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Ozlem Aytac  
Indiana University Bloomington

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# **A MODEL OF EXCHANGE-RATE-BASED STABILIZATION FOR TURKEY**

**Ozlem Aytac  
Indiana University**

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## ABSTRACT

The literature on the exchange-rate-based stabilization has focused almost exclusively in Latin America. Many other countries however, such as Egypt, Lebanon and Turkey; have undertaken this sort of programs in the last 10-15 years. I depart from the existing literature by developing a model specifically for the 2000-2001 heterodox exchange-rate-based stabilization program in Turkey: When the government lowers the rate of crawl, the rate of domestic credit creation is set equal to the lower rate of crawl, bond sales finance the fiscal deficit, and money growth occurs only through capital inflows. Without appealing to high intertemporal elasticity of substitution, the model does very well at replicating the magnitude of the current account deficit (5.5% of GDP predicted vs. 5% of GNP actual), the peak in total consumption spending (10.08% predicted vs. 9.6% actual), average growth rate in total consumption spending (6.7% predicted vs. 6% actual), the peak in durables spending (37.06% predicted vs. 39.5% actual), and the average growth rate in durables spending (24% predicted vs. 27.4% actual) observed in Turkey following the inception of the program.

The difference between an exchange-rate-based stabilization (ERBS henceforth) and a money-based stabilization formally lies in the selection of the nominal anchor: the exchange rate or a monetary aggregate. However, the consequences of the choice of the nominal anchor differ considerably: Inflation stabilization programs that use money as the nominal anchor involve an initial recession followed by the recovery of economic activity. Tight monetary policy brings down inflation gradually at the cost of higher unemployment and lower output.

Based on the experience from money-based stabilization programs, disinflation has been viewed as contractionary. Although the conventional view about the contractionary effects of inflation stabilization has not gone unchallenged<sup>1</sup>, the fundamental challenge emerged in the late 1970s when Chile, Argentina and Uruguay relied on an exchange rate peg as the main instrument of disinflation. These programs, known as the Southern Cone tablitas, followed strict orthodox lines in the sense that exchange rate was the sole nominal anchor. Inflation was to decline quickly to the rate of devaluation. Contrary to the expectations, however, the inflation declined only slowly, which resulted in a sustained and large real exchange rate appreciation.<sup>2</sup> Disinflation was accompanied by a boom in private consumption and real GDP. A more striking fact was the surge in consumers' demand for durable goods.<sup>3</sup> The recessionary phase appeared only later in the programs. And the programs eventually ended in full-blown balance of payments crises with costly devaluations and large losses of international reserves. In the mid 1980s, Argentina, Brazil, and Israel supplemented exchange rate with wage-price controls to bring down inflation quickly. In these heterodox exchange-rate-based stabilization plans inflation came down rapidly to much lower levels compared with the Southern Cone orthodox ERBS episodes.

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<sup>1</sup> Sargent (1982), Vegh (1992).

<sup>2</sup> In Uruguay, real exchange rate appreciated by a staggering 78.8% (Table.5 in Calvo and Vegh, 1995). During the Chilean tablita, real exchange rate appreciated by 25%. And in Argentina, real appreciation was 15% (Table.1 in Helpman and Razin, 1987).

<sup>3</sup> In Chile, real per capita consumption of durable goods rose by 120-130% from the beginning of the program to the year in which private consumption peaked. In Uruguay, real per capita car sales (a proxy for durable goods) rose by 140% from the beginning of the program to the year in which private consumption peaked (Figure.1 in De Gregorio et.al, 1998). In the case of Argentine tablita, the average annual real rate of growth of car sales in the three years before the plan was -7.2%. The growth rate jumped to 31.9% in the early stages of the program (Table.1 in De Gregorio et.al, 1998).

Real appreciation remained as an issue however, and the boom-recession cycle observed in the Southern Cone tablitats reemerged.

The experience from ERBS programs generated a very controversial literature regarding the effects of disinflation programs especially on real consumption and output. Based on the twelve major ERBS programs which were undertaken in Argentina, Brazil, Chile, Israel, Mexico and Uruguay empirical studies in the eighties and early nineties have identified the following stylized facts associated with ERBS<sup>4</sup>: After the exchange rate is fixed, private consumption rises rapidly driven mainly by a boom in consumption of durable goods and continues to increase for several years. Large increases in imports of durable goods lead a considerable deterioration in trade balance. The increase in consumption is accompanied by an expansion in output in the early stages. Inflation usually falls, but convergence to the devaluation rate is slow and incomplete, which results in sustained real exchange rate appreciation. During the program, the current account deficit increases sharply and is financed by large capital inflows, leading to an increase in foreign liabilities. The capital inflows are also associated with a large increase in the ratio of money balances to GDP. The duration and depth of this expansionary phase varies considerably across stabilization episodes. Later on, however, the initial boom is reversed and real output contracts. The recession may occur either before or when the program ends. Most of the time, it starts before the program ends and as the recession sets in the real exchange rate continues to appreciate. The program ends usually with a massive attack on currency, is followed by a sharp nominal devaluation; sometimes inflation then surges to a level even higher than before the program was implemented.<sup>5</sup>

Aside from the empirical studies, various theoretical models have been advanced in order to replicate and explain the stylized facts associated with ERBS programs. One of these, often referred to as the “weak credibility”, is predicated on the idea that given a long

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<sup>4</sup> Corbo (1985), Hanson and de Melo (1985), Kiguel and Liviatan (1992), Vegh (1992), Reinhart and Vegh (1995b), De Gregorio et al. (1998), Calvo and Vegh (1999).

<sup>5</sup> Although later empirical studies based on larger and more diverse panel data sets (Easterly, 1996; Hamann, 2001; Hamann et. al., 2005) dispute the validity of empirical regularities associated with ERBS, the results found can be doubted considering the major obstacles that these studies face about the definition of stabilization episodes, the classification of episodes by type of nominal anchor, and the need to control for other domestic and external shocks. Overall, the evidence supports the view that there exists a boom-bust cycle associated with exchange rate based stabilization plans.

history of failed disinflation policies stabilization attempts in chronic inflation countries are likely to suffer from lack of credibility. Weak credibility has been first introduced by Calvo (1986). Later, Calvo and Vegh (1993) developed this theory further by adding non-traded good and sticky prices. Models of weak credibility rely on intertemporal substitution effects as the key channel through which stabilization plans may have real effects. When the reduction in the rate of devaluation is not credible, in the sense that the public expects that the program will be abandoned at some point in the future, the fall in the nominal interest rate resulting from the lower devaluation rate and perfect capital mobility, is viewed as temporary. Because of the cash-in-advance constraint this temporary fall in the nominal interest rate reduces the effective price of consumption today relative to the future. Hence, demand for both traded and non-traded goods increases and leads to an initial expansion in the non-traded goods sector and a current account deficit. Since prices are sticky, the slow convergence of inflation results in a sustained real exchange rate appreciation, which eventually reduces the demand for non-traded goods. As a consequence, output falls and a recession sets in. The recession may occur either before or when the program ends.

The qualitative predictions of Calvo and Vegh (1993) are generally consistent with the stylized facts. As for its quantitative explanatory power, the theory has been criticized for relying on high intertemporal elasticity of substitution to be able to generate strong short-run quantitative effects comparable to those observed in the data<sup>6</sup>. Reinhart and Vegh (1995a) have examined the empirical relevance of this hypothesis, by estimating the intertemporal elasticity of substitution for five chronic inflation countries (Argentina, Brazil, Israel, Mexico, and Uruguay). Using these estimates, ranging from 0.19 to 0.53, they computed the predicted increases in consumption for seven major ERBS programs (the Southern-Cone orthodox stabilizations of the 1970s in Argentina, Uruguay, and Chile; and the heterodox stabilizations of the 1980s in Brazil, Argentina, Israel, and Mexico). Unfortunately, weak credibility could account for 60 percent of the observed increase in consumption in the four heterodox plans, whereas it could account for only about 10

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<sup>6</sup> Estimates places intertemporal elasticity of substitution between .20 and .50 for developing countries (Table 10.1 in Agenor and Montiel, 1996).

percent of the actual increase in consumption in the Southern Cone tablitas. Later, Uribe (2002) introduced habit formation in a general equilibrium context with flexible prices and weak credibility. When combined with habit formation, weak credibility generates the stylized facts very well at a qualitative level. However, adding habit formation has not improved the quantitative aspect of the results. Predicted consumption boom, real exchange rate appreciation and current account deficit were still smaller than those observed during ERBS programs.

