_{IM} < 1 \) measures the speed of adjustment, and \( \sigma_{IM} > 0 \) the partial elasticity of migration flows with respect to expected wages. Because the employment probability affects the expected domestic wage, the prevailing unskilled unemployment rate in the formal urban sector affects indirectly the decision to migrate. Again, costs associated with migration (such as relocation costs) are assumed to introduce some degree of persistence. As discussed later, remittances associated with international migration flows of unskilled labor are assumed to benefit unskilled households in the urban formal and informal sectors.

### 2.3 Export Supply and Import Demand

Given the CET functions (3) and (11), the efficient allocation of production between domestic sales and exports in the rural and private urban formal
sectors yields export supply equations that depend on the price of exports ($PE_A$ and $PE_P$, respectively) vis-à-vis domestic prices ($PD_A$ and $PD_P$, respectively):

$$E_i = D_i \left( \frac{PE_i}{PD_i} \cdot \frac{1 - \beta_{ED_i}}{\beta_{ED_i}} \right)^{\sigma_{ED_i}}, \quad i = A, P. \quad (40)$$

Imports in both of these sectors compete with domestic goods. In the Armington tradition, both categories of goods are combined through CES aggregation functions to give composite goods, $Q_i^s$:

$$Q_i^s = \alpha_Q \{ \beta_Q D_i^{-\rho_Q_i} + (1 - \beta_Q_i)M_i^{-\rho_Q_i} \}^{-\frac{1}{\rho_Q_i}}, \quad i = A, P. \quad (41)$$

Assuming cost minimization, import demand for both sectors, $M_A$ and $M_P$, can be written solely as a function of relative prices:

$$M_i = D_i \left( \frac{PD_i}{PM_i} \cdot \frac{\beta_{Qi}}{1 - \beta_{Qi}} \right)^{\sigma_{Qi}}, \quad i = A, P, \quad (42)$$

where $PM_i$ is the domestic price of imports (inclusive of tariffs) and $\sigma_{Qi} = 1/(1 + \rho_{Q_i})$ the elasticity of substitution between domestic and imported goods.

### 2.4 Aggregate Supply and Demand

As noted earlier (see equation (41)), supply of rural and private urban formal sector goods consists of composite goods, which combine imports and domestically produced goods. Both the informal and public sector goods are nontraded; total supply in each sector is thus equal to gross production, that is

$$Q_i^s = X_i, \quad i = I, G. \quad (43)$$

Aggregate demand in the rural and informal sectors, $Q_A^d$ and $Q_I^d$, consists of intermediate consumption and demand for final consumption—by both the government and households for the former, $C_A$ and $G_A$, and by households only in the latter, $C_I$ (the government does not spend on informal sector goods). Aggregate demand for the public and private goods, $Q_G^d$ and $Q_P^d$, consists not only of intermediate consumption and final consumption, but
also of investment demand by private firms in the urban formal sector, $Z^G_F$ and $Z^P_F$, and the government, $Z_G$:

\[ Q^d_A = C_A + G_A + INT_A, \]  
\[ Q^d_I = C_I + INT_I, \]  
\[ Q^d_G = C_G + G_G + Z^G_F + INT_G, \]  
\[ Q^d_P = C_P + G_P + Z^P_F + Z_G + INT_P, \]

where $INT_j$ is defined as total demand (by all $i$ productions sectors) for intermediate consumption of good $j$:

\[ INT_j = \sum_i a_{ji}X_i. \]

Total real government consumption of goods and services, $G$, is allocated in fixed proportions to the rural, private formal, and public goods:

\[ G_i = gg_i \frac{PG \cdot G}{PC_i}, \quad \text{for } i = A, P, G, \]

where $PG$ is the government consumption deflator, and $PC_i$ the sales price of good $i$, and $\sum_i gg_i = 1$.

Private final consumption for each production sector $i$, $C_i$, is the summation across all categories of households of nominal consumption of good $i$, deflated by the sales price of good $i$:

\[ C_i = \sum_h C_{ih} = \sum_h x_{ih} + \sum_h cc_{ih}(CON_h - \sum_i PC_i x_{ih}), \]

where $C_{ih}$ is consumption of good $i$ by household $h$, $x_{ih}$ is the autonomous level of consumption of good $i$ by household $h$, and $CON_h$ total nominal consumption expenditure by household $h$. Equations (50) are based on the linear expenditure system. Coefficients $cc_{ih}$ indicate how total consumption expenditure by household $h$ is allocated to each type of good. They satisfy the usual restrictions, $0 < cc_{ih} < 1$ and $\sum_i cc_{ih} = 1, \forall h$.

Private investment by urban formal sector firms, $Z_P$, is allocated between purchases of both public services and private goods ($Z^G_F$ and $Z^P_F$, respectively):

\[ Z^i_P = zz_i \frac{PK \cdot Z_P}{PC_i}, \quad zz_G + zz_P = 1, \]

where $PK$ is the price of capital goods.
2.5 Profits and Income

Firms’ profits in the rural and urban informal sectors are given by

$$PROF_i = PV_i V_i - W_i U_i, \text{ for } i = A, I.$$  \hspace{1cm} (52)

In addition to wages paid to both categories of workers, firms in the private formal urban sector are subject to payroll taxes and pay interest on the loans that they receive for working capital needs. Their profits are thus

$$PROF_P = PV_P V_P - (1 + IL)(1 + paytax_U)W_M U_P + (1 + paytax_S)W_S S_P.$$  \hspace{1cm} (53)

Firms in the formal urban economy also pay income taxes and interest on their domestic and foreign borrowing, which serves to finance investment. Their income therefore differs from profits, and is given by

$$YF_P = (1 - ftax_P)PROF_P - IL \cdot DL_{P,-1} - ILF \cdot DLF_{P,-1} - IF^W \cdot ER \cdot FL_{P,-1},$$  \hspace{1cm} (54)

where $ftax_P$ is the corporate income tax rate, $DL_P$ and $DLF_P$ are investment-related domestic- and foreign-currency loans allocated by domestic banks, $FL_P$ foreign borrowing for the purpose also of physical capital accumulation, $ILF$ the interest rate charged on foreign-currency loans by domestic banks, and $IF^W$ the interest rate on foreign loans.

Profits from public production are given by

$$PROF_G = PV_G V_G - (1 + paytax_U)W_{UG} U_G - (1 + paytax_S)W_{SG} S_G.$$  \hspace{1cm} (55)

Commercial banks’ profits, $PROF_B$, are defined as the difference between revenues from loans to firms (be it for working capital or investment needs, in domestic and foreign currencies) and formal sector households, $DL_F$, income from government bonds (perpetuities, whose nominal price is assumed fixed at unity), and interest payments on borrowing from the central bank plus interest payments on both households’ deposits (denominated in domestic and foreign currencies) and foreign loans:

$$PROF_B = IL \cdot (DL_{P,-1} + DLF_{-1}) + ILF \cdot DLF_{P,-1} + IL \cdot [(1 + paytax_U)W_M U_P + (1 + paytax_S)W_S S_P] + IB \cdot GB^T_{B,-1},$$

$$-IR \cdot DL_{B,-1} - ID \sum_h DD_{h,-1} - IDF \cdot ER \sum_h FD_{h,-1} - IF^W \cdot ER \cdot FL_{B,-1},$$ \hspace{1cm} (56)
where $IR$ (respectively $ID$) is the interest rate on central bank financing (respectively domestic-currency denominated bank deposits), $IB$ the nominal rate of return on government bonds, $IDF$ the domestic interest rate on foreign-currency deposits held in the domestic banking system by each category of household $h$, $FD_h$, $GB^T_B$ total government bond holdings by commercial banks, $DL_B$ (respectively $FL_B$) borrowing from the central bank (respectively abroad), and $DD_h$ domestic-currency deposits by household $h$.

We assume that there are four categories of households in the economy. *Rural households*, identified with the sub-index $A$, consist of all workers employed in the rural sector. *Informal sector households*, identified with the sub-index $I$, consist of all the (unskilled) workers employed in the informal economy. *Formal sector households*, identified with the sub-index $F$, consist of all workers (skilled and unskilled) employed in the formal sector, both public and private. For all three groups, income is based on the return to labor (salaries), distributed profits, government transfers, remittances from abroad, and interest receipts on holdings of financial assets (net of borrowing from domestic banks). The fourth group consists of *profit earners*, identified with the sub-index $E$, whose income comes from firms’ net earnings in the rural and formal private sectors, profits of commercial banks, interest on deposits, and government transfers.

Profits from rural production are assumed to be distributed in proportion $0 < shp_A < 1$ to rural households and $1 - shp_A$ to (urban) profit earners. Using (52), income of rural households is given by

$$YH_A = W_A U_A + shp_A PROF_A + \gamma_A TRH + ID \cdot DD_{A,-1},$$

(57)

where $0 < \gamma_h < 1$ is the portion of total government transfers ($TRH$) each household $h$ receives, so that $\sum_h \gamma_h = 1$, and $DD_h$ domestic-currency deposits in domestic banks by households $h$. Rural and informal sector households are assumed not to hold foreign-currency deposits, either domestically or abroad.

To capture the fact that firms in the informal urban sector tend to be small, family-owned enterprises, we assume that households in that sector own the firms in which they are employed. Using again (52), income of the informal sector households is given by

$$YH_I = PV_I V_I + \gamma_I TRH + ID \cdot DD_{I,-1} + \tau_I ER \cdot REMIT,$$

(58)

where $REMIT$ measures the foreign-currency value of the flow of remittances.
from (unskilled) workers employed abroad, and $0 < \tau_I < 1$ the fraction of these remittances that are allocated to households in the informal economy.

Income of the formal sector household consists of net salaries (that is, take-home pay) collected from private firms and the government, income from formal sector firms, transfers from the government, remittances from abroad, and interest receipts on deposits (in domestic and foreign currency, held both domestically and abroad), net of interest payments on borrowing from commercial banks:

$$Y_{HF} = (1 - \text{sstat}_U) \sum_{j \in P,G} W_{U_j} U_j + (1 - \text{sstat}_S) \sum_{j \in P,G} W_{S_j} S_j + \text{shp}_F^E Y_{FP}$$

$$+ W_{SG} S_G^E + \gamma_F \text{TRH} + ID \cdot DD_{F,-1} + ER(\text{IDF} \cdot FD_{F,-1} + IF_{RF}^W FD_{F,-1}^W)$$

$$- IL \cdot DL_{F,-1} + (1 - \tau_I)ER \cdot \text{REMIT},$$

where $0 < \text{shp}_F^E \leq 1$ is the share of private formal sector firms’ net income distributed to households in that sector, $FD_f$ foreign-currency deposits held domestically, $IF_{RF}^W$ the risk-free foreign interest rate on foreign-currency deposits held abroad by household $h$, $FD_{W,h}$, and $DL_F$ domestic borrowing from commercial banks. $\text{sstat}_U$ and $\text{sstat}_S$ are the social security taxes (assumed proportional to the wage) that workers employed in the private formal sector must pay.

Profit earners receive a fraction $0 < \text{shp}_P^E \leq 1 - \text{shp}_P^F$ of private formal sector firms’ retained earnings, as well as a share $1 - \text{shp}_A$ of profits from the rural sector, a share $0 < \text{shp}_B^E < 1$ of commercial banks’ income, $\text{PROF}_B$, and interest on bank deposits (held both domestically and abroad). Thus, profit earners’ income is:

$$Y_{HE} = (1 - \text{shp}_A) \text{PROF}_A + \text{shp}_P^E Y_{FP} + \text{shp}_P^E \text{PROF}_B$$

$$+ \gamma_E \text{TRH} + ID \cdot DD_{E,-1} + ER(\text{IDF} \cdot FD_{E,-1} + IF_{RF}^W FD_{E,-1}^W) + IB \cdot GB_{E,-1},$$

where $GB_E$ denotes government bond holdings by profit earners, who are the only category of households to hold such bonds. Note also that profit earners do not borrow directly from commercial banks or abroad.

### 2.6 Savings and Wealth Accumulation

Each category of household $h$ saves a fraction, $0 < \text{srate}_h < 1$, of its disposable income:

$$SAV_h = \text{srate}_h (1 - \text{inctax}_h) Y_{H_h},$$

$$27$$
where $0 < inctax_h < 1$ is the income tax rate applicable to household category $h$.