Recently, Atolia and Buffie (2005) have established the additional quantitative power of weak credibility hypothesis via its impact on durables spending. In the model they developed, the private sector consumes both durable and nondurable goods, domestic and foreign currency are imperfect substitutes, prices are sticky, and fiscal adjustment is delayed until after ERBS collapses. Consumption boom and real exchange rate appreciations generated in this model are in the order of magnitude that has been observed in ERBS programs. Incorporating durable consumer goods particularly improves the quantitative power of the weak credibility cum sticky prices hypothesis by generating a strong consumption boom even with very low values for the intertemporal elasticity of substitution. Durables expenditure is a form of investment because most of the good is consumed in the future. Therefore, irrespective of whether the intertemporal elasticity of substitution is large or small, there is an incentive to make large purchases of durable good when its price is temporarily low. This is what Calvo (1988) calls *intertemporal price speculation*.

This paper is another attempt to explain the stylized facts surrounding ERBS by appeal to weak credibility cum sticky prices. I work with a variant of the model developed in Atolia and Buffie (2005), which is a currency substitution model of a small open economy that operates under an open capital account and a crawling peg exchange rate. My model differs in two respects, however: First, I relax the assumption that traded and nontraded durables are consumed in fixed proportions. Second, I analyze a heterodox program where bond sales finance the fiscal deficit and money growth occurs only through capital inflows. Furthermore, by developing a model specifically for the 2000-2001 heterodox ERBS

program in Turkey, I also depart from the existing literature which has focused almost exclusively in Latin America.

In order to assess the model's quantitative performance; it is calibrated by using data restrictions mainly from the Turkish economy. Without appealing to high intertemporal elasticity of substitution, the model can generate consumption boom, the current account deficit, and real exchange rate appreciation that are comparable to those observed in Turkey in the aftermath of 2000-2001 ERBS program. The single major shortcoming is regarding the timing of the response of consumption. Instead of displaying an inverted-U shape, consumption declines steadily after a one time jump at the time the policy is announced. Following Atolia and Buffie (2006), I incorporated habit formation in deliberation costs in order to overcome the problem regarding the shape of consumption. In the numerical simulations with habit affecting deliberation costs, the paths of durables spending and total consumption spending are hump-shaped but the timing of the downturn is not quite right. In all of the runs, the turning points come at the end of the first quarter following the implementation of the program whereas the downturn in consumption boom came at the end of the third quarter in Turkey.

The paper is organized into six sections. First section presents the policy measures of the 2000-2001 ERBS program in Turkey and then discusses the macroeconomic developments after the implementation of the program. Section 2 lays out the model. Section 3 provides a brief sketch of the solution procedure and calibration. Section 4 follows with numerical simulations and investigates the sensitivity of the results to key parameters. Section 5 examines the results of the habit incorporated model. The final section contains concluding remarks.

## **1. 2000-2001 Turkish ERBS Program**

Turkey has had a long history of chronic and high inflation. Inflation started to take off during the 1970s, though fell briefly after the initiation of a far-reaching stabilization and liberalization program in January 1980, the success did not last long. Both public sector deficit and inflation reversed their declining pattern in the mid 1980s. Over the 1990s, the economy never achieved a period of sustained fiscal control. Public accounts continuously deteriorated except some small and short lived improvements in 1995 and 1998 caused by



the stabilization programs. Weak governments consisting of multiparty coalitions and frequent elections reflected in stop-go pattern of economic management, chronic and high inflation, and an increasing debt position.

Against this background, in an attempt to stabilize the Turkish economy plagued by the chronic inflation and high real interest rates; authorities launched an exchange-rate-based stabilization program in January 2000. The central bank moved from a “managed float” to a pre-announced exchange rate path against a currency basket composed of a weighted average of the euro and the US dollar. The programmed depreciation of the TL was equal to the WPI inflation target (20 percent) for the year of 2000. The exchange rate policy was to be assisted by a monetary policy similar to a currency board. Net domestic assets of the central bank were not to exceed their end-1999 level at the end of each quarter. Fiscal deficit was to be financed mainly by selling bonds. Sterilization was completely excluded. Therefore, base money was to be changed only in connection with balance of payments inflows or outflows, with interest rates being fully market determined. In order to break downward rigidity in inflation, the program also included temporary wage-prize controls.

As for the macroeconomic developments after the implementation of the program, they are in line with the general dynamics displayed by other ERBS programs. Upon the announcement, nominal interest rates declined immediately<sup>7</sup>. The sharp decline in interest rates was accompanied by a surge in spending. The real rate of growth in imports rose from -2 percent in 1999:3 to 5.2 percent in 1999:4 and jumped to quarterly rates of 34.9 percent and 25.2 percent in the first half of 2000. The surge in sales of durable goods and cars was remarkable. The growth rate in sales of durable goods jumped from 4.3 percent in December of 1999 to 62 percent in January of 2000, while the rate of growth of car sales jumped from 29 percent to 107.5. Because of the very strong upturn in domestic demand, real GDP which has fallen 5 percent in 1999, expanded at a rate of 7.4 percent in 2000. The program succeeded in reducing the inflation, but not enough to prevent the sizable real appreciation associated with ERBS episodes. Due to slow convergence of inflation, real

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<sup>7</sup> Nominal interest rates on three month maturity of Treasury secondary market securities fell from 96.4 percent in September 1999 to 51.6 percent in December upon the announcement of the program and continued to fall until mid-summer (OECD, 2001; Table.6).

exchange rate appreciated 16 percent by the end of 2000. Real appreciation was accompanied by massive net capital inflows by non-residents, which reached 15.5 billion US dollars by the end of October 2000. Surge in domestic absorption coupled with real appreciation of the domestic currency led to the rapid expansion in current account deficit reaching 9.8 billion US dollars (almost 5 % of GNP) by the end of the year.

By November 2000 IMF officials started to express their concerns on the widening current account deficit. On November 22<sup>nd</sup>, a financial distress emerged in domestic banking sector turned into a full-blown liquidity crisis in no time when the sustainability of the peg was called into question. More than one quarter of the total central bank reserves flowed out during the November crisis. Only after the announcement of the IMF package on 6 December, the capital outflow stopped. After a few months of muddling through to keep the nominal anchor at all costs, a second attack came on February 20<sup>th</sup>. The overnight interest rates jumped to sky-high levels and the central bank sold \$5.2 billion within two days<sup>8</sup>. Two days later, the exchange rate system collapsed and domestic currency depreciated by 40 percent in a day. The currency peg was abandoned and replaced with a regime of free floating.

The economy fell into a severe recession in February 2001, which continued almost until the last quarter of 2002. Real GDP declined by 7.5 percent after expanding at a rate of 7.4 percent in 2000. Of the consumption expenditures, the deepest slump was witnessed in durables, with contractions of 20.32 percent and 36.12 percent in the first half of 2001. After durables, the highest contraction was in imports, with annual real rates of growth of -14.5 percent in the first quarter and -31 percent in the second quarters. Following the severe downturn in domestic absorption, the current account balance tilted to a surplus of 3.3 billion US dollars from a deficit of 9.8 billion US dollars. Post crisis fiscal policy in 2001 relied mainly on severe contraction of non-interest expenditures and sharp increase in administered prices. Government consumption expenditures contracted substantially in real terms throughout the year.