The savings rate is a positive function of the expected real interest rate on domestic-currency deposits:

$$srate_h = s^h_0 \left( \frac{1 + ID}{1 + EINFL} \right)^{\sigma^{h}_{SAV}}, \quad s^h_0 > 0.$$  \hfill (62)

In principle, given the portfolio structure described later, the expected rate of return on other interest-bearing assets should also affect the propensity to save. However, as illustrated in Figure 3, the evidence for Turkey suggests that it is mostly the real interest rate on domestic-currency deposits that matters for private savings (see Ozcan, Gunay, and Ertac (2003)). For simplicity, we therefore chose to exclude other rates of return from our specification.

The portion of disposable income that is not saved is allocated to consumption:

$$CON_h = (1 - inctax_h)YH_h - SAV_h.$$  \hfill (63)

The total flow of savings of each household category is channeled into the accumulation of financial wealth, $WT_h$, which also accounts for valuation effects on the stock of foreign-currency deposits held domestically and abroad, $FD_h$ and $FD^W_h$, associated with changes in the nominal exchange rate:

$$WT_h = WT_{h, -1} + SAV_h + \Delta ER \cdot (FD_{h, -1} + FD^W_{h, -1}),$$  \hfill (64)

with $FD_h = FD^W_h = 0$ for $h = A, I$.

### 2.7 Private Investment

The determinants of private investment in Turkey have been the subject of a large literature, going back to, among others, Chibber and van Wijnbergen (1992), and including more recently studies by Guncavdi, Bleaney, and McKay (1998, 1999) and Erden (2002). Chibber and van Wijnbergen (1992), in a study over the period 1970-86, found that private investment in Turkey depends positively on the rate of capacity utilization (which captures aggregate demand pressures) and the ratio of private sector credit to GNP, and negatively on the real effective cost of borrowing and non-infrastructure
public investment (which captures crowding out effects associated with public spending). Guncavdi, Bleaney, and McKay (1998) developed an error-correction model in which private investment depends in the long run on output and the relative cost of capital (as measured by the ratio of the cost of credit to the wage rate), but can be influenced in the short run by the availability of bank credit. Focusing on the period 1963-92, they found that, following the financial liberalization program implemented in the early 1980s, private investment in Turkey became less sensitive to credit supply and somewhat more sensitive to the cost of capital. By contrast, Erden (2002), in a study over the period 1968-98, found that both credit availability and uncertainty over the cost of credit (rather than its level) affect private investment, the first positively, and the second negatively. In a study covering the period 1968-94, Guncavdi, Bleaney, and McKay (1999) found that financial liberalization (as measured by a dummy coefficient for the post-1980 period) appears to have had an adverse effect on investment by raising the relative cost of capital, and a positive effect by reducing credit constraints. They also find evidence of a strong accelerator effect (in both the short and the long run) and overall public investment appears to have a significant, negative effect on private capital formation.

The specification of the determinants of private investment in our model dwells on these results. As noted earlier, only firms in the private formal urban sector invest in physical capital; their desired rate of capital accumulation is assumed to depend on several factors. The first is the public capital stock in infrastructure (in proportion of the urban labor force), which has a positive impact, through its complementarity effect. The second is the growth rate of real GDP, which captures the conventional accelerator effect. The third is the expected real cost of borrowing from domestic banks, which has a negative effect. Figure 4 illustrates well the positive correlation between changes in private investment and real output growth (the accelerator effect), as well as the tendency for private capital formation to evolve in opposite direction to movements in real interest rates.

18 Neither one of these two studies accounts for the impact of public investment, as in Chhibber and van Wijnbergen (1992). In addition, both studies use deposit rates to measure the cost of credit—a debatable assumption, as discussed subsequently.

19 See Agénor and Montiel (1999) and Agénor (2004, Chapter 2) for a detailed discussion of this effect and a review of the empirical evidence in general.

20 In Figure 3 the deposit rate is used instead of the lending rate, because we do not have sufficiently long time series on the latter variable. This is far from being a good proxy for
We do not account explicitly for the quantity of credit, in addition to its cost, in our specification of the investment function, for two reasons. First, the evidence provided by Guncavdi, Bleaney, and McKay (1999), as well as others, suggests that the impact of credit constraints on investment is less significant nowadays than was the case in the early 1980s, following financial reforms; at the same time, the (expected) cost of credit appears to have become a more important consideration for firms. Second, even in the context of the recent crisis, there is no strong evidence that the fall in credit to private sector firms (at least the bigger ones) resulted from a credit crunch, that is, a supply-induced contraction in lending; on the contrary, a recent study by the World Bank (2003) suggests that demand-side factors (high interest rates, low economic activity) were largely to blame. In fact, as discussed later, we assume that the supply of bank loans to private sector firms is perfectly elastic at the prevailing interest rate, and that only formal sector households are subject to credit rationing.

Formally, the desired level of investment, \( Z^d_p \), is given by

\[
\frac{PK \cdot Z^d_p}{NGDP_{-1}} = \left( \frac{K_{INF}}{U_{URB} + S} \right)^\sigma_{KINF} (1 + \frac{\Delta RGDP_{-1}}{RGDP_{-2}})^\sigma_{ACC} \left( \frac{1 + IL}{1 + EINFL} \right)^{-\sigma IL},
\]

(65)

where \( NGDP \) is nominal GDP at market prices, defined as the sum of value added and indirect taxes on goods and services (including tariff revenue):

\[
NGDP = \sum_i PV_i + INDTAX,
\]

or equivalently, as the sum of expenditure and net exports:

\[
NGDP = \sum_i PC_i(C_i + G_i + Z^i_p) + Z_G + ER(wpe_iE_i - wpm_iM_i). \quad (66)
\]

Real GDP, \( RGDP \), is defined as, using base-period prices:

\[
RGDP = \sum_i PC_{i,0}(C_i + G_i + Z^i_p) + Z_G + ER_0(wpe_{i,0}E_i - wpm_{i,0}M_i), \quad (67)
\]

the cost of credit, for reasons that we discuss later on.

\(^{21}\)It should be noted that Sancak (2002) did not find any evidence that financial liberalization led to a relaxation of the borrowing constraints faced by Turkish firms in the 1980s and 1990s. However, the methodology that he used to test for structural breaks is rather weak.
where $Z^i_P = 0$ for $i = A, I, G_i = 0$ for $i = I$, and $E_i = 0$ for $i = I, G$.

Actual investment adjusts to its desired level through a partial adjustment mechanism:

$$
\Delta \left( \frac{PK \cdot Z_P}{NGDP_{-1}} \right) = \lambda_{PINV} \left( \frac{PK \cdot Z^d_P}{NGDP_{-1}} - \frac{PK_{-1} \cdot Z_{P,-1}}{NGDP_{-2}} \right),
$$

where $0 < \lambda_{PINV} < 1$.

The private capital stock depends on the flow level of investment and the depreciation rate of capital from the previous period, $0 < \delta_P < 1$:

$$
K_P = K_{P,-1}(1 - \delta_P) + Z_{P,-1}. \tag{68}
$$

### 2.8 Asset Allocation and the Credit Market

We consider in turn the determination of the portfolio structure of each category of households, the demand for credit by firms, and the behavior of commercial banks. The balance sheets of all agents (including the central bank and the consolidated public sector) are summarized in Table 1.

#### 2.8.1 Households

Households’ financial wealth is allocated to five categories of assets: domestic money (cash holdings, which bear no interest), $H_h$, domestic currency-denominated bank deposits held at home, $DD_h$, foreign currency-denominated deposits held domestically, $FD_h$, foreign currency-denominated deposits held abroad, $FD^W_h$, and holdings of government bonds, $GB_h$. By allowing households to hold foreign-currency denominated deposits in the domestic banking system, we therefore account for the high level of dollarized liabilities of the Turkish financial system. Indeed, as shown in Figure 1, such deposits continue to account for a sizable share of total bank deposits in Turkey.\(^{22}\)

Given liabilities of $DL_h$, net financial wealth, $WT_h$, is defined as

$$
WT_h = H_h + ER(FD_h + FD^W_h) + DD_h + GB_h - DL_h. \tag{69}
$$

As noted earlier, rural and informal sector households hold no foreign-currency deposits, banks lend only to urban formal sector households (in

\(^{22}\)See Civcir (2002) for a discussion of dollarization in Turkey. Note that our specification of dollarization on the asset side of banks’ balance sheets accounts only for foreign-currency denominated loans to firms, not households.
addition to formal sector firms), and only profit earners hold government bonds. Thus, in the above equation, \( FD_h = FD^W_h = 0 \) for \( h = A, I \), \( DL_h = 0 \) for \( h \neq F \), and \( GB_h = 0 \) for \( h \neq E \).

The demand function for currency by each household \( h \) is taken to be positively related to consumption of that group (to capture a transactions motive), \( CON_h \), and negatively to expected inflation, \( EINFL \), and the interest rate on domestic-currency deposits, \( ID \). In addition, for formal sector households and profit earners, it also depends negatively on the rate of return on foreign-currency denominated assets, defined as a weighted average of the interest rates on foreign-currency deposits held at home and abroad, \( 1 + IDF \) and \( 1 + IF^W_{RF} \), with both rates adjusted for the expected rate of depreciation, \( 1 + EDEPR \):\(^{23}\)

\[
H^d_h = \frac{CON^\theta h_{CON} EINFL^{-\theta h_{EINFL}}(1 + ID)^{-\theta h_{DD}}}{\{(1 + IDF)(1 + EDEPR)^{\theta h_{IF}}[(1 + IF^W_{RF})(1 + EDEPR)]^{1-\kappa h_{IF}}\}}^{\theta h_{IF}}.
\]

or equivalently

\[
H^d_h = \frac{CON^\theta h_{CON} EINFL^{-\theta h_{EINFL}}(1 + ID)^{-\theta h_{DD}}}{(1 + EDEPR)(1 + IDF)^{\theta h_{IF}}[(1 + IF^W_{RF})^{1-\kappa h_{IF}}]}^{\theta h_{IF}}, \quad (70)
\]

where \( \theta h_{IF} = 0 \) for \( h = A, I \). The coefficient \( \kappa h_{FD} \) is the relative weight attached to the domestic interest rate on foreign-currency deposits held at home in the overall measure of the rate of return on foreign-currency denominated assets. It is calculated as the relative share of these deposits in the previous period:

\[
\kappa h_{FD} = \frac{FD_{h,-1}}{FD_{h,-1} + FD^W_{h,-1}}, \quad h = F, E. \quad (71)
\]

The total demand for cash is thus

\[
H^d = \sum_h H^d_h, \quad (72)
\]

\(^{23}\)Note that in equation (70), as well as in (74), (75) and (76), it is the risk-free world interest rate (which is the relevant measure of the rate of return for lenders) that appears.
To determine the allocation of bank deposits, we must distinguish between rural and urban informal sector households, on the one hand, and formal sector households and profit earners, on the other. For the first group, which holds no foreign-currency deposits, no government bonds, and does not borrow from banks, the demand for domestic-currency deposits can be obtained from the wealth equation (69), given that \((64)\) determines \(W^d_h\) and \((70)\) determines the demand for currency:

\[
DD^d_h = W^d_h - H^d_h, \quad h = A, I.
\] (73)

For formal sector households and profit earners, we assume that portfolio choices follow a two-step process similar to the one described in Agénor and Khan (1996). First, households determine the allocation between domestic- and total foreign-currency denominated deposits (held either at home or abroad). Second, they decide how to allocate total foreign-currency denominated deposits between deposits in the domestic banking system and deposits abroad.

Formally, in the first stage formal sector households and profit earners determine the ratio \(DD^d_h/ER(FD^d_h + FD^W_h)\) as a function of the interest rate on domestic-currency deposits, on the one hand, and the overall rate of return on foreign-currency denominated assets, defined again as a weighted average of the rates of return on foreign-currency deposits held at home and abroad:

\[
\frac{DD^d_h}{ER(FD^d_h + FD^W_h)} = \left\{ \frac{1 + ID}{(1 + EDEPR)(1 + IDF^{FD})(1 + IF_{RF}^{W})^{1 - \kappa^{FD}_h}} \right\}^{\frac{\theta}{DD^d_h}},
\] (74)

where \(h = F, E\) and \(\kappa^{FD}_h\) is as defined earlier.\(^{24}\)

In the second stage, the allocation of foreign-currency denominated deposits between home and abroad is given by

\[
\frac{FD^d_h}{FD^W_h} = \left( \frac{1 + IDF^{FD}}{1 + IF_{RF}^{W}} \right)^{\frac{\theta}{FD^d_h}}, \quad h = F, E,
\] (75)

which does not depend on exchange rate expectations.