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<sup>8</sup> Interbank weighted average overnight simple interest rates, which were 43 % on February 19<sup>th</sup>, jumped to 2058 % on the 20<sup>th</sup>, peaked at 4019 % on the 21<sup>st</sup>, fell to 1195 % on the 22<sup>nd</sup>, then to 568 % on the 23<sup>rd</sup>, finally settled at around 100 % by end – February (Gokkent et.al, 2001).

## 2. The Model

There are three financial assets in the model: domestic currency  $M$ , foreign currency  $F$ , and indexed treasury bonds. Both domestic and foreign currencies provide liquidity services. Considering the fact that Turkey has been a highly dollarized economy I prefer foreign currency rather than a foreign bond as the foreign asset. Over the 1990s, the ratio of foreign currency deposits to broad money has been 45-47 percent on average in Turkey. The share of foreign currency deposits in total deposits rose from 25.5 percent in 1990 to 45.9 percent in 1999 and reached 57.6 percent by the end of 2001<sup>9</sup> even though the average real rates of return on TL denominated assets were generally higher than those on foreign currency denominated deposits<sup>10</sup>. The collapse of the ERBS program in February 2001 promoted currency substitution further. The level of foreign currency deposits which was \$36 billion at the end of 2000 continued to increase and reached \$45 billion in 2003. A recent study by the Fed also confirms that Turkey has been one of the highly dollarized economies in the world. In that study, Turkey ranks as the fifth largest US currency holder with an estimated \$10 billion in circulation as of 2002. Another reason for choosing foreign currency rather than a foreign bond is to make sure that foreign and domestic currency assets are not perfect substitutes. In an optimizing, perfect –foresight model with an open capital account, domestic and foreign bonds are perfect substitutes and the domestic interest rate differs from the foreign rate only by the percentage depreciation of the exchange rate. Thus is not consistent with the data from developing countries.

The economy produces a nontraded good and a traded good. Real output in the tradables sector is fixed whereas it is demand determined in the nontradables sector. The nontraded good can be consumed either as a durable or a nondurable good. The private sector also consumes an imported durable good. World prices equal unity, so the domestic price of the tradable good is set by the nominal exchange rate  $e$ .  $P$  is the overall price level (i.e., consumer price index).  $P_n$  and  $\gamma$  denote the relative price of the nontraded good and its share in aggregate consumption respectively.  $Q_i$  is output in sector  $i$ .  $F$ ,  $m$ , and  $E$  are the

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<sup>9</sup> Bahmani-Oskooee and Domac (2002)

<sup>10</sup> Between 1990 and 2000, the average real rates of return on TL denominated deposits were 20 percent while the same rate were about 3 percent for foreign currency denominated deposits. See Civcir (2003).

stock of foreign currency, real money balances, and real nondurables expenditure measured in units of the traded good (i.e., measured in dollars).

### Prices

The overall price level  $P$  is a geometric average of the prices of the traded and nontraded goods. Since the nominal exchange rate sets the domestic price of the traded good,

$$P = e P_n^\gamma \quad (1)$$

The inflation rate is

$$\pi = (1 - \gamma) \chi + \gamma \pi_n \quad (2)$$

where  $\gamma \equiv \gamma_{nd} \gamma_d + \gamma_{ne} \gamma_e$ ;  $\gamma_d$  and  $\gamma_e$  are the respective weights of durables and nondurables in the CPI;  $\gamma_{nj}$  is the share of nontradables in total spending on consumer good of type  $j$ ;  $\chi$  is the rate of currency depreciation; and  $\pi_n$  is the rate of price growth in the nontradables sector.

### The Nontradables Sector

The nontraded good can be consumed either as a nondurable or a durable good. Consumption on nontraded nondurables is given by the Marshallian demand function  $C_n(P_n, E)$  and the demand for durables is given by gross new purchases of the nontraded durables,  $S_1$ . Since consumer purchases are the only source of demand, the nontradables market clears when

$$C_n(P_n, E) + S_1 = Q_n \quad (3)$$

Prices in the nontradables sector are sticky a la Calvo and Vegh (1993). Firms adjust prices only when they receive a random “price-change signal”. Firms that receive a signal choose a new price by forecasting the future paths of the price level and excess demand. Therefore, price adjustment is forward-looking. Forward-looking price setting is also consistent with the price setting behavior in the Turkish economy. Although part of public wage and price setting involves ex-post inflation indexation, wages have been determined flexibly in the private sector. Shiller (1997) as a matter of fact, shows Turkey as a surprising example of a country that has lived with persistently high inflation for such a long time without widespread indexation. Empirical findings in Celasun, Gelos, and Prati

(2003), and Celasun and McGettigan (2005) also fit with the limited evidence of indexation. Back to the model, Calvo (1983) shows that when the price-change signal obeys a Poisson process

$$\dot{P}_n = (\pi_n - \chi)P_n \quad (4)$$

$$\dot{\pi}_n = -\alpha \left[ C_n(P_n, E) + S_1 - \bar{Q}_n \right], \quad \alpha > 0, \quad (5)$$

where  $\bar{Q}_n$  denotes notional output (i.e., the level of output associated with a normal capacity utilization rate) and a dot signifies a time derivative (i.e.,  $\dot{x} = \frac{dx}{dt}$ ). Equation (4)

follows from the fact that, at any point in time, the nominal price of the nontraded good is fixed by past price quotations. (More precisely, at any time  $t$  the set of firms that adjust their prices is of measure zero.) Equation (5) is a higher-order Phillips Curve. It says that the *change* in  $\pi_n$ , the inflation rate in the nontradable sector, is a decreasing function of excess demand. The parameter  $\alpha$  is larger the shorter the length of the average price quote.

### The Private Agent's Optimization Problem

All economic activity in the private sector is undertaken by a representative agent who possesses an instantaneous utility function of the form,

$$H(C_n, C_T, D_1, D_2) = \frac{C(C_n, C_T)^{1-\frac{1}{\tau}}}{1-\frac{1}{\tau}} + \frac{D_1^{1-\frac{1}{\psi}}}{1-\frac{1}{\psi}} + k_4 \frac{D_2^{1-\frac{1}{\psi}}}{1-\frac{1}{\psi}} - R_1 \left( \frac{\dot{D}_1}{D_1} \right) D_1 - R_2 \left( \frac{\dot{D}_2}{D_2} \right) D_2,$$

where  $D_1$  is the stock of nontraded durables,  $D_2$  is the stock of imported durables,  $C(C_n, C_T)$  is an index of nondurables consumption and  $k_4$  is a constant which determines the ratio of nontraded durables to imported durables at the initial steady state equilibrium.  $R_i(\cdot)$ , introduces a friction that prevents durables purchases from being too volatile. It captures the costs incurred when consumers adjust their durables stock through new durables purchases. As Bernanke emphasizes, new durables purchases are not easy or automatic. In contrast to nondurables spending, the decision to buy a durable often

involves time consuming search and careful deliberation. The utility cost of worrying and lost leisure time is assumed to be increasing, symmetric, and convex in net purchases of durable goods:  $R_i(0) = 0, R_i' \geq 0$  as  $\dot{D}_i \geq 0$  and  $R_i'' > 0$