\(^{24}\)For profit earners, both the demand for cash (equation (70)) and the relative demand for domestic-currency deposits (equation (74)) could also be specified as negatively related to the expected rate of return on government bonds.
The second-stage portfolio decision is generally non-trivial because households may not be indifferent as to the location of their deposits as a result, for instance, of high transactions costs associated with shifting funds across borders, or a perceived risk of confiscation—which could take for instance the form of a forced conversion of foreign-currency deposits held in domestic banks into assets denominated in domestic currency. If formal sector households and profit earners were indifferent as to the location of their foreign-currency deposits, \( FD_h \) and \( FD^W_h \) would be perfect substitutes. In that case \( \theta_{FD}^h \to \infty \) and, in the absence of capital controls, the following interest rate parity condition would hold exactly:

\[
1 + IDF = 1 + IF^W_{RF}. 
\]

This condition implies that the interest rate on foreign-currency denominated deposits at home cannot deviate from the world risk-free interest rate. In general, however, we will assume that foreign-currency deposits at home and abroad are imperfect substitutes, and that (as discussed later) \( IDF \) is set domestically by commercial banks.

The demand for government bonds by profit earners, \( GB^d_E \), measured as a proportion of interest-bearing wealth, depends on rates of returns on all interest-bearing assets:

\[
\frac{GB^d_E}{WT_E - H_E} = \frac{(1 + EIB)^{\theta_{GB}^E} (1 + ID)^{-\theta_{DD}^E}}{[(1 + EDEPR)(1 + IDF)^{\kappa_{FD}^E} (1 + IF^W_{RF})^{1 - \kappa_{FD}^E}]^{\theta_{FD}^E}}, \tag{76}
\]

where \( \kappa_{FD}^E \) is defined in (71) and \( EIB \) is the expected rate of return on government bonds.

Note that, given (64), (70), (74), (75), and (76), the budget constraint (69) can be used to determine residually the demand for one of the four interest-bearing assets by profit earners—for instance the demand for domestic-currency bank deposits, in a manner similar to equation (73) for rural and informal sector households:

\[
DD_E = WT_E - H_E - ER(FD_E + FD^W_E) - GB_E. 
\]

Similarly, for formal sector households,

\[
DD_F = WT_F - H_F - ER(FD_F + FD^W_F) + DL_F. 
\]
2.8.2 Firms

Domestic firms borrow both domestically (in domestic and foreign currencies) and abroad not only to finance their working capital needs, as discussed earlier, but also to finance their investment plans. Borrowing on world capital markets, $FL_P$, is treated as exogenous. Taking into account retained earnings, the investment financing constraint requires that

$$PK \cdot Z_P = (1 - shp_p^F - shp_p^E)YF_P + \Delta DL_P^T + ER \cdot \Delta FL_P,$$

where $DL_P^T$ represents total domestic borrowing from commercial banks.

Equation (77) can be solved for $DL_P^T$, that is, total demand for bank loans:

$$DL_P^T = DL_{P,-1}^T + PK \cdot Z_P - (1 - shp_p^F - shp_p^E)YF_P - ER \cdot \Delta FL_P. \quad (78)$$

2.8.3 Commercial Banks

The balance sheet of commercial banks shows, on the asset side, loans to formal sector households and private formal sector firms for investment purposes, $DL_F + DL_P^T$, holdings of government bonds, $GB^T_B$, and reserve requirements at the central bank, $RR$. On the liability side, it accounts for domestic- and foreign-currency deposits by the public, $\sum_h (DD_h + ER \cdot FD_h)$, borrowing from the central bank, $DL_B$, and foreign loans (measured in domestic-currency terms), $ER \cdot FL_B$. With $NW_B$ denoting commercial banks’ net worth, their balance sheet can be written as

$$DL_F + DL_P^T + GB^T_B + RR - NW_B = \sum_h (DD_h + ER \cdot FD_h) + DL_B + ER \cdot FL_B. \quad (79)$$

Reserve requirements are assumed to be levied at the same proportional rate on both domestic- and foreign-currency denominated deposits:

$$RR = req \sum_h (DD_h + ER \cdot FD_h), \quad (80)$$

where $0 < req < 1$ is the (effective) reserve requirement rate. For simplicity, banks are assumed to hold no excess liquid reserves.

Firms’ total domestic borrowing from commercial banks is defined as

$$DL_P^T = DL_P + ER \cdot DLF_P,$$
which implies, using (78),

\[ DL_P = DL_P^T - ER \cdot DLF_P. \]  

(81)

Foreign-currency loans to domestic firms are assumed to remain constant relative to banks’ foreign currency liabilities, which consist of foreign borrowing and foreign currency deposits from households:

\[ ER \cdot DLF_P = \phi_{DL}(FL_B + \sum_h ER \cdot FD_h). \]  

(82)

Commercial banks’ holdings of government bonds, \( GB_B^T \), are made up of two components:

\[ GB_B^T = GB_B^p + GB_B^d, \]  

(83)

where \( GB_B^p \) is direct placement of bonds by the government and \( GB_B^d \) is additional commercial banks’ demand for bonds. Direct bond placement with commercial banks is given as a constant share of the total outstanding stock of government bonds:

\[ GB_B^p = \phi_{GB}^B \cdot GB^s, \quad \phi_{GB}^B > 0. \]  

(84)

The additional demand for government bonds by commercial banks (as a ratio of net wealth) is positively related to the interest rate on these bonds and negatively to their opportunity cost, that is, the lending rate:

\[ GB_B^d NW_B = \phi_{GB}^{dB} (1 + EIB) \frac{1 + IL}{1 + IL} \theta_{GB}^B, \quad \phi_{GB}^{dB} > 0, \]  

(85)

where \( EIB \) is again the expected rate of return on government bonds. We assume that due to existing banking regulations, domestic banks cannot choose to allocate freely a fraction of their wealth to holdings of foreign bonds; as a result, we exclude the rate of return on foreign-currency assets from (85).

The demand for foreign loans by commercial banks depends on the cost of domestic funding from households and the central bank, in addition to the (premium-inclusive) cost of foreign borrowing. Given the arbitrage conditions described later (equations (89) and (91)), this demand function can be specified only as a function of the official interest rate, \( IR \), and the world

\[ 25 \] This placement rule can be thought of as accounting for the bonds held by public banks, which are not explicitly modelled.
interest rate (inclusive of the external risk premium), $IF^W$, adjusted for expected depreciation:

$$\frac{ER \cdot FL_B}{NW_B} = \phi_{FL}^B \left[ \frac{1 + IR}{(1 + IF^W)(1 + EDEPR)} \right]^\theta_{FL}, \quad \phi_{FL}^B > 0. \quad (86)$$

This equation implies that if domestic and foreign borrowing are perfect substitutes (that is, $\theta_{FL}^B \to \infty$), then the central bank’s refinancing rate cannot deviate from the premium-inclusive, and expectations-adjusted, world interest rate:

$$1 + IR = (1 + IF^W)(1 + EDEPR).$$

As indicated earlier, banks’ net income is distributed in proportion $shp_B^E$ to profit earners. Commercial banks’ net worth therefore evolves over time according to

$$\Delta NW_B = (1 - shp_B^E) PROF_B - \Delta ER \left( \sum_h FD_{h,-1} + FL_{B,-1} - DL_{F,-1} \right), \quad (87)$$

where the first term on the right-hand side represents retained earnings by commercial banks and the second term represents capital losses (gains) associated with nominal exchange rate depreciations (appreciations).

Lending by commercial banks to formal sector households, $DL_F$, is assumed exogenous. This is consistent with the recent evidence suggesting that in Turkey households—and to some extent small businesses—appear to be significantly affected by supply-side constraints on the credit market (see World Bank (2003)). By contrast, lending to firms is taken to be demand determined, as shown in equation (78). At the same time, banks have access to an infinitely elastic supply of loans by the central bank at the prevailing official interest rate. They therefore borrow whatever residual liquidity they need, given their domestic deposit base and foreign borrowing. $DL_B$ is thus determined residually from the balance sheet constraint (79), that is, using (80):

$$DL_B = DL_F + DL_T + GB_B^T - (1 - rreq) \sum_h (DD_h + ER \cdot FD_h) - ER \cdot FL_B - NW_B. \quad (88)$$
2.8.4 Interest Rates and Risk Premia

Banks set both deposit and lending interest rates. The deposit rate on domestic currency-denominated deposits, $ID$, is set equal to the cost of funds provided by the central bank, $IR$:

$$1 + ID = 1 + IR.$$  \hspace{1cm} (89)

This specification implies that banks are indifferent as to the source of their domestic-currency funds—or, equivalently, they view domestic-currency deposits and loans from the central bank as perfect substitutes (at the margin).\footnote{ Alternatively, it could be assumed that there is imperfect substitution between borrowed reserves and deposits. The deposit rate could then be specified as a positive function of both the cost of borrowing from the central bank and variables such as the expected inflation rate.} The lower panel of Figure 5 shows the behavior of the deposit rate, the money market rate (the rate at which banks borrow from each other) and the three-month repurchase rate (which can be viewed as the policy rate, $IR$). The figure shows that, although there are periods during which the three rates tend to evolve in different directions, the degree of synchronization appears to have increased in recent years. We therefore view the “pricing” (or arbitrage) condition (89) as a reasonable approximation to current facts.

The interest rate on foreign-currency deposits at home is set on the basis of the (premium-inclusive) marginal cost of borrowing on world capital markets:

$$1 + IDF = 1 + IF^W.$$  \hspace{1cm} (90)

In turn, $IF^W$ depends on the world risk-free interest rate, $IF^W_{RF}$, and an external risk premium, $EXTPR$:

$$1 + IF^W = (1 + IF^W_{RF})(1 + EXTPR).$$  \hspace{1cm} (91)

Combining equations (75), (90), and (91) implies that the allocation of foreign-currency deposits between home and abroad by formal sector house-
holds and profit earners depends only on the external risk premium:\(^{27}\)

\[
\frac{FD_h}{FD_h^W} = (1 + EXT PR) \theta_h^{FD}, \quad h = F, E.
\]

The external risk premium consists of two components: an exogenous element, denoted \(CONTAG\), which captures idiosyncratic changes in “sentiment” on world capital markets (including contagion effects), and an endogenous component, which captures the perceived degree of country risk and depends on the ratio of the economy’s total foreign debt to exports:

\[
EXT PR = CONTAG + \frac{\kappa_{ERP}}{2} \left(\frac{\sum_{i=P,B,G} F L_i}{\sum_{i=A,P} w p e_i E_i}\right)^2, \tag{92}
\]

where \(\kappa_{ERP} > 0\) and the quadratic form is used to capture the idea that the external risk premium is a convex function of the debt-to-export ratio.\(^{28}\)

The impact of expectations of exchange rate depreciation on the interest rate on foreign-currency deposits in the domestic banking system can be gauged from Figure 6, which shows the behavior of three-month deposit rates on Turkish liras and U.S. dollars. The lower panel of the figure shows a dramatic fall in the expected depreciation rate in late 1999, which tends to indicate that the stabilization program introduced at that time gained rapid credibility. However, the data also show that the credibility gain disappeared equally rapidly in the ensuing months. Figure 7 displays a measure of the external risk premium for Turkey, J. P. Morgan’s stripped spread for that country. The figure shows as well the behavior of the spread from J. P. Morgan’s emerging markets bond index (EMBI). Co-movements in the two series tend to capture “contagion” effects, which are apparent in the period leading up to Argentina’s peso crisis for instance.

The interest rate on domestic-currency loans, \(IL\), is set as a premium over the marginal cost of funds. Given the arbitrage conditions (89) and

\(^{27}\) Note the importance of distinguishing between the premium-inclusive world interest rate faced by domestic borrowers, \(IF^W\), on the basis of which banks set the interest rate on foreign-currency deposits held domestically, and the risk-free rate faced by lenders, \(IF^{RF}_h\), which affects the demand for deposits held abroad by households. In the absence of a risk premium, both rates would be equal and, given the pricing condition (90), equation (75) would imply that the ratio \(FD_h/FD_h^W\) is constant over time.

\(^{28}\) In line with the results of Fiess (2003) for several middle-income Latin American countries, the country risk premium could also be made a function of the domestic public debt to GDP ratio. This would provide an additional channel through which fiscal consolidation may affect the economy.
(90), this cost is simply a weighted average of the cost of borrowing from the central bank (or, equivalently, the deposit rate), and borrowing on world capital markets. Taking into account as well the (implicit) cost of holding reserve requirements, the lending rate is thus determined by

\[
1 + IL = \frac{((1 + IR)^{\kappa_B^L}[(1 + IF^W)(1 + EDEPR)]^{1-\kappa_B^L})}{(1 + DOMPR)^{-1}(1 - rreq)},
\]

(93)

where \(0 < \kappa_B^L < 1\) denotes the relative share of domestic-currency borrowing by banks in the previous period,

\[
\kappa_B^L = \frac{\sum_h DD_h_{-1} + DL_{B-1}}{\sum_h DD_h_{-1} + DL_{B-1} + ER_{-1}(\sum_h FD_h_{-1} + FL_{B-1})},
\]

and \(DOMPR\) is the domestic risk premium, which is inversely related to the ratio of firms’ assets over their liabilities:

\[
DOMPR = \left[\frac{\delta_c PK_{-1}K_{P-1}}{DL_{P-1} + ER_{-1}(DLF_{P-1} + FL_{P-1})}\right]^{-\kappa_{DRP}},
\]

(94)

where \(\kappa_{DRP} > 0\) and \(0 < \delta_c \leq 1\).

The risk premium charged by banks reflects the perceived risk of default on their loans to domestic firms. The link between the premium and firms’ net worth has been much emphasized in the recent literature on real-financial sector linkages. Bernanke, Gertler, and Gilchrist (2000), and Gertler, Gilchrist, and Natalucci (2001), in particular, emphasized the impact of collateralizable wealth on bank pricing decisions.\(^{29}\) The higher the value of firms’ physical assets (which measures “pledgeable” collateral), \(PK \cdot KP\), or an “effective” fraction \(\delta_c\) of that amount, relative to both domestic and foreign financial liabilities, \(DL_P + ER \cdot (DLF_P + FL_P)\), the higher the proportion of total lending that banks can recoup in the event of default. This reduces the risk premium and the cost of borrowing.

This specification has important implications for understanding the interactions between the real and financial sides in the model. A large nominal

\(^{29}\) Collateralizable wealth (or the net present value of firms’ profits) could also act as a quantity constraint on bank borrowing, as for instance in the models of Krishnamurthy (2003), which extends the analysis of Kiyotaki and Moore (1997), and Xie and Yuen (2003). In both settings, shocks to credit-constrained firms are amplified through changes in collateral values and transmitted to output. See, however, Cordoba and Ripoll (2004) for a dissenting view on the ability of collateral constraints to generate output amplification.
exchange rate depreciation (that is, a rise in $ER$), would reduce firms’ net worth, thereby raising the cost of capital and leading to a contraction of private investment. In turn, this would exert contractionary pressures. The extent to which output contracts would depend, in a general equilibrium setting, on the elasticity of the demand for loans. In the model, the demand for loans is residually determined to finance investment expenditures (see equation (78)), whose desired level depends on both the growth rate of output and the real lending rate (see equation (65)). The direct effect of a rise in the lending rate resulting from lower net worth would reduce desired investment and the demand for domestic loans, thereby offsetting at least to some extent the impact of a currency depreciation on firms’ financial liabilities (which operates through $ER \cdot (DLF_P + FL_P)$), by reducing $DL_P$ and $DLF_P$.

In addition, if households are net creditors in foreign currency (as is the case here), the depreciation could have a positive effect on private spending (through its impact on disposable income), thereby stimulating output. In general, therefore, the extent to which a currency depreciation is contractionary through its effect on the risk premium depends not only on the elasticity of the premium with respect to net worth but also the sensitivity of investment to the lending rate and the magnitude of wealth effects on consumption.

Changes in the risk premium may explain why, in practice, spreads between the loan and deposit rates appear to fluctuate significantly over time, as shown in Figure 5.\textsuperscript{30} In fact, as suggested in Figure 8, the bank lending spread tends to follow a counter-cyclical pattern. This behavior is consistent with the view that, in downswings, the value of borrowers’ collateral tends to fall—as a result of a fall in asset prices in general, and in our case more specifically a drop in the price of capital goods.\textsuperscript{31} With the perceived risk of default increasing, and the value of “seizable” collateral falling, banks may

\textsuperscript{30}Other factors that affect the behavior of lending-deposit spreads include, of course, operating costs (which we abstract from), taxation, changes in banks’ degree of risk aversion, and changes in market structure and the degree of competition. Indeed, in Turkey banks and borrowers are subject to a variety of taxes—the banking and insurance transaction tax, the foreign exchange transaction tax, and a tax levy on checks, among others. In addition, depositors must pay up to 20 percent in withholding tax on interest income. Spreads tend to be larger for loans in Turkish lira, as opposed to foreign currency. Nevertheless, we abstract from these other considerations.

\textsuperscript{31}Note that the spread could also be made a direct function of the level of economic activity (or the output gap), as for instance in Atta-Mensah and Dib (2003).
charge a higher premium, as hypothesized in (94). To our knowledge, there
has not been any systematic study of the link between collateral and lending
spreads in Turkey; given the obvious importance of this mechanism in the
model, we will assess the sensitivity of the simulation results reported later
to alternative values of $\kappa_{DRP}$, the parameter measuring the elasticity of the
domestic premium to the “effective” collateral-to-liability ratio.

Banks are indifferent between lending in domestic or foreign currency.
Thus, the interest rate on foreign-currency denominated loans, $ILF$, is de-
termined from the arbitrage condition

$$(1 + ILF)(1 + EDEPR) = 1 + IL.$$  

(95)

2.9 Public Sector

The public sector in our framework consists of the central bank and the
government. We specify each agent’s budget constraint (in stock and flow
terms for the central bank) and account for transfers between them. We also
discuss the determination of official interest rates, as well as the composition
of public investment.

2.9.1 Central Bank

The balance sheet of the central bank consists of, on the asset side, loans to
commercial banks, $DL_B$, foreign reserves, $FF$, changes in which are taken as
exogenous (possibly reflecting central bank intervention aimed at managing
the exchange rate), and government bonds, $GB_{CB}$. Liabilities consist of the
monetary base, $MB$. With $NW_{CB}$ denoting the central bank’s net worth,
we have

$$DL_B + ER \cdot FF + GB_{CB} - NW_{CB} = MB.$$  

(96)

The monetary base is the sum of currency in circulation, $H^s$, and required
reserves, $RR$:

$$MB = H^s + RR.$$  

(97)

Assuming no operating costs, net profits of the central bank, $PROF_{CB}$,
are given by the sum of interest receipts on loans to commercial banks, and
interest receipts on holdings of foreign assets and government bonds:

$$PROF_{CB} = IR \cdot DL_{B,-1} + IF_{RF} \cdot ER \cdot FF + IB \cdot GB_{CB,-1}.$$  

(98)
A fraction $shp_G$ of the central bank’s profits are transferred to the government. Thus, the central bank’s net worth evolves over time according to:

$$NW_{CB} = NW_{CB,-1} + (1 - shp_G)PROF_{CB} + \Delta ER \cdot FF_{-1},$$

(99)

where the last term represents valuation effects. Thus, exchange rate changes that affect the domestic-currency value of the central bank’s stock of foreign reserves do not affect the monetary base; these capital gains and losses are instead absorbed via changes in the central bank’s net worth. Taking first differences of (96) and using (99), the monetary base changes according to

$$\Delta MB = \Delta DL_B + ER \cdot \Delta FF + \Delta GB_{CB} - (1 - shp_G)PROF_{CB},$$

(100)

where the last term is zero if all central bank profits are transferred to the government ($shp_G = 1$).

As noted earlier, the supply of liquidity to commercial banks by the central bank is taken to be perfectly elastic at the prevailing official interest rate $IR$, which is itself treated as predetermined. Alternatively, we could endogenize the official interest rate by specifying a monetary policy reaction function that would relate $IR$ to, say, the output gap, and deviations of inflation from a target value, as in Taylor-type rules (see Svensson (2003)). Experiments with feedback rules of this type would be particularly important for Turkey, given the expected move to a (flexible) inflation targeting framework in the near future.

### 2.9.2 Government Budget

The government primary balance, $PRBAL$, can be defined as

$$PRBAL = TXREV + PROF_G + shp_GPROF_{CB},$$

(101)

$$-W_{SG}S^E_G - TRH - PG \cdot G - PC_PZ_G$$

where $TXREV$ represents total tax revenues, $PROF_G$ profits by the government from sales of the public good (defined in (55)), $shp_GPROF_{CB}$ the share of central bank profits transferred to the government, $W_{SG}S^E_G$ salaries of teachers in public education, $TRH$ total government transfers to households, and $G$ real government consumption of goods and services. Public investment, $Z_G$, is valued at the sales price of the composite private formal sector good, $PC_P$, because it is assumed to consist of expenditure on the private formal composite good only.
The overall fiscal balance, $OVBAL$, is defined as

$$OVBAL = PRBAL - IF^W_G \cdot ER \cdot FL_{G,-1} - IB \cdot GB_{-1}.$$  \hspace{1cm} (102)

where the last two terms account for interest payments on foreign loans (at an exogenous rate $IF^W_G$) and payments on government bonds held by commercial banks, the central bank, and profit earners—the stock of which is denoted $GB^s$:\footnote{Note that non-residents are assumed not to hold domestic government bonds, in line with the evidence for Turkey, which suggests that such holdings are relatively small. This component—which would alter not only (103) but also the balance-of-payments equilibrium condition (108)—can be easily added.}

$$GB^s = GB^T_B + GB_{CB} + GB_E.$$ \hspace{1cm} (103)

Total tax revenues consist of direct taxes, $DIRTAX$, indirect taxes on goods and services, $INDTAX$, as well as payroll taxes on employers in the formal private sector and in public production, and social security contributions by employees in the private sector:\footnote{Although payroll taxes incurred in the production of public services appear in the definition of total tax revenues, they have no effect on the primary balance because (as shown in (55)) they are netted out of profits transferred to the government.}

$$TXREV = DIRTAX + INDTAX + \sum_{j=P,G} W_{Uj}U_j + \sum_{j=P,G} W_{Sj}S_j + \sum_{j=U,S} paytax_j(W_{jG}G + W_{jp}P).$$

Direct income taxes are levied on households (except those in the informal sector) and private formal sector firms:

$$DIRTAX = \sum_{h=A,F,E} inctax_h Y_h + ftax_P PROF_p.$$  \hspace{1cm} (104)

Indirect taxes consist of revenue from import tariffs, taxes on gross production (at the rate $protax_i$), and taxes on domestic sales (at the rate $saltax_i$):

$$INDTAX = ER \sum_{i=A,P} wpm_i tm_i M_i + \sum_{i \neq I} protax_i PX_i X_i + \sum_{i=A,P} saltax_i P Q_i Q_i.$$  \hspace{1cm} (104)
Public investment consists of investment in infrastructure (roads, power plants, hospitals, and so on), $I_{INF}$, and investment in education (school buildings, libraries, and so on, $I_{EDU}$, which are both considered given in real terms:

$$Z_G = I_{INF} + I_{EDU}. \quad (105)$$

Accumulation of each type of capital evolves according to

$$K_i = (1 - \delta_i)K_{i,-1} + I_{i,-1}, \quad i = INF, EDU,$$

where $0 < \delta_i < 1$ is a depreciation rate.

The model closure specifies a fixed growth path for government bond issuing and foreign borrowing. With no central bank financing, and exogenous foreign borrowing (in foreign-currency terms), the government budget deficit, $-OVBAL$, is therefore given from “below the line”:

$$-OVBAL = ER \cdot \Delta FL_G + \Delta GB^s. \quad (107)$$

Given the path of the overall fiscal balance set by (107), equation (102) is solved for the primary balance, $PRBAL$, and (101) residually for the level of transfers to households, $TRH$.