The representative agent has homothetic preferences and possesses perfect foresight. The private agent's optimization problem is solved in two stages. In the first stage,  $C_n, C_T$  are chosen to maximize  $C(C_n, C_T)$  for given values of  $P_n$  and  $E$ . Write this part of solution as  $C^* = V(P_n, E)$ .  $V(P_n, E)$  is a standard indirect utility function that measures felicity gained from consumption of nondurables ( $V_E > 0, V_{P_n} < 0$ ). In the second stage, the private agent chooses  $m, F, b, S_1, S_2$  and  $E$  to maximize,

$$U = \int_0^\infty \left\{ V(P_n, E) + k_4 \frac{D_2^{\frac{1}{1-\psi}}}{1 - \frac{1}{\psi}} + \frac{D_1^{\frac{1}{1-\psi}}}{1 - \frac{1}{\psi}} - R_1 \left( \frac{S_1}{D_1} - c \right) D_1 - R_2 \left( \frac{S_2}{D_2} - c \right) D_2 \right\} e^{-\rho t} dt, \quad (6)$$

subject to the wealth constraint

$$A = m + F + P_n' b, \quad (7)$$

the budget constraint,

$$\dot{A} = P_n Q_n + Q_T + \bar{g} + r P_n' b + (\pi - \chi) P_n' b - \chi m - Y \left( 1 + L \left[ \frac{\phi(m, F)}{Y} \right] \right), \quad (8)$$

and,

$$\dot{D}_1 = S_1 - c D_1, \quad (9)$$

$$\dot{D}_2 = S_2 - c D_2, \quad (10)$$

where  $\rho$  is the time preference rate,  $c$  is the depreciation rate for durables,  $m = \frac{M}{e}$  is the

real domestic money balances,  $b = \frac{B}{P}$  is the real stock of bonds,  $r$  is the real interest,

$S_1$  and  $S_2$  represent the new purchases of nontraded and imported durables,

$Y = E + P_n S_1 + S_2$  is aggregate spending and  $\bar{g}$  is lump sum transfers. Domestic and

foreign currencies are held to reduce transactions-costs<sup>11</sup>. Transactions costs,  $YL\left[\frac{\phi(m,F)}{Y}\right]$ , are assumed to be decreasing in the ratio of liquidity services  $\phi$  to aggregate spending. Liquidity services are generated by domestic and foreign currency.  $\phi(\cdot)$  is homogeneous of degree one, increasing and strictly concave in  $m$  and  $F$  ( $\phi_m, \phi_F > 0, \phi_{mm}, \phi_{FF} < 0$ ).  $L(\cdot)$  is decreasing and strictly convex ( $L'(\cdot) < 0, L''(\cdot) > 0$ ). In the budget constraint,  $P_n^\gamma$  multiplies  $b$  because wealth is measured in dollars but bonds are indexed to the price level. Let  $\omega_1, \omega_2$ , and  $\omega_3$  be the multipliers attached to the constraints (8), (9) and (10). The first order conditions are

$$V_E(P_n, E) = \omega_1 \left( 1 + L - L' \frac{\phi}{Y} \right), \quad (11)$$

$$-L' \phi_m = r + \pi, \quad (12)$$

$$-L' \phi_F = r + \pi - \chi, \quad (13)$$

$$\omega_2 = \omega_1 P_n \left( 1 + L - L' \frac{\phi}{Y} \right) + R_1', \quad (14)$$

$$\omega_3 = \omega_1 \left( 1 + L - L' \frac{\phi}{Y} \right) + R_2', \quad (15)$$

and the co-state equations are

$$\dot{\omega}_1 = \omega_1 (\rho + \chi - r - \pi), \quad (16)$$

$$\dot{\omega}_2 = \omega_2 (\rho + c) + R_1 - R_1' \frac{S_1}{D_1} - D_1 \frac{1}{\psi}, \quad (17)$$

$$\dot{\omega}_3 = \omega_3 (\rho + c) + R_2 - R_2' \frac{S_2}{D_2} - D_2 \frac{1}{\psi}, \quad (18)$$

Equation (11) states that the marginal utility of consumption of nondurables equals the shadow price of wealth times the effective price of nondurables consumption. Effective price consists of the market price of the good plus the transactions costs incurred by

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<sup>11</sup> See Rebelo and Vegh (1995), Reinhart and Vegh (1995), and Uribe (2002) for the same specification of transactions costs.

purchasing an additional unit of the good. Equations (12) and (13) are straightforward arbitrage conditions. Consumer equates, at the margin, the reduction in transaction costs that result from real holding of an additional domestic (or foreign) currency to its opportunity cost which is nominal interest rate for domestic currency. Equations (14), (15), (17) and (18) define a Tobin's  $q$  model of durables purchases.

$$\frac{\omega_i}{\omega_1 P_n \left(1 + L - L \frac{\phi}{Y}\right)} = \frac{\omega_i}{V_E P_n}, (i = 2, 3) \text{ is the ratio of the demand price (or shadow price) of a}$$

durable to its supply price.  $R'_i$  captures the additional adjustment costs incurred by increasing  $S_i$  a small amount. And equation (16) is simply an Euler equation.

### The Public Sector

The public sector is composed of the government and the central bank. The central bank issues high powered money ( $M$ ) in order to finance the fiscal deficit of the government and holds foreign exchange reserves ( $Z$ ). I assume that the foreign exchange reserves do not bear interest. The central bank's balance sheet is

$$M = DC + eZ \quad (19)$$

where  $DC$  is the central bank's domestic credit to the government.

Money is injected into the economy whenever the central bank accumulates foreign exchange reserves or runs the printing press to finance the fiscal deficit.

$$\dot{m} + \chi m = \frac{\dot{DC}}{e} + \dot{Z}, \quad (20)$$

The government makes lump sum transfers to the private agent and collects fees,  $YL(\cdot)$ , for liquidity services. Fees are then returned to the private sector through transfers. Therefore, lump sum transfers have two components: True transfers,  $P_n^\gamma g$  and rebated fees,  $YL\left[\frac{\phi(m, F)}{Y}\right]$ .

$$\bar{g} = P_n^\gamma g + YL\left[\frac{\phi(m, F)}{Y}\right], \quad (21)$$



$P_n^\gamma$  multiplies  $g$  because  $\bar{g}$  is measured in dollars but transfers are indexed to the price level.

In addition to paying out lump-sum transfers, the government makes unproductive purchases of  $X$  units of the traded good. The government also issues indexed domestic bonds which are held by the private agent. The government budget constraint is thus

$$\frac{\dot{DC}}{e} + P_n^\gamma \dot{b} = \bar{g} + rP_n^\gamma b + X - YL,$$

or,

$$\frac{\dot{DC}}{e} + P_n^\gamma \dot{b} = P_n^\gamma g + rP_n^\gamma b + X, \quad (22)$$

Combining equations (20) and (22) yields the consolidated public sector budget constraint

$$\dot{m} + P_n^\gamma \dot{b} = P_n^\gamma g + rP_n^\gamma b + X + \dot{Z} - \chi m, \quad (23)$$

### **Crawling Peg and Bond-Financed Fiscal Deficit During ERBS**

At the pre-ERBS steady-state equilibrium, seigniorage pays for the entire fiscal deficit, the current account deficit is zero, the real interest rate equals the time preference rate, the real money supply and the real stock of bonds are constant. That is

$$\pi = \pi_n = \chi_0, \quad (\text{Pre-ERBS phase})$$

$$\dot{m} = \dot{b} = \dot{Z} = \dot{F} = 0, \quad (\text{Pre-ERBS phase})$$

$$\frac{\dot{DC}}{e} = \chi_0 m, \quad (\text{Pre-ERBS phase})$$

$$\chi_0 m_0 = P_n^\gamma g + rP_n^\gamma b_0 + X \quad (\text{Pre-ERBS phase})$$

When the government lowers the rate of crawl from  $\chi_0$  to  $\chi_1$ , the rate of domestic credit creation is set equal to the lower rate of crawl ( $\chi_1$ ), and bond sales adjust as needed in order to cover the rest of the fiscal deficit.

$$\frac{\dot{DC}}{e} = \chi_1 m, \quad 0 \leq t < t_1 \quad (\text{ERBS phase}) \quad (24)$$

Therefore, during the ERBS phase  $b$  and  $m$  evolve according to

$$\dot{m} = \dot{Z}, \quad 0 \leq t < t_1 \quad (\text{ERBS phase}) \quad (25)$$

$$\dot{b} = g + rb + \frac{X - \chi_1 m}{P_n'}, \quad 0 \leq t < t_1 \quad (\text{ERBS phase}) \quad (26)$$

As it is pointed out in Rebelo and Vegh (1995) many ERBS programs got out off the track quickly due to insufficient fiscal adjustment<sup>12</sup>. As comes to the 2000-2001 Turkish ERBS, the program rested on an upfront fiscal adjustment worth of 6.5 percent of GNP in order to reduce the WPI inflation from 63 percent to 20 percent by the end of 2000. Although fiscal benchmarks were attained successfully the economy was hit by a severe currency crisis in November 2000; and the program collapsed after a couple of months. As in many other failed stabilization episodes post crisis fiscal policy relied on sharp fiscal adjustments. In 2001, government consumption expenditures fell by 8.5 percent in real terms. Given the circumstances, doubts arise about the sufficiency of initial fiscal adjustment to support a permanently lower crawl in Turkey. Accordingly, I assume that the reduction in the rate of crawl from  $\chi_0$  to  $\chi_1$  is not supported by a fiscal adjustment.