### 2.10 The Balance of Payments and the Exchange Rate

Because foreign reserves are constant, the balance-of-payments constraint implies that any current account imbalance must be compensated by a net flow of foreign capital, given by the sum of changes in households’ holdings of foreign-currency denominated deposits abroad, $\sum_h \Delta FD_W^h$, changes in foreign loans made to the government, $\Delta FL_G$, and to private firms, $\Delta FL_P$ (both taken to be exogenous), changes in loans to domestic banks, $\Delta FL_B$, minus the change in official reserves (also assumed to be exogenous), $\Delta FF$, all measured in foreign-currency terms:

$$0 = \sum_{i=A,P} (wpe_i E_i - wpm_i M_i) + IF_{RF}^W \sum_{h=F,E} FD_{h,-1}^W$$
$$+ REMIT + IF_{RF}^W FF - IF_{RF}^W \sum_{h=P,B} FL_{j,-1}^W - IF_G^W FL_{G,-1}$$
$$- \sum_{h=F,E} \Delta FD_{h}^W + \sum_{j=G,P,B} \Delta FL_j - \Delta FF,$$
where \( REMIT \) is the flow of remittances, defined as

\[
REMIT = \kappa_{REM} W_F \text{FORL}_{-1}, \quad 0 < \kappa_{REM} < 1,
\]

with \( W_F \) denoting again the foreign wage (measured in foreign-currency terms), \( \text{FORL} \) the number of Turkish nationals working abroad, and \( \kappa_{REM} \) the share of wages being remitted. In turn, \( \text{FORL} \) is given by

\[
\text{FORL} = (1 - \delta_{IMIG}) \text{FORL}_{-1} + \text{IMIG}, \tag{109}
\]

where \( 0 < \delta_{IMIG} < 1 \) is the rate of “attrition” of the stock of migrants and \( \text{IMIG} \) is determined by equation (39). Equation (108) determines implicitly the equilibrium nominal exchange rate.

### 2.11 Currency and Bond Market Equilibrium

With equation (100) determining changes in the monetary base, \( MB \), the supply of domestic currency can be derived from equation (97):

\[
H^s = MB - RR. \tag{110}
\]

Equality between the supply and demand for cash requires that, using (72):

\[
H^s = H^d = \sum_h H^d_h. \tag{111}
\]

The equilibrium condition of the market for government bonds, which can be solved for the expected interest rate \( EIB \), is given as

\[
\text{GB}^s = \text{GB}^d_E + \text{GB}^T_B + \text{GB}_{CB}, \tag{112}
\]

or, using (76), as well as (83), (84) and (85):

\[
(1 - \phi_{GB}^{B_F})\text{GB}^s = NW_B \phi_{GB}^{B_d}(1 + \frac{EIB}{1 + \text{IL}})^{\theta_{GB}} + \text{GB}_{CB} \tag{113}
\]

\[
+ \frac{(W_T - H_E)(1 + EIB)^{\theta_{GB}}(1 + ID)^{\theta_{DD}}}{[(1 + \text{EDEPR})(1 + IDF)^{\kappa_{FD}}(1 + IF_{RF}^{W})^{1 - \kappa_{FD}}]^{\theta_{FD}}}
\]

This equation can be solved for the expected bond rate, \( EIB \).
2.12 Price Determination

Value added prices, $PV_i$, are given by adjusting gross prices, $PX_i$, for production taxes and the cost of intermediate inputs:

$$PV_i = V_i^{-1} \left( PX_i(1 - \text{protax}_i) - \sum_j a_{ji}PC_j \right) X_i,$$

where $\text{protax}_I = 0$ because there is no indirect taxation of informal sector output.

The world prices of imported and exported goods, $wpe_i$ and $wpm_i$, are taken to be exogenously given. The domestic currency price of these goods is obtained by adjusting the world price by the nominal exchange rate, with import prices also adjusted by the tariff rate, $tm$:

$$PE_i = wpe_i ER, \text{ for } i = A, P,$$

$$PM_i = wpm_i(1 + tm_i) ER, \text{ for } i = A, P.$$ (115) (116)

Gross output prices of the rural and urban private goods, $PX_A$ and $PX_P$, are derived from the expenditure identity:

$$PX_i = PD_i D_i + PE_i E_i X_i, \text{ for } i = A, P.$$

(117)

For the informal and public sectors (both of which do not export and do not compete with imports), the price of gross output is equal to the domestic price, $PD_i$, only:

$$PX_i = PD_i, \text{ for } i = I, G.$$ (118)

For the rural sector and formal private urban production, the composite price is determined accordingly by the expenditure identity:\footnote{In principle, the cost functions derived from first-order conditions for the CET and CES aggregation functions (3), (11) and (41) could be used to determine $PX$ and $PQ$ prices in these two sectors. However, because CES and CET functions are linearly homogeneous, the cost functions can be replaced with the accounting identities shown in equations (117) and (119); the first-order conditions are incorporated in the export supply and import demand functions, (40) and (42).}

$$PQ_i = \frac{PD_i D_i + PM_i M_i}{Q_i}, \text{ for } i = A, P.$$ (119)
Prices of the composite inputs $J_1$ and $J_2$ are derived in similar fashion, as a result of the linear homogeneity of the nested CES production functions imposed in the production of private formal urban goods:

\[ PJ_1 = J_1^{-1} \left\{ PROF_p + (1 + IL_{-1})(1 + paytax_s)W_{SP}S_P \right\}, \quad (120) \]

\[ PJ_2 = J_2^{-1} \left\{ PJ_1 \cdot J_1 + (1 + IL_{-1})(1 + paytax_u)W_{UP}U_P \right\}, \quad (121) \]

where $PROF_p$, as defined earlier, denotes profits of private firms in the urban formal sector.

The price of capital is defined as a geometric weighted average of the sales prices of the goods for which there is investment demand, namely, the public good and the private formal urban good (see equation (51)):

\[ PK = \prod_{i=G,P} PC_{zi}, \quad (122) \]

where $PC_i = PD_i$ for $i = G$.

The price of government spending, $PG$, is defined in similar fashion (see equation (49)):

\[ PG = \prod_{i=A,G,P} PC_{gi}. \quad (123) \]

Markets for informal goods and government services clear continuously; equilibrium conditions are thus given by

\[ Q_{sI} = Q_{dI}, \quad Q_{sG} = Q_{dG}. \]

These conditions are used to determine $PD_i$ and $PD_G$.

As in Karadag and Westaway (1999), the value added tax is modeled as an ad valorem tax on purchases of final goods. Specifically, the sales price for the rural and formal private sector goods, $PC_i$, differs from the composite price as a result of a sales tax, levied at the rate $0 < saltax_i < 1$:

\[ PC_i = (1 + saltax_i)PQ_i, \quad \text{for } i = A,P. \]

The consumption price index for the rural and urban sectors are given by

\[ P_{RUR} = \prod_i PC_{iRUR}, \quad P_{URB} = \prod_i PC_{iURB}. \quad (124) \]

\footnote{Indeed, in Turkish fiscal accounts, what is referred to as the “value added tax” is actually an ad valorem sales tax. We therefore chose to model it as applying to composite good prices, instead of value added prices.}
where $0 < \omega_r, \omega_u < 1$ are the relative weights of good $i$ in each index. These weights sum to unity ($\sum_i \omega_r = \sum_i \omega_u = 1$) and are fixed according to the share of each of these goods in rural and urban consumption in the base period. Finally, the aggregate price level, $CPI$, is defined as a weighted average of rural and urban prices:

$$CPI = P_{wcp}^R \cdot P_{1-wcp}^U,$$

where $0 < w_{cp} < 1$ is the relative share of spending by rural households in total consumption. The inflation rate is simply

$$INFL = \frac{\Delta CPI}{CPI_{-1}}.$$

### 2.13 Default Risk, Credibility, and Expectations

Our analysis of default risk dwells on the presumption that, faced with an unsustainable fiscal deficit, a government can either take fiscal measures to increase revenue, or be tempted to default at some point in the future—either through monetization or outright repudiation. In practice, governments are often tempted to resort to monetization as deficits and public debt rise because of constraints in the ability to adjust taxes; the increase in tax rates or in the tax base necessary to balance the budget may be large and politically unfeasible. The inflation tax may be an easier option, because it is the accumulation of debt that leads to a perverse increase in interest payments. In addition, there are no explicit costs associated with collecting the inflation tax, whereas with “conventional” taxes collection costs may be a convex function of the amount of revenue raised. In the Turkish case, however, we also view outright debt repudiation as a source of concern by asset holders. Expectations concerning the possibility of default will therefore affect their current behavior.

Specifically, we assume that the demand for government bonds is affected by the probability that the government will opt for (partial) default, in the form of either outright repudiation or monetization to finance its deficits.\(^{36}\) Private investors assign a nonzero probability to default in the current period. The expected rate of return will reflect this probability, and they will demand

\(^{36}\)In principle, as noted by Masson (1985), changes in the perceived risk of default will also affect the marginal rate of substitution across periods, and thus saving. In the present setting, however, intertemporal considerations by households are not directly captured, and thus we ignore this effect.
compensation in the form of a higher nominal interest rate on government bonds. Thus, the expected rate of return on government bonds, $EIB$, can be defined as

$$EIB = (1 - PDEF)IB,$$  \hspace{1cm} (127)

where $PDEF$ is the subjective probability of default, which is supposed to depend (with a one-period lag) on the current debt-to-tax revenues ratio:\footnote{Note that using GDP as a scale variable instead of tax revenue in the probability of default would not be appropriate here, because neither agriculture nor the informal sector are subject to taxation. Thus, an increase in GDP resulting from higher output from either one of those sectors would not signal a greater capacity to repay.}

$$PDEF = 1 - \exp\left[-\alpha_0\left(\frac{GB_{-1}}{TAXREV_{-1}}\right)\right].$$  \hspace{1cm} (128)

This specification shows that, when debt is zero, the probability of default is also zero; by contrast, as the stock of debt (relative to tax revenues) increases without bounds, the perceived risk of default approaches unity. Put differently, the larger the stock of debt is in relation to the capacity to repay, the higher the perceived risk of default.\footnote{In principle, the government could meet its debt obligations by cutting spending (or selling assets) instead of raising taxes. Our view, however, is that (given the large share of spending allocated to wages and interest payments) most of the adjustment to cover obligations in case of default would have to come from higher tax revenues.}

The view underlying our specification in (128) is that tax revenues are constrained by some upper bound, whereas the real value of the outstanding debt (and of the debt service) can be significantly reduced by a surprise increase in the rate of inflation.\footnote{See Spaventa (1987) for a detailed discussion of the view that governments typically face a limit to the tax burden that they can impose on their citizens—notably because of adverse effects on incentives and income distribution.}

The outcome of a postponement of action on the deficit would then eventually translate into a steadily increasing interest rate on government bonds, as a result of two factors. First, demand for these bonds depends on the expected rate of return, which is the product of the probability of repayment times the interest rate, as shown in equation (127). For a given probability of default, a continued increase in the supply of bonds will require an increase in interest rates, to induce investors to hold them. This can be seen by combining the solution to condition (113) and equation (127), to write the actual, equilibrium interest rate on government bonds as

$$IB = \frac{\Lambda(GB^*, \ldots)}{1 - PDEF},$$  \hspace{1cm} (129)
where $\Lambda(\cdot)$ is a functional form that depends positively on $GB^s$ and the dots represent the other determinants of the demand for government bonds by domestic banks and profit earners. An increase in the supply of bonds $GB^s$, fueled by an increase in the government deficit, would indeed raise the equilibrium bond rate, everything else equal.

Second, an increase in the stock of public debt will lead (with a one-period lag) to a rise in the perceived probability of default by investors, which will also tend to lead to higher interest rates on government bonds. As can be inferred from the previous equation, an increase in $PDEF$ would indeed raise the equilibrium bond rate. The rise in interest rates would in turn worsen the overall deficit of the government—making the adoption of corrective fiscal policies inevitable. Higher interest rates therefore make an unsustainable fiscal policy more unsustainable, hastening the need for policy reforms.