### Net Foreign Asset Accumulation and the Current Account Balance

Adding consolidated public sector and private agent budget constraints yields

$$\dot{Z} + \dot{F} = P_n Q_n + Q_T - E - P_n S_1 - S_2 - X,$$

or,

$$\dot{m} + \dot{F} = P_n Q_n + Q_T - E - P_n S_1 - S_2 - X$$

since

$$\dot{m} = \dot{Z}$$

Under a crawling peg, the money supply adjusts endogenously through the capital account in order to satisfy money demand. But while domestic currency can be swapped for foreign currency at the central bank, the total dollar value of currency holdings

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<sup>12</sup>For instance Argentine 1978 tablita, and 1986 Brazilian Cruzado.

predetermined. Thus we need to define  $J \equiv m + F$  as a state variable in the dynamic system. That is

$$\dot{J} = P_n Q_n + Q_T - E - P_n S_1 - S_2 - X, \quad (27)$$

### The Post-ERBS Period

At time  $t_1$ , the program collapses, bond sales stop and the deficit is fully monetized. From

$t_1$  onward, therefore,  $\dot{b} = 0$  and

$$\dot{m} = P_n' g + r P_n' b(t_1) + X + \dot{Z} - \chi m, \quad t \geq t_1. \quad (\text{Post-ERBS phase}) \quad (28)$$

When the program collapses, the government raises the crawl by the amount  $K$  and curtails lump sum transfers  $g$  by the amount  $W$ . I assume that the first adjustment in the crawl is inadequate and followed by further increases at the rate

$$\dot{\chi} = \nu(\chi_0 - \chi), \quad \nu > 0, \quad t \geq t_1, \quad (29)$$

The path for the crawl is described by (29) and the exogenous adjustment at time  $t_1$  is

$$\chi(t) = \chi_1 + K + (\chi_0 - \chi_1 - K) \left[ 1 - e^{-\nu(t-t_1)} \right], \quad t \geq t_1. \quad (30)$$

Since the inflation will go to its original level  $\chi_0$  in the long run, any increase (or decrease) in domestic debt has to be offset by permanently lower (or higher) transfers.

Therefore, after the program fails,  $g$  goes toward its post-stabilization level  $\tilde{g}$ , associated with permanently higher domestic debt. The path for  $g$  is

$$\dot{g} = y(\tilde{g} - g), \quad y \geq 0, \quad t \geq t_1. \quad (31)$$

$$g(t) = \tilde{g} + \left( g(t_1) - \tilde{g} \right) e^{-y(t-t_1)} \quad t \geq t_1. \quad (32)$$

where

$$\tilde{g} = \chi_o m_o - \rho b(t_1) - X_o$$

### 3. A Brief Sketch of the Solution Procedure and Model Calibration

#### Solution Procedure

Since the perfect foresight solution to the model generates a dynamic system with characteristic equation of a high-order polynomial there is no hope of deriving a closed-form solution. It is necessary therefore to rely on a mix of numerical and analytical methods. Because the algebra is unpleasant, I skip over most of the details and simply outline the logic of the solution procedure. A more detailed mathematical solution is relegated to the appendix.<sup>13</sup>

The first step in the solution procedure is to eliminate the unobservable shadow prices from the dynamic system. Differentiating (11) with respect to time and substituting for  $\dot{\omega}_1$  from (16) gives<sup>14</sup>

$$\begin{aligned} \left[1 - \frac{\tau}{\beta} a_1 \gamma_e\right] \frac{\dot{E}}{E} = & \left[ \tau \gamma - \gamma_{ne} (\tau - 1) + \frac{\tau}{\beta} a_1 \gamma_{nd} \gamma_d \right] (\pi_n - \chi) + \frac{\tau}{\beta} a_1 \gamma_{nd} \gamma_d \frac{\dot{S}_1}{S_1} + \frac{\tau}{\beta} a_1 \gamma_d (1 - \gamma_{nd}) \frac{\dot{S}_2}{S_2} \\ & - \frac{\tau}{\beta} a_1 \left(1 - \theta_F \frac{J}{F}\right) \frac{\dot{m}}{m} - \frac{\tau}{\beta} a_1 \theta_F \frac{J}{F} \frac{\dot{J}}{J} + \tau(r - \rho) \end{aligned} \quad (33)$$

Applying the same thing to (14), (17) and (15), (18) produces

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<sup>13</sup> Appendix is available upon request

<sup>14</sup>  $\tau = -\frac{V_E}{V_{EE}E}$  is the intertemporal elasticity of substitution for nondurables,  $\beta = -\frac{L'}{L'' \frac{\phi}{Y}}$  is

the inverse of the elasticity of marginal utility of real liquidity holding,  $\theta_F = \frac{\phi_F F}{\phi}$  is the

share of liquidity services generated by foreign currency, and  $a_1 = \frac{L' \frac{\phi}{Y}}{1 + L - L' \frac{\phi}{Y}}$ .

$$\begin{aligned}
\frac{R_1''}{D_1} \dot{S}_1 &= \frac{R_1''}{D_1^2} S_1 (S_1 - cD_1) + \rho R_1' + R_1 + R_1' \left( c - \frac{S_1}{D_1} \right) - D_1^{-\frac{1}{\psi}} + V_E P_n (r + c) + V_E P_n \frac{a_1}{\beta} \gamma_{nd} \gamma_d \frac{\dot{S}_1}{S_1} \\
&+ V_E P_n \left[ (\gamma - 1) + \frac{a_1}{\beta} \gamma_{nd} \gamma_d \right] (\pi_n - \chi) - V_E P_n \frac{a_1}{\beta} \left( 1 - \theta_F \frac{J}{F} \right) \frac{\dot{m}}{m} - V_E P_n \frac{a_1}{\beta} \theta_F \frac{J}{F} \frac{\dot{J}}{J} \\
&+ V_E P_n \frac{a_1}{\beta} \gamma_e \frac{\dot{E}}{E} + V_E P_n \frac{a_1}{\beta} \gamma_d (1 - \gamma_{nd}) \frac{\dot{S}_2}{S_2} \quad (34)
\end{aligned}$$

$$\begin{aligned}
\frac{R_2''}{D_2} \dot{S}_2 &= \frac{R_2''}{D_2^2} S_2 (S_2 - cD_2) + \rho R_2' + R_2 + R_2' \left( c - \frac{S_2}{D_2} \right) - D_2^{-\frac{1}{\psi}} + V_E (r + c) + V_E \frac{a_1}{\beta} \gamma_{nd} \gamma_d \frac{\dot{S}_1}{S_1} \\
&+ V_E \left[ \gamma + \frac{a_1}{\beta} \gamma_{nd} \gamma_d \right] (\pi_n - \chi) - V_E \frac{a_1}{\beta} \left( 1 - \theta_F \frac{J}{F} \right) \frac{\dot{m}}{m} - V_E \frac{a_1}{\beta} \theta_F \frac{J}{F} \frac{\dot{J}}{J} + V_E \frac{a_1}{\beta} \gamma_e \frac{\dot{E}}{E} \\
&+ V_E \frac{a_1}{\beta} \gamma_d (1 - \gamma_{nd}) \frac{\dot{S}_2}{S_2} \quad (35)
\end{aligned}$$

During the ERBS phase the dynamic system involves  $P_n, \pi_n, D_1, D_2, S_1, S_2, E, J, b$ . Equations (33), (34), and (35) have variables ( $m, r$ , and  $Q_n$ ) that change on the transition path although they are not part of the dynamic system. Therefore, we need to relate these to all other variables which belong to the system. To accomplish this, use (12) and (13) from the first order conditions and assume  $\phi(m, F)$  is a linearly homogeneous CES function with  $\sigma$  being the elasticity of substitution between  $m$  and  $F$ . In this case (12) and (13) yield

$$\frac{(\sigma\theta_m + \beta\theta_F)}{\sigma} \hat{m} + \frac{(\sigma - \beta)}{\sigma} \theta_F \hat{F} = \hat{Y} - \frac{\beta}{i} (dr + d\pi), \quad (36)$$

$$\frac{(\sigma - \beta)}{\sigma} \theta_m \hat{m} + \frac{(\sigma\theta_F + \beta\theta_m)}{\sigma} \hat{F} = \hat{Y} - \frac{\beta}{(i - \chi)} (dr + d\pi - d\chi), \quad (37)$$

where a circumflex indicates a percentage change (i.e.,  $\hat{x} = \frac{dx}{x}$ ),  $i = r + \pi$  is the nominal interest rate, and

$$\theta_m \equiv \frac{\phi_m m}{\phi} = \frac{\phi_m m}{\phi_m m + \phi_F F}, \quad \theta_F \equiv \frac{\phi_F F}{\phi} = \frac{\phi_F F}{\phi_m m + \phi_F F}$$

are the shares of liquidity services provided by domestic and foreign currency. Equations (36) and (37) can be solved for  $m$  and  $r$  as a function of  $E, P_n, S_1, S_2, J, \pi_n, \chi$ . That is

$$m = f^1(E, S_1, S_2, J, P_n, \chi), \quad r = f^2(E, S_1, S_2, J, P_n, \chi, \pi_n) \quad (38), (39)$$

By using  $J \equiv m + F$ , (38) and (39) equations (33), (34), and (35) can be solved for  $\dot{E}, \dot{S}_1, \dot{S}_2$ . The full solutions are stated in the appendix. To economize on space, I express the solutions here in the general form

$$\dot{E} = f^3(E, S_1, S_2, D_1, D_2, P_n, \pi_n), \quad (40)$$

$$\dot{S}_1 = f^4(E, S_1, S_2, D_1, D_2, P_n, \pi_n), \quad (41)$$

$$\dot{S}_2 = f^5(E, S_1, S_2, D_1, D_2, P_n, \pi_n), \quad (42)$$

After obtaining the solution for the  $Q_n$  as a function of  $S_1, P_n, E$ ; equations (4), (5), (9), (10), (26), (27), (40), (41), (42) together with (38) and (39) define a self-contained system of nine differential equations in  $E, S_1, S_2, \pi_n, J, P_n, D_1, D_2$  and  $b$ . In this  $9 \times 9$  system which controls the equilibrium path during the stabilization period where the rate of crawl is constant;  $J, P_n, D_1, D_2, b$  are predetermined and  $E, S_1, S_2, \pi_n$  are jump variables.

In the post-ERBS period,  $\dot{b}$  (equation 26) drops out, and  $\chi$  and  $g$  enter through (29) and (31) as additional state variables ( $\chi$  and  $g$  jump at  $t_1$ , but the jumps are exogenous.) This produces a  $10 \times 10$  system in which  $J, P_n, D_1, D_2, \chi, g$  are predetermined and  $E, S_1, S_2, \pi_n$  are jump variables. Thus, the dynamic system that takes over at time  $t_1$  is saddlepoint stable iff six of the system's ten eigenvalues are negative.

I assume that the reduction in the rate of crawl catches the public by surprise. The subsequent policy reversal at  $t_1$ , however, is perfectly anticipated. The public knows from

the outset that ERBS is not sustainable and the government will eventually abandon the policy at time  $t_1$ . From  $t = 0$  up to time  $t_1$ , the economy follows a nonconvergent path of the system associated with the low rate of crawl,  $\chi_1$ . At time  $t_1$ , this path connects with the saddle path that leads back pre-ERBS equilibrium.

### Model Calibration

In order to prepare the model for calibration I use the following functional forms in order to describe preferences, the production of liquidity services, transactions costs and deliberation costs

$$\phi(m, F) = \left[ k_2 m^{\frac{\sigma-1}{\sigma}} + k_3 F^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}},$$

$$V(P_n, E) = \frac{E^{1-\frac{1}{\tau}} (1 + k_1 P_n^{1-\delta})^{\frac{\tau-1}{\tau(\delta-1)}}}{1 - \frac{1}{\tau}},$$

$$L\left(\frac{\phi}{E + P_n S_1 + S_2}\right) = k_6 \left(\frac{\phi}{E + P_n S_1 + S_2}\right)^{1-\frac{1}{\beta}}, \quad k_6 > 0, \quad 0 < \beta < 1,$$

$$R_i\left(\frac{S_i}{D_i} - c\right) = \frac{k_5 \left(\frac{S_i}{D_i} - c\right)^2}{2}, \quad k_5 > 0,$$

where  $k_1 - k_6$  are distributional parameters and  $\tau, \delta, \sigma$  are, respectively, the intertemporal elasticity of substitution for nondurables, the elasticity of substitution between traded and nontraded durable, and the elasticity of substitution between domestic and foreign currency. Deliberation costs are a quadratic function of new durables purchases. The specification of transactions costs is the same as in Reinhart and Vegh (1995) and Uribe (2002), with liquidity services generated by a CES aggregate of domestic and foreign currency. The computer needs the number for substitution parameters, initial asset holdings, the rate of crawl before and after ERBS, etc., in order to solve the model. Table 5 lists the values for the base case and the alternative simulations. With respect to the choices:

*Intertemporal elasticity of substitution for nondurables ( $\tau$ ) and durables ( $\psi$ )*. Estimates for LDCs place the elasticity of intertemporal substitution between 0.20 and 0.50 (Agenor and Montiel, 1999, Table 12.1). I used therefore 0.25 and 0.50 as the low and high values for the intertemporal elasticity of substitution.

*The elasticity of substitution between traded and nontraded nondurables ( $\delta$ )*. The value set for this parameter agrees with the empirical studies that the scope for substitution is limited at high levels of aggregation.

*The elasticity of substitution between foreign and domestic currency ( $\sigma$ )*. Estimates for Latin America range from one to six. I decided to set  $\sigma$  at 2 which is also close to the estimate for Turkey (1.4) in Selcuk (2003). Then I used 0.50 in the alternative run.

*Convexity of the transactions costs function ( $\beta$ )*. Reinhart and Vegh (1995), Rossi (1989), and Arrau et al. (1995) have estimated interest elasticity of money demand by using money demand functions of the type used in this model. Ignoring Arrau et al.'s estimate for Brazil (3.26 is implausibly high) the average of the estimated interest elasticities for Chile, Argentina, Brazil, Israel, Mexico, and Uruguay is 0.36. Including Arrau et al.'s estimate for Brazil, it is 0.72. Setting  $\beta$  at 0.25 makes the interest elasticity of money demand 0.56 in the base run which is consistent with the simple average of 0.36 and 0.72. For Turkey, the estimates of inflation elasticity of money demand range from 2.62 to 2.9 (Ozmen, 1998; Selcuk, 2001; Ozdemir and Turner, 2004) that makes interest elasticity of money demand around 2.25 which is unreasonably high.

*Depreciation rate for durables ( $c$ )*. There is no data for LDCs. Following Buffie and Atolia (2005) I fix this parameter at 0.10.