To model credibility, we assume that the expected rate of inflation (which affects directly the demand for domestic currency, private investment, saving rates, and wage formation in the private formal sector), is given as a weighted average of the perceived (or explicitly announced) inflation target of the central bank, $INFL^{TARG}$, and the one-period lagged inflation rate:

$$EINFL = CREDIB \cdot INFL^{TARG} + (1 - CREDIB)INFL_{-1},$$

where $INFL$ is defined in (126) and $0 < CREDIB < 1$ is our measure of credibility, defined as

$$CREDIB = 1 - PDEF.$$  

Credibility in our framework depends therefore only on fiscal policy; the stance or effectiveness of monetary policy (as measured, for instance, by deviations between actual and target inflation rates) plays no role.\textsuperscript{40} Full credibility ($CREDIB = 1$) occurs only if the probability of default $PDEF$ is zero. An increase in the probability of default lowers credibility and leads

\textsuperscript{40}In Ozatay (2000) and Civecir (2002), credibility is measured by the average maturity of new domestic non-indexed public debt issues. However, maturity is treated as an exogenous variable, instead of being (inversely) related to the debt-to-GDP ratio, as one would expect. For other ways of modeling credibility involving forward-looking expectations in stochastic models, see Laxton, Ricketts, and Rose (1994), Huh and Lansing (1999), Isard, Laxton, and Eliasson (2001), and Erceg and Levin (2003). For econometric studies, see Ruge-Murcia (1995) and Agénor and Taylor (1992).
agents to reduce the weight attached to the inflation target in forming expectations (thereby imparting greater persistence to inflation), because default is associated with a perceived increase in the risk of monetization and thus higher future inflation. In a sense, therefore, inflation expectations depend essentially on the fiscal stance—in line with the empirical results of Celasun, Gelos and Prati (2004), based on survey data for Turkey. Although they do not provide a formal characterization of their argument, they note (p. 494) that “...A credible fiscal consolidation is probably the key to reducing inflation, because inflation expectations will decline only if the public perceives that the need to monetize fiscal deficits or inflate away the debt stock has come to an end.”41

The expected nominal depreciation rate, $EDEPR$, which affects portfolio decisions and the pricing rules of commercial banks, is defined as a weighted average of its past value and expected changes in the real exchange rate, measured as the difference between expected domestic inflation (given in (130)) and foreign inflation, $FINFL$, with a one-period lag:

$$EDEPR = \chi EDEPR_{-1} + (1 - \chi)(EINFL - FINFL_{-1}),$$

(132)

where $0 < \chi < 1$. Thus, when domestic inflation is expected to exceed foreign inflation, that is, when the real exchange rate is expected to appreciate, agents will also expect the nominal exchange rate to depreciate, to prevent a loss in competitiveness.42

Note that in the model exogenous changes in the probability of default lead in general to an inverse correlation between credibility and the government bond rate. An increase in $PDEF$, for instance, raises directly the bond

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41 They also found that inflation expectations appear to be forward-looking, rather than backward-looking. However, this result is not consistent with those obtained by Agénor and Bayraktar (2002), who found that forward- and backward-looking components have similar weights in expectations.

42 Alternatively, it could be assumed that expectations are rational (or, more precisely, model consistent), so that the expected depreciation rate is equal to the one-period ahead “actual” rate, as derived from the model itself. This, however, is a lot more involved from a computational standpoint. Other options, as suggested to us by Peter Montiel, would be to make the expected future exchange rate a function of the current spot rate (with some elasticity parameter linking the two, and with perhaps a “shift” term to capture exogenous changes in exchange rate expectations), or to make the expected future exchange rate proportional to the model’s steady-state solution for the exchange rate, with the factor of proportionality representing the perceived rate at which the exchange rate converges to its steady-state value.
rate, as implied by (129). At the same time, it also reduces credibility, as implied by (131), thereby raising expected inflation, as can be inferred from (130), as long as $INFL_{-1} > INFL^{TARG}$. In turn, higher expected inflation raises the expected rate of depreciation of the nominal exchange rate, as implied by (132). From (76), and the equilibrium condition (113), the rise in $EDEPR$ lowers the demand for government bonds by households. With a fixed supply of bonds, this requires an offsetting increase in $EIB$, that is, a rise in $IB$ itself (as implied by (127)), which compounds the initial effect of the increase in $PDEF$ on the actual bond rate.

3 Calibration and Solution

Appendix C reviews the structure of the financial SAM that underlies the model, our calibration procedure, and the parameter values (estimated and non-estimated) that we use in the behavioral equations. A more detailed description of the data and adjustment procedures used to construct the financial SAM is provided in Jensen and Yeldan (2004). Essentially, the calibration of the model was done by building a Financial Social Accounting Matrix (FSAM). The FSAM itself was built in two steps: a) construction of a MacroSAM; and b) disaggregation into a MicroSAM. The construction of the MacroSAM was split into a real MacroSAM and a financial MacroSAM. The link between the two types of MacroSAMs was made through the savings-investment balance account.

The solution of the model is performed with GAMS. When solving the model, the equilibrium condition (111) is dropped from the system as a result of Walras’ law—if all other markets but the money market are in continuous equilibrium, then the money market must be in continuous equilibrium as well. That this is indeed the case is checked automatically when solving the model.

4 Policy Experiments

In this section, we report two sets of experiments. The first aims to analyze the real and financial effects of a disinflation program taking the form of a permanent increase in the official interest rate. The second set relates to fiscal adjustment and considers two scenarios: an increase in the VAT rate
and an increase in the tax rate on income of profit earners. The public sector closure rule implies that transfers to households adjust to clear the public sector budget.\footnote{Given this closure rule, the simulation results would be significantly affected if we were to assume that in the probability of default it is taxes net of transfers that matter, instead of taxes \textit{per se}. However, doing so would implicitly amount to assuming that transfers would not be cut to redeem the debt in case of default.} In both cases we focus on the impact of these policies on the sustainability of domestic public debt and the behavior of the labor market. We refer to effects occurring in the first two years as the “short run,” those occurring between the third and fifth years as the “medium run,” and those occurring between the seventh and the tenth year as the “long run.”

As noted earlier, the growth path for domestic bond financing is exogenously specified in the baseline solution.\footnote{Note that, because GDP changes across experiments, the debt-to-GDP ratio will also change, despite the fact that the growth rate of the stock of public debt is constant.} The bond market also includes a placement rule whereby the government places a pre-determined fraction of the outstanding stock of bonds with commercial banks. The remaining share of outstanding bonds are allocated among commercial banks and profit earners according to their respective portfolio-balance equations. As can be inferred from (113) and (129), it is this secondary allocation of bond holdings that determines (together with the supply of bonds, the probability of default, and interest rates on alternative assets) the equilibrium bond rate. The two fiscal experiments are carried out using a non-neutral public sector closure. Thus, given that the overall balance is fixed by (107), the tax adjustment affects the size of the primary balance (as implied by (102)) and transfers to households (as inferred from (101)). In turn, transfers affect households’ disposable income, private spending, and tax revenue. As a result of this closure rule, in each experiment deviations of the probability of default from its baseline value will reflect essentially changes in tax revenues, which are themselves closely correlated with activity in the formal sector (given that the rural and informal sectors are essentially untaxed).

### 4.1 Increase in Official Interest Rates

We first consider a permanent, 5 percentage point increase in the official interest rate, $IR$. Results are presented in Tables 2 and 3. The inflation rate is reduced significantly in the short run by almost 3.8 percent, and remains below its baserun value until period 6. The medium run maximum reduction...
in the price level (in both rural and urban areas) is around 9 percent while the long-run reduction is around 5.5 percent. The general reduction in the level of prices is the consequence of changes in factor costs and the relative demand and supply of goods and services. Indeed, the increase in the official rate raises the lending rate, which in turn exerts two types of direct effects: first, it leads to a reduction in formal sector wages through an increase in the cost of working capital; second, it leads to a strong decline in investment demand for formal sector goods.

The reduction in formal sector wages leads to a fall in real disposable income for the formal sector household. Because formal sector households have a relatively high consumption share of formal sector goods, the relative demand for formal sector goods tends to decline. In this way, the reduction in formal sector wages tends to be self-reinforcing. At the same time, the reduction in formal sector disposable income is exacerbated by the strong increase in the bond rate, despite a concomitant increase in deposit rate. The increase in the bond rate leads to higher interest payments by the government on its debt and (as a result of the public sector budget closure) a decline in transfers to households. The reduction in household transfers affects mostly the formal sector household and profit earners, because they are the main beneficiaries of public transfers. But the reduction in income is more pronounced for formal sector households, because they are affected adversely not only by the reduction in transfers, but also by the increase in the cost of borrowing. Indeed, because formal sector households (which are the only ones borrowing from banks) are net debtors in the initial scenario, their net borrowing costs increase, despite the fact that the increase in the deposit rate (which matches the increase in the official rate) cushions the impact of the higher lending rate. Overall, real disposable income of formal sector households decline by around 12 percent in the medium run (see Table 3, period 5) and 5 percent in the long run (see Table 3, period 10). In contrast, profit earners (who do not borrow directly from banks) benefit relatively strongly from increasing interest receipts on their deposits held with commercial banks and from government bond holdings. Real disposable income of this group of households increase by around 10 percent in the medium run and 6 percent in the long run (see, again, Table 3).

The bond rate increases strongly until period 5. Most of the upward pressure on the bond rate results from the fact that the increase in deposit rates tends to reduce the demand for bonds by profit earners; the net worth of commercial banks remain low through the medium run (making them
therefore reluctant to increase bond holdings above direct placement holdings), and central bank holdings are exogenous. Given that the supply of bonds does not change across experiments, the bond rate must increase to maintain market equilibrium and maintain bond holdings of profit earners around baserun levels.\footnote{This is so despite the fact that savings by profit earners tend to increase as a result of the rise in deposit rates—an increase that tends to raise total financial wealth over time (as implied by (64)) and thus to increase the demand for bonds (as implied by (76)).} The impact on the bond rate reaches a maximum of 11 percentage points in period 5, after which increases in the net worth of commercial banks start to kick in. The bond rate therefore increases less strongly after that period, by about 6 percentage points in the long run.

Banks’ net worth is negatively affected by the increasing cost of central bank funding. However, it is positively affected by the increase in the bond and lending rates. The lending rate on domestic-currency loans increases by 4.8 percent in the short run and 4.5 percent in the medium run. This reflects the countering effects of \( a \) the initial increase in the official rate of 5 percent; and \( a \) the subsequent reductions in the expected rate of depreciation of the nominal exchange rate and a slight fall in the domestic premium. Declining expectations of nominal depreciation follow from a general decline in actual exchange rate depreciation. This affects the cost of funding through foreign-currency deposits and therefore lowers the lending rate. The domestic premium also declines slightly due to the exchange rate appreciation, which lowers the domestic-currency value of firms’ foreign liabilities and therefore increases the value of their net collateral-debt ratio.

The nominal exchange rate appreciates by around 10 percent in the medium run, and 6 percent in the long run. The growth path of the nominal exchange rate closely resembles the growth path of the domestic price level, and this is reflected in a relatively stable real exchange rate. Indeed, the real exchange rate depreciates by about 0.3 percent in the short run and appreciates by about 0.5 percent in the medium run, before settling down to a real appreciation of only 0.1 percent in the long run. Movements in the real exchange rate are mirrored in the trade balance and the current account, which improves in the short run but deteriorates slightly in the medium and long run.

As noted earlier, the increase in lending rates induced by the hike in official interest rates affects the real economy through two main channels: \( a \) reduced investment demand; and \( b \) increased costs of working capital. The
first channel directly reduces demand for private formal sector investment goods. Combined with the reduction in formal sector disposable income and consumption, this leads to a sharp reduction in demand for private formal sector goods compared to other sectors of the economy. In addition, the medium and long run impact of lower investment (or more accurately, the reduction in the stock of private physical capital that it entails) is to lower production capacity and reduce the marginal product of other production factors (most notably skilled labor) in the private formal sector. Value added in the urban formal sector is therefore particularly affected and declines by 0.8 percent in the long run. The urban informal sector also experiences a small decline in value added of less than 0.1 percent in the long run, whereas value added in the rural sector expands by 0.2 percent. These developments are mainly due to relative price effects and the reduced outflow of workers from rural to urban areas. Overall, GDP declines by 0.3 percent in the long run.

The decline in real GDP is the outcome of the decline in private investment demand dominating the real increase in consumption. Over time, private investment declines strongly not only as a result of the increasing lending rate but also because of the negative accelerator effect emanating from the decline in GDP itself. In contrast, private consumption increases due to the income effect (alluded to above) of the increase in the deposit and bond rates, particularly on the disposable income of profit earners. Combined with a decline in relative formal sector prices, this leads to a sharp increase in real consumption of that category of households. The increase in overall real household consumption is moderated by the decline in disposable income and consumption by the formal sector household, for the reasons discussed earlier.