*Time preference rate ( $\rho$ )*. Time preference rate plays two roles in the model: it discounts future utility and determines the steady state real rate of return on domestic bonds. Therefore I chose 0.10 for  $\rho$  which is actually still low given that the real interest rates have been in the range of 12%-16% in Turkey over the nineties.

*Speed of price adjustment in the nontradables sector ( $\alpha$ )*. I let  $\alpha$  to vary between 3 and 1. The value assigned in the base case implies that price adjustment is fast but not instantaneous.

*Length of the ERBS program ( $t_1$ )*. The low crawl lasts one year to be consistent with Turkey.

*q-elasticity of durables spending ( $\Omega$ )*. Not much is known about the magnitude of  $\Omega$ . Baxter and Crucini (1993) and Rebelo and Vegh (1995) set  $\Omega$  at 15. Baxter (1996) sets  $\Omega$



at 200. Buffie and Atolia (2005) and Buffie and Atolia (2006) place it in a range of 3-10. I on the other hand, put  $\Omega$  in a range of 3-5.

*Rate of crawl before vs. during ERBS ( $\chi_0, \chi_1$ )* I cut the rate of crawl from an initial value of 60% to 20% during ERBS.

*Ratio of foreign currency to national income ( $F_o$ )*. The number for ratio of foreign currency to national income (0.12) is in line with the data. Dollarization ratio, the ratio of foreign currency deposits to broad money, has been 45%-47% on average in Turkey over the 1990s. Besides, a significant portion of liquid assets is held in foreign currency, which is labeled as “under the mattress dollars”. Therefore, 45%-47% should be considered only as a lower bound for dollarization in Turkey.

*Ratio of domestic currency to national income ( $m_0$ )*. The number for the sum of currency held by the public plus reserves of commercial banks as % of GDP (0.08) is in line with the data.

*Ratio of domestic debt to national income ( $b_0$ )*. Central government debt held by the private sector was 29.3% in Turkey at the end of 1999.

*Consumption share of durables ( $\bar{\gamma}_d$ )*<sup>15</sup>. Following Buffie and Atolia (2005) I set this at 0.20. Weight of durables in the Turkish CPI is 0.073. This figure however, imputes a service flow to housing and excludes it. Adding the CPI share of housing, which is 0.258, raises the CPI share of durables to 0.33, which is also consistent with the value assigned to the consumption share of durables.

*Share of nontradables in nondurables expenditure and in durables expenditure ( $\gamma_{nd}, \gamma_{ne}$ )*. Share of nontradables in the Turkish CPI is 0.58. According to the data in Burnstein, Neves, and Rebelo (2001), tradable consumer goods include a large nontraded distribution component and distribution costs amount to 60% of the retail price for durable and nondurable goods in Argentina. Taking this into account raises the weight of nontradables in the Argentine CPI to 0.71. Since there is no data for Turkey regarding to distribution costs, I used the share of nontradables in the Argentine CPI in order to set the initial shares for  $\gamma_{nd}$  and  $\gamma_{ne}$ .

*Paths of currency depreciation and government spending in the post-ERBS period (the two slope parameters  $v$  and  $y$ , and the two jumps  $K$  and  $W$ )*. At the end of ERBS the rate of crawl jumps from 20% to 40% and government spending (lump-sum transfers) is cut by 6% of initial GDP. Following the initial adjustment, crawl rate and lump sum transfers rise

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<sup>15</sup>  $\bar{\gamma}_d = \frac{P_n S_1 + S_2}{E + P_n S_1 + S_2}$

steadily at rates controlled by  $\nu$  and  $\gamma$ . The two jumps at the end of the program and the slope parameters  $\nu$  and  $\gamma$  were chosen to be consistent with post-crisis period Turkey: Following the float of the domestic currency on February 22th, exchange rate depreciated very fast in the second and third quarters and stabilized as of November 2001. Fiscal adjustment was very fast therefore, I set the slope parameter so that lump-sum transfers are at the new long-run level 6 months after the program collapsed.

#### 4. Numerical Solutions

Figures 1-8 present the solution paths for the base case and for the cases where intertemporal substitution is stronger for nondurables ( $\tau = 0.50$ ) or for durables ( $\psi = 0.50$ ), domestic and foreign currencies are not close substitutes ( $\sigma = 0.75$ ), interest elasticity of money demand is smaller ( $\beta = 0.10$ ), q-elasticity of durables spending is higher, price adjustment is faster ( $\alpha = 3$ ), and prices are stickier ( $\alpha = 1$ ). The paths track the percentage deviation of the stated variable from its pre-ERBS value. Total consumption is nondurables consumption plus total durables purchases, the current account balance is measured as a percentage of GDP, and the positive values for the change in the real exchange rate signify appreciation. For an easy comparison, Table 6 collects the results of the consumption paths.

Despite the shortness of the ERBS period<sup>16</sup>, almost all of the runs capture the stylized facts. Equally important, the numbers for the consumption boom, the current account deficit, and the appreciation of the real exchange rate are of the same order of magnitude as observed in the aftermath of the ERBS program in Turkey. Led by an eye-catching surge in durables purchases, total consumption spending increases 7-8% on average. Current account deficit soars to 3-5.5% of GDP. The real exchange rate appreciates 16-20% before the end of the program. Both the boom and the contractionary phases in consumption are driven by durables. During the boom phase, the percentage increase in durables expenditure is 3-4 times larger than the increase in total consumption spending. When the recession hits, spending on durables contracts 2-3 times more than spending on total consumption.

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<sup>16</sup> Average length is three year in Calvo and Vegh (1999) data set for major ERBS episodes.

While the results are generally parallel to the empirical regularities associated with ERBS, they display some variation in terms of the magnitude of the consumption boom, the amount of real exchange rate appreciation and the severity of the recession. Below I comment on the logic underlying these variations.

*The consumption boom:* The magnitude of the initial boom displays variations across the runs. In the best run ( $\beta = 0.10$ ) for instance, total consumption spending and total durables purchases increase 10% and 37% respectively and current account deficit swells to 5.5% of GDP. Because reducing  $\beta$  makes interest elasticity of money demand smaller, the temporary windfall gain delivered by the lower crawl rate is larger. Specifically, the decline in the inflation tax following the announcement of the low crawl increases the private disposable income. Since the program is believed to be abandoned at some point in the future, the private agent will try to save his temporarily higher disposable income by making large purchases of durables. Increasing intertemporal elasticity of substitution of durables does not deliver a larger increase in durables spending. Conversely, the increase in durables is slightly smaller when  $\psi$  is 0.50. The reason is that spending on durables is driven mainly by “*intertemporal price speculation*” rather than intertemporal elasticity of substitution. Durable goods generate services long after the date of purchase, so irrespective of the magnitude of intertemporal elasticity of substitution there is always an incentive to make large purchases of durables when its price is temporarily lower. Strong intertemporal elasticity of substitution of nondurables ( $\tau = 0.50$ ) makes the percentage increase in nondurables at least two times larger. In terms of its effect on the increase in total consumption spending however, making  $\tau$  bigger does not deliver a considerable difference since the heavy lifting belongs to durables.

*Ease of currency substitution:* A well known fact about inflation stabilization episodes is that slowdown in inflation is typically accompanied by strong money demand and reverse currency substitution. Note from the first-order conditions (12) - (13), at the initial steady state  $\rho + \chi$  is the opportunity cost of holding domestic currency while  $\rho$  is the opportunity cost of holding foreign currency. A reduction in crawl obviously reduces the opportunity cost of domestic currency hence stimulates a reverse currency substitution.