Wages in the labor market generally mirror changes in the overall price level. Fully indexed public sector wages move (downward) with the urban formal sector consumer price index. In addition, lower public sector wages (through their signaling effect), together with higher lending rates, higher (skilled) unemployment, and declining private sector investment, combine to lower relative wages in the formal private sector. The decline in formal sector wages spills over into declines in rural and informal sector wages as well. The former fall by more, implying that the expected wage differential between the formal and informal urban sectors drops by about 8 percentage points in the medium run (periods 4 and 5 in Table 2) and 4 percentage points in the long run, whereas the wage differential between the rural and
urban sectors drops by about 3 percentage points in the medium run and 0.3 percentage point in the long run. Movements in these wage differentials lead to reduced migration of labor between sectors, and account for the increase in employment and value added in the rural sector, and the drop in both variables in the informal sector.

The external premium faced by domestic banks (as shown in (92)) fluctuates essentially with changes in exports. The initial exchange rate depreciation increases exports. The fall in the ratio of foreign debt (which does not change across simulations) to exports therefore lowers the external premium in the short run. The subsequent exchange rate appreciation and associated reduction in exports means, however, that the external premium increases in the long run. This leads to a higher interest rate on foreign-currency deposits held domestically (as implied by (90) and (91)), as well as higher rates charged on domestic- and foreign-currency loans by domestic banks (as implied by (91), (93), and (95)). In principle, the effect of interest rates on foreign-currency deposits and loans could be significant. For instance, the increase in interest rates on foreign-currency loans raises interest payments for firms in the private formal sector (which reduces income distributed to profit earners and thus dampens the increase in that group’s consumption expenditure); at the same time, it raises banks’ profits and thus income received by profit earners. However, because these effects tend to offset each other, and because the quantity of domestic loans denominated in foreign currency is relatively small, the net quantitative impact is not large.

The probability of government default increases due to the reduction in nominal tax revenues and the resulting increase in the debt-to-tax revenues ratio. This increase in the default probability is matched by a similar decline in credibility, due to increased expectations of monetization or outright default. As a result, the bond rate tends to rise (compounding the demand effects discussed earlier) and expectations of inflation tend to increase. Over time, the rise in expected inflation tends to mitigate the positive impact of the rise in deposit rates on households’ savings rates (see equation (62)). For private investment, by contrast, the rise in expected inflation tends to reduce the initial magnitude of the increase in the real lending rate, thereby dampening over time the adverse effect of a higher cost of borrowing on

46Note that in Table 2 the ratio of total tax revenues to GDP increases throughout the simulation period. This is because, although both variables fall, the reduction in GDP exceeds that of tax revenues.
private capital formation.

Finally, it can be noticed that the government primary surplus-to-GDP ratio increases both in the short and the long run. The increase reaches a maximum of 5.6 percentage points over the reference path (Table 2, period 5), reflecting a sharp decline in government transfers to households. These transfers are squeezed due to the strong increase in the bond interest payments resulting from our assumption that bond financing is maintained at baserun levels, implying that (with exogenous foreign borrowing in foreign-currency terms) the government deficit is given from “below the line.”

It is worth noting that the magnitude of the long-run decline in GDP would of course be smaller if, as a result of a Taylor-type rule, the authorities were to lower interest rates in response to lower inflation. It is also interesting to note that this experiment, a disinflation attempt based on a rise in official interest rates, leads to a rise in the probability of default (essentially because the increase in interest rates has a contractionary effect, which translates into lower tax revenues), and an initial real depreciation (see Table 3). These results are consistent with those derived by Blanchard (2004) in a very different setting, characterized by a direct link between the probability of default, capital flows, and movements in the exchange rate. Nevertheless, our experiment carries a similar note of caution: in an inflation targeting framework (in which interest rates are used to achieve a specific level of inflation), an initial inflationary shock can have perverse effects. An increase in real interest rates to “choke off” inflationary pressures can lead to a real depreciation, and thus higher inflation, which may lead in turn to further increases in interest rates. In our experiment, fiscal policy is also an important potential tool to reduce inflation: by issuing less domestic debt and reducing the debt-to-tax ratio, the government would mitigate the increase in the probability of default, which would in turn dampen the rise in the bond rate. This would reduce pressure on cutting the primary deficit through a drop in transfers, thereby dampening the adverse effect on activity and tax revenues.

4.2 Fiscal Adjustment

As noted earlier, we discuss two types of fiscal adjustment policies: an increase in the VAT rate and a rise in the tax rate on income of profit earners.
4.2.1 Increase in the VAT Rate

We first consider fiscal adjustment in the form of a permanent, 2.5 percentage point increase in the value added tax, which (as noted earlier) applies solely to private formal sector goods. Results are presented in Tables 4 and 5.

The increase in the tax rate raises both the level and the growth rate of prices. Overall inflation rises by about 3.6 percent in the short and medium run (see Table 4, period 4). The inflationary impact becomes negative after period 6, before returning to slightly positive values in the long run. In level terms, prices increase by about 15 percent above their baserun value in the long run. This general increase is driven by changes in relative demand and supply of goods and services. First, the tax hike leads directly to an increase in the price of the private formal sector good. This tends to lower demand for that good, lowering production and increasing unemployment (particularly among the unskilled) in the formal sector. At the same time, the increase in government revenues is transferred back to households, due to the public sector closure rule; this tends to stimulate consumption spending across all categories of goods and to put further upward pressure on prices. Furthermore, the bond rate declines markedly, thereby lowering interest payments and borrowing needs by the government, and reinforcing the increase in demand through higher household transfers (which increase by about 3.4 percent of GDP in the long run). Reduced investment demand for formal sector goods pulls in the other direction. Investment is negatively affected by increasing lending rates and the “reverse” accelerator effect associated with a decline in the growth rate of GDP. However, improved credibility (through its effect on inflation expectations and the real lending rate, as discussed later) reduces the impact of this effect in the medium and long run.

The bond rate declines by less than 1 percentage point on impact and reaches a maximum reduction of 8 percentage points in the medium run (see Table 4, period 5). In the long run, it declines by about 6 percentage points. This decline results essentially from the increase in the nominal disposable income of profit earners. While these households experience a strong drop in real disposable income due to falling commercial bank profits (see Table 5), the impact of inflation on nominal income, and thus savings and wealth, is such that the nominal demand for bond holdings increases. With the supply of bonds exogenously fixed, the increase in demand tends to lower bond rates. The smaller long-run decline in the bond rate is due to movements in the net worth of commercial banks. Indeed, the declining bond rate exerts over time
a self-correcting feedback effect through lower commercial banks’ profits and net worth. This lowers the overall demand for bonds and creates pressure for a (partial) long-run correction in the drop in the bond rate.

Banks’ net worth is also affected by a slight increase in the interest rate on domestic-currency loans, of the order of 0.3 percentage point in the long run. This increase follows mainly from a rise in the domestic premium, which results in turn from actual exchange rate depreciation: by increasing the domestic-currency value of foreign-currency loans, the nominal depreciation reduces the net value of firms’ collateral. At the same time, expectations of exchange rate depreciation remain relatively unchanged. The reason is that the higher actual rate of exchange rate depreciation is mitigated by lower expected inflation in the long run, due to improved credibility and declining inflation in the long run. In turn, credibility improves because increasing (nominal) tax revenues lower the debt-to-tax ratio, thereby lowering the probability of default. In turn, the reduction in the probability of default (that is, the credibility gain) tends to lower the actual bond rate, thereby contributing to the decline discussed earlier.

The nominal exchange rate depreciates by around 13 percent in the medium run and 10 percent in the long run. The growth path of the nominal exchange rate resembles the growth path of the domestic price level, but less so than in the case of an increase in the official interest rate (as discussed earlier). Accordingly, the real exchange rate tends to appreciate, remaining around 0.5 percent below the base run level in the long run (see Table 5). Nevertheless, both the trade balance and the current account tend to improve in the long run. This occurs both because of the decline in real total consumption induced by the fall in disposable income (which reduces overall spending on the composite private formal sector good) and because the relative price of private formal sector goods declines strongly—in spite of the increase in the tax rate. Combined with strong nominal depreciation, this leads to a decline in the relative demand for imports of the private good and (despite an appreciation of the “overall” real exchange rate) a slight improvement in the current account in the long run.

The combination of an increasing lending rate and tax-induced increases in the price of formal sector investment goods leads to a strong reduction in investment demand initially. In the short run, increased expectations of inflation due to high actual inflation reduce the cost of borrowing, which tends to mitigate the fall in investment demand over the medium run. However, improved credibility and declining actual inflation lead to lower expected in-
flation in the long run, pushing the real cost of borrowing back up. The
increase in the (expected) real lending rate, combined with a negative accele-
erator effect, tend to reduce real private investment again, by 3.6 percent in
the long run. Over time, lower levels of investment lead to lower production
capacity and a reduction in the marginal product of other production factors
in the private formal sector. The general decline in demand for formal sector
goods therefore leads to a sharp long-run reduction in unskilled employment,
of about 4.3 percent, whereas skilled employment drops by about 0.2 per-
cent. As a consequence, value added in the urban formal sector declines by
0.8 percent in the long run. Urban informal sector value added also declines
by 0.3 percent, whereas value added in the rural sector improves by about
0.6 percent in the long run. Increasing value added in the rural sector and
reduced value added in the urban informal sector result mainly from lower
migration of workers from rural to urban areas, itself reflecting movements
in wage differentials. Overall, GDP declines by 0.3 percent in the long run.

The decline in real GDP mainly reflects the diverging growth paths of
components of aggregate demand. While private investment demand declines
strongly at first, recovers somewhat, and starts declining again, real private
consumption remains relatively unchanged in the long run; it experiences an
initial short-run expansion of 0.4 percent, followed by a medium-run contrac-
tion of the same magnitude. These movements reflect the behavior of the
real disposable income of profit earners, which declines strongly by 11 per-
cent in the medium run and by 9 percent in the long run. In turn, as noted
earlier, the declining income of profit earners is mainly due to the sharp drop
in interest income from bond holdings.

Over time, declining real investment tends to reduce the capital stock in
the private formal sector—and therefore the demand for skilled labor, given
the high degree of complementarity between these factors. Combined with
reduced demand for formal sector goods, this leads to a reduction in skilled
employment, but only by a moderate amount in the long run (0.2 percent). In
contrast, the long-run reduction in unskilled employment amounts to 4.3 per-
cent, indicating that bargained wages for unskilled workers are increasing too
fast. Partly because of the marked increase in formal sector unemployment,
the wage differential between formal and informal sector declines strongly.
This (together with a reduction in the probability of finding a job in the pri-
ivate formal sector) implies that migration toward the formal sector is reversed
in the long run. Nevertheless, the reduced level of formal sector migration
cannot fully compensate for reduced employment in that sector. Unskilled
open unemployment therefore increases by 1.4 percent in the long run. By contrast, skilled unemployment increases by a much smaller proportion (0.1 percent) at the same horizon.

Finally, the results indicate that the hike in the tax rate leads to a sharp increase (by 11 percent) in the ratio of tax revenues to domestic debt in the long run. This is partly due to the direct impact of an increased VAT rate, but mostly due to the impact of higher prices on tax revenues. Combined with the strong decline in the bond rate, this leads to a significant long-run reduction in the interest payments-to-tax revenue ratio. Furthermore, the reduced interest payments implies that there is less need for a government primary surplus. Accordingly, the reduction in interest payments leads to increased household transfers (and thus higher spending, as noted earlier) and a long-run reduction in the primary surplus of around 2.4 percent of GDP.

4.2.2 Increase in the Tax Rate on Profit Earners

We next consider a permanent, 5 percentage point increase in the tax rate on income of profit earners. Results are reported in Tables 6 and 7.

The main impact of the tax increase is to lower real disposable income of profit earners (by about 3.2-3.8 percent in the short and long run) and to increase real disposable income of other urban sector households. It also leads to an increase in government revenues amounting to 1 percent of GDP in the short to medium run, and 1.2 percent of GDP in the long run.