From the same first-order conditions it is easily seen that one unit of domestic currency provides more liquidity services than one unit of foreign currency does<sup>17</sup>. Therefore, the private agent ends up with more liquidity services by simply swapping foreign for domestic currency. If that's the case then the private agent may increase his consumption of liquidity services by holding more domestic currency but less total currency (domestic plus foreign) and meanwhile consume part of his stock of broad money assets. As long as domestic and foreign currencies are close substitutes ( $\sigma = 2$ ) this is true. In all of the runs, except  $\sigma=0.75$ , total currency holding declines considerably during ERBS. This is what Buffie and Atolia (2005) call “*spending down of wealth*” effect and it operates in seven of the eight simulations. Compared to the other simulations the results of the run with  $\sigma=0.75$  are poor and unrealistic; suggesting that  $\sigma=0.75$  is too low for an economy like Turkey where capital inflows/outflows are extremely fast.

*Speed of price adjustment:* Stickier prices in the nontraded goods sector leads to a larger real exchange rate appreciation (24% vs. 19% in the base case); and more severe and prolonged recession. Total consumption spending is still 2.34% below its pre-ERBS value two years after the collapse of the program.

In addition to replicating the general qualitative effects of a currency peg, the model can also account quantitatively for the responses of consumption and current account balance observed in Turkey. Table 7 provides a quantitative comparison of the numerical simulation results with the actual numbers observed during the ERBS episode in Turkey. The model does very well at replicating the magnitude of the current account deficit (5.5% of GDP predicted vs. 5% of GNP actual), the peak in total consumption spending (10.08% predicted vs. 9.6% actual), average growth rate in total consumption spending (6.7% predicted vs. 6% actual), the peak in durables spending (37.06% predicted vs. 39.5% actual), and the average growth rate in durables spending (24% predicted vs. 27.4% actual).

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<sup>17</sup>  $\phi_m = \frac{\rho + \chi}{-L'}$  vs.  $\phi_F = \frac{\rho}{-L'}$

## 5. Habit Formation

The model can account reasonably well for the empirical regularities observed in Turkey after the implementation of ERBS in January 2000. But it does a poor job of accounting for the timing of how consumption responds: In all of the numerical simulations, there's a once-and-for-all increase in consumption at the time the lower crawl rate is announced, and then the consumption declines steadily. During ERBS episodes, however, consumption first increases gradually for a while, reaches a peak at some point before the abandonment of the currency peg, and then declines. Another problem is that the rate of growth in consumption drops below its pre-ERBS level before the program collapses which is not consistent with actual ERBS episodes where the consumption growth does not drop below its pre-ERBS level until after the policy collapse.

The results in Atolia and Buffie (2006) suggests that a model with habit affecting deliberation costs may induce hump-shaped profiles for durables spending and total consumption spending which agrees with the data. Following Atolia and Buffie (2006), the private agent experiences psychological unease when durables spending,  $S_i$  ( $i = 1, 2$ ), varies from its customary level. In other words, deliberation costs depend on how fast the stock of habit changes

$$R_i(S_i, H_i) = k_s \frac{\left(\frac{S_i}{H_i} - 1\right)^2}{2} H_i$$

$$\dot{H}_i = \nu(S_i - H_i), \quad \nu > 0$$

where  $\nu$  indicates the rate at which the habit stock catches up with durables spending.

Since habit-forming agents dislike changes in their habit-adjusted durables spending levels, habit formation moderates durables spending growth and thereby total consumption spending in the early and late stages of ERBS. For habit-forming agents, a once-and-for all increase in durables spending at the time of policy announcement is not optimal because the increase in habit stock that results from higher durables spending makes future marginal utilities of durables consumption larger than today's. Habit-formation thus mitigates the intertemporal substitution effect brought about by currency peg and induces

private agents to increase their path of durables spending gradually. Habit-forming agents also start reducing their stock of habit by cutting back durables spending before the program collapses and the relative price of consumption goes back to its pre-ERBS level.

Figure 9 shows the solution paths when  $\nu = 6.5$ <sup>18</sup>. Results reveal a marked improvement in the model's performance regarding the timing of the response of durables spending and total consumption spending. Both durables and total consumption spending display hump-shaped paths with the downturn coming towards the end of the first quarter after the program is implemented. Durable spending does not drop below its pre-ERBS level until after the collapse whereas the total consumption growth drifts into negative figures at the time the program ends. In the model without habit, the recovery in consumption starts right at the time the program ends. Allowing for habit makes both durables spending and total consumption spending follow their contractionary trend throughout the year after the currency peg is abandoned, which is also more consistent with the Turkish ERBS episode. Habit incorporated model does a reasonably good job at accounting for both the qualitative and quantitative effects of ERBS program. Compared to the 2000-2001 ERBS episode in Turkey however, it has a single shortcoming: The turning points in consumption boom come toward the end of the first quarter following the implementation of the program whereas the downturn in consumption boom came at the end of the third quarter in Turkey. Although I tried to move the turning points in consumption forward by changing parameters, the results suggest that the timing of the downturn is quite robust.<sup>19</sup>

## 6. Concluding Remarks

In this paper I have analyzed the real effects of a temporary heterodox ERBS program where bond sales finance the fiscal deficit and money growth occurs only through capital inflows. The model allows for consumption of both durables and nondurables. In order to assess the model's quantitative performance; it is calibrated by using data restrictions mainly from the Turkish economy. Results show that adding consumer durables improves

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<sup>18</sup> The stock of habit covers 80% of the distance to its new long-run level within one quarter.

<sup>19</sup> The rest of the simulation results when habit affects deliberation costs are available upon request from the author.

the quantitative performance of weak credibility hypothesis considerably. Without appealing to high intertemporal elasticity of substitution, the model can generate consumption boom, the current account deficit, and real exchange rate appreciation that are comparable to those observed in Turkey in the aftermath of 2000-2001 ERBS program. The single major shortcoming is regarding the timing of the response of consumption. Instead of displaying an inverted-U shape, consumption declines steadily after a one time jump at the time the policy is announced. Following Atolia and Buffie (2006), I incorporated habit formation in deliberation costs in order to overcome the problem regarding the shape of consumption. In the numerical simulations with habit affecting deliberation costs, the paths of durables spending and total consumption spending are hump-shaped but the timing of the downturn is not quite right. Consumption boom peaks too early, and the turning points come at the end of the first quarter following the implementation of the program whereas the downturn in consumption boom came at the end of the third quarter in Turkey.

The main reason of consumption boom peaking too early is the price setting mechanism in the nontraded goods sector. Prices are sticky, thus at any point in time the nominal price of the nontraded good is fixed by past price quotations. Producers know that the program will be abandoned at some point and the relative price of the nontraded good will decline. Thus, they keep increasing the prices even after the demand for nontraded good starts to decline. Since prices in the nontraded goods sector do not follow the demand closely, consumption boom does not last long. Developing a flexible price version of the model with CES production functions in the two sectors might induce better results. Because when prices are flexible, they will probably track the demand for nontraded goods. And there is a high chance that I will get a more gradual consumption boom with downturn coming at the right time.

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**Table.1 Financial and Fiscal Indicators for the Turkish Economy**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
(as % of GNP)												
<b>Current Account Balance *</b>	-1.7	0.2	-0.6	-3.5	2.0	-1.4	-2.9	-1.4	1.0	-0.7	-4.9	1.3
<b>Foreign Debt Stock</b>	32.2	33.2	34.6	37.0	49.6	43.1	42.9	43.3	46.8	54.9	59.0	79.0
<b>Domestic Debt Stock</b>	6.1	6.8	11.7	12.8	14.0	14.6	18.5	20.2	21.7	29.3	29.0	69.2
<b>Central Government Budget Balance *</b>	-3.0	-5.3	-4.3	-6.7	-3.9	-4.0	-8.3	-7.6	-7.3	-11.9	-10.9	-16.9
<b>Central Government Primary Budget Balance *</b>	0.5	-1.5	-0.6	-0.9	3.8	3.3	1.7	0.1	4.3	1.8	5.3	6.4
<b>PSBR **</b>	7.4	10.2	10.6	12.3	7.9	5.0	8.6	7.7	9.4	15.5	11.8	16.4
<b>Short-term foreign debt as % of Central