As a result of our public budget closure rule (which, again, keeps the supply of bonds fixed and treats foreign borrowing as exogenous), the increase in government revenue translates into higher transfers to households. Given the initial distribution of these transfers, they go mainly toward urban formal households and profit earners. Nevertheless, urban informal households are initially the main beneficiaries of the increased transfers, with their real disposable income rising by 2.0 percent in the short run, compared to 0.9 percent for urban formal households and -0.2 percent for rural households. The strong relative increase in informal sector income is due to \( a \) increasing demand for informal sector goods and production input (labor); and \( b \) the fact that informal sector households are not subject to direct tax payments. Profit earners have relatively low consumption shares in informal sector goods. The redistribution of household income therefore increases demand for informal sector goods by a relatively large amount. In turn, this
raises informal sector output, labor demand, and wages, thereby leading to higher real disposable income.

In the medium run (period 5), formal sector households enjoy a relatively strong increase in real disposable income (2.9 percent) compared to urban informal households (1.9 percent). The income of profit earners is relatively high in the medium run, and tax-induced redistribution toward formal sector households is therefore relatively high. In the long run, the initial pattern re-establishes itself: urban informal households gain the most (about 2 percent) compared to urban formal households (1 percent) and rural households (-0.3 percent).

Inflation is high in the short run but declines toward zero in the medium run. Rural and urban price levels reach a maximum increase of 3.1-3.4 percent (see Table 7, period 5). In subsequent periods, inflation turns negative and price levels return gradually to values close to their baserun levels. Price movements are driven by the increase in sectoral demand (relative to supply) for goods and services and tend to be reflected in movements of the nominal exchange rate. The real exchange rate appreciates somewhat in the short and medium run, but remains virtually unchanged in the long run. The initial exchange rate appreciation worsens the current account slightly in the short run. In the longer run, however, there is no discernible impact on external balance.

Similar to price levels, nominal wage levels reach a maximum increase in the medium run. High wage increases of about 5.5 percent are experienced by informal sector workers. In comparison, private formal skilled and unskilled workers benefit from smaller increases, of the order of 1.5 and 2.3 percent, respectively. In the long run, the informal sector wage level increases by 2.7 percent whereas formal sector wages (both skilled and unskilled) decline. This decline is due to a combined switch in consumption and investment demand away from formal sector goods. The fall in unskilled wages in the formal private sector is somewhat mitigated in the medium and long run as a result of an increase in the reservation wage due to increasing public sector wages (private formal unskilled workers benefit from a high public sector leadership effect on their wages), and subsequently due to declining unskilled unemployment.

The long-run decline in unskilled unemployment (following an increase in the short and medium run) results mainly from a reduction in the supply of unskilled labor to the formal sector. The reason is that the increase in the informal sector wage relative to the private formal unskilled wage lowers
the expected wage differential between the formal and informal sectors. This reduces migration into the formal sector (and thus the number of unskilled job seekers in that sector) and gradually eliminates the increase in unemployment that occurred during the short and medium run. As for rural-urban migration, the expected wage differential between urban and rural areas gets smaller relative to the baseline, because of the decline in relative formal sector wages (and in spite of the increase in informal sector wages). The subsequent “reverse” migration from urban to rural areas implies that informal sector employment contracts slightly in the medium run; it also expands in the long run, when migration out of urban areas tapers off. Labor movements imply that rural employment continuously expands during the simulation horizon.

Unskilled employment in the urban formal sector declines both in the short and the long run, as a result of declining demand for formal sector goods. Skilled employment also declines (marginally) in the short run, but increases (marginally) in the medium term due to increasing investment and capital accumulation. As noted earlier, skilled workers benefit from the complementarity between physical capital accumulation and skilled labor employment. But because the increases in real private investment recorded between periods 2 and 6 are subsequently reversed (see below), this complementarity effect is muted. Skilled employment remain essentially unchanged in the long run.

Overall, the redistributive policy of increasing taxation of profit earners leaves real GDP unchanged in the long run. Migration increases employment and real value added in rural areas by a small amount (0.1 percent). By contrast, reduced demand for formal sector goods leads to reduced relative formal sector wages, reduced formal sector migration, and lower value added in the formal sector (-0.1 percent). The net effect of increased migration to rural areas and reduced formal sector migration means that value added in the informal sector remains virtually unchanged in the long run.

Real investment declines on impact due to the accelerator effect. During the following periods (and until period 6), real investment expands because increasing inflationary expectations reduce the expected cost of borrowing for investment purposes. By the same token, real investment declines in the long run as expected inflation and the expected cost of borrowing drop. Real consumption falls in line with disposable income, whereas overall disposable income itself declines due to increasing consumer prices.

Regarding the financial sector, the interest rate on domestic-currency loans increases marginally in the medium run, and declines slightly in the
long run. The medium-run increase follows from small increases in domestic and external risk premia, whereas the long-run decline follows from improved credibility, which spills over into declining expectations of inflation and exchange rate depreciation—thereby lowering the expected cost of funds. Improved credibility is the mirror image of a declining probability of default, which itself follows directly from the increase in tax revenues. The reduction in the probability of default puts downward pressure on the actual bond rate. Overall, however, the bond rate increases in both the short and the long run, as a result of a decline in the demand for bonds by profit earners, induced by lower disposable income, lower savings, and thus lower wealth accumulation over time for that category of households. In between, during the medium run, the bond rate declines slightly because of a wealth-induced increase in demand for government bonds by commercial banks. Nominal exchange rate depreciation increases the net worth of commercial banks in the medium run, and this indeed stimulates their demand for bonds.

Public finance indicators show that tax revenues expand significantly as a proportion of domestic debt throughout the adjustment period, reaching 2.4 percent in the long run. The increase in government resources implies that interest payments as a proportion of tax revenues decline strongly during the medium term. However, the subsequent increase in the bond rate implies that the interest payments-tax revenue ratio returns to a value close to its baserun level in the long run. Due to the model closure rule (flexible household transfers balancing the public sector budget), the primary budget surplus naturally reflects additional financing needs. Accordingly, the primary budget balance follows movements in the bond rate: as a proportion of GDP, the primary surplus deteriorates in the medium term, and improves (by about 0.7 percentage point) in the long run.

Finally, in evaluating the fiscal effects of a tax increase on profit earners, it should be kept in mind that the model does not account for the possibility that higher tax rates may increase incentives for tax evasion (thereby reducing the increase in the “effective” tax rate) and/or reduce incentives to participate in the labor force (which would affect output growth in the medium and long run). Both effects may lead to lower increases in tax revenues than those indicated by our simulation results. At the same time, however, there is limited evidence that participation rates are highly sensitive to tax rates in Turkey.
5 Concluding Remarks

The purpose of this paper has been to analyze the effects of monetary and fiscal adjustment on public debt sustainability and the behavior of wages and unemployment in Turkey. The model on which the analysis is based captures a number of important structural characteristics of the Turkish economy, such as rural-urban migration, a large urban informal sector, bilateral bargaining in the formal sector, dollarization of the banking system (on both asset and liability sides), as well as the interactions between credibility, default risk on government debt, and inflation expectations. Accounting for default risk on public debt is indeed a key feature of the model, despite its deterministic nature. Our basic assumption is that if the government must engage in large-scale borrowing to meet its debt service payments and finance its deficit, investors will be unwilling to accumulate public bonds indefinitely. We endogenized investors’ behavior by assuming that there is a non-zero perceived probability of default that depends on the debt-to-tax revenue ratio. The higher the perceived risk of default is, the lower will be the degree of credibility of the fiscal stance. Lower credibility, in turn, translates into greater inflation persistence and upward pressure on interest rates on government bonds. Thus, an unsustainable fiscal policy may force the government to adjust, as a result of growing pressure on borrowing costs.

Various simulations were performed. Specifically, we conducted two sets of experiments: a restrictive monetary policy taking the form of a permanent increase in official interest rates, and fiscal adjustment, taking the form of an increase in the VAT rate and an increase in the tax rate on income of profit earners. The results highlighted the importance of accounting for general equilibrium effects in interest rate determination, as well as the link between default risk and credibility in understanding the real and financial effects of adjustment policies. In addition, they also indicated the importance of a broad range of fiscal measures for putting domestic public debt on a sustainable path. These results are consistent with those of several other recent studies of the Turkish economy. For instance, Voyvoda and Yeldan (2003), using an overlapping-generations framework, found that whether the primary surplus target of 6.5 percent of GDP embedded in the May 2001 program is sustainable depended heavily on the vulnerability of the Turkish economy to adverse growth shocks. In addition, the debt-to-GDP ratio was likely to fall only gradually. They called for further fiscal reform to ensure a speedier fall in that ratio—and therefore allow domestic risk premia (or default
probabilities) to fall and interest rates to come down, as in our framework.

As one would naturally expect in a model of this type, our simulation results depend very much on the type of closure rule that we adopted for the government budget. Instead of assuming that the supply of bonds follows an exogenous path and that any residual budget gap is “closed” through an adjustment in transfers to households—a plausible adjustment scenario for a country where the recent crisis has led to a dramatic drop in real wages and a sharp increase in poverty—we could have assumed for instance that the supply of domestic bonds (or foreign borrowing) is endogenous, with an adjustment rule involving either a change in government spending on goods and services produced in the formal sector, or a change in the VAT tax rate, when the ratio of domestic (or foreign) debt to tax revenues reaches a particular level. Such threshold rules are attractive from an empirical standpoint to the extent that they describe quite well the way policymakers tend to respond to excessive growth in their liabilities. Intuitively, the implications for our model are quite clear: by allowing the debt-to-tax ratio to fluctuate a lot more, the probability of default would also fluctuate more, thereby implying a larger effect of default risk (or, equivalently here, credibility) on the actual bond rate. In turn, fluctuations in the bond rate would imply larger effects of any given shock on the financial sector and the real economy.

In addition to the policies considered in this paper, the model can be used to analyze the fiscal and labor market effects of a wide range of shocks. For instance, the model could be used to study the impact of various interest rate rules on output, inflation, and unemployment, or alternative fiscal rules aimed at limiting discretion in spending and ensuring public debt sustainability in the long run (see, for instance, Perry (2003) and Wyplosz (2002)). An analysis of the performance of alternative interest rate rules—which could capitalize on some of the recent research by Berument and Malatyali (2001), Berument and Tasci (2004), and Elekdag (2003)—would be particularly desirable, given Turkey’s planned transition to inflation targeting. The response of Turkey’s economy to various types of external shocks (such as contagion effects, autonomous changes in sentiment on world capital markets, as in Agénor (2005b), or terms-of-trade disturbances) could also be analyzed in the model.

On the labor market side, an important experiment would be to examine the impact of a cut in payroll taxation. Employer-paid social security contributions averaged about 36 percent of total labor costs during 1996-2000; it has been argued that these high social security taxes create strong
disincentives to job creation. More generally, many observers have called for a thorough overhaul of Turkey’s social insurance system. A key issue in this context is how to shift the main pillar of unemployment protection from the severance payment system to the unemployment insurance scheme established in June 2000, and the extent to which this shift will promote labor adjustment in response to changing economic conditions.\textsuperscript{47} The model could also be used to analyze the macroeconomic effects of a reduction in employment of unskilled workers in government. This last simulation is quite important because some observers have argued that continued fiscal adjustment in Turkey may require a sustained retrenchment in public sector employment, given a public sector wage bill that accounted for about 24 percent of central government expenditure in recent years.\textsuperscript{48}

Finally, although already quite complex, our model can be extended or modified in various directions. We assumed that the market for bank credit was imperfectly competitive. Alternatively, it could be assumed that the banking system is oligopolistic, as for instance in Beenstock et al. (2003). This type of market structure could lead to higher, and more rigid, bank lending spreads. Second, workers’ reservation wage could be made a function of severance payments, as for instance in Agénor’s (2003) specification of the wage target of trade unions. This would allow the model to address an important issue for the Turkish labor market (see Tunali (2003)): the wage and employment effects of a reduction in firing costs. Finally, we did not model the stock market. Although the existing evidence suggests that the stock market does not play a significant financial role in Turkey at the present time, its importance may increase in the future—and so will, therefore, its potential effects on private investment and portfolio allocation.

\textsuperscript{47}Social security could be modeled along the lines of Agénor, Nabli, Yousef, and Jensen (2004).

\textsuperscript{48}During the period 1999-2001, public sector employment increased by 5 percent, whereas private employment fell by 6 percent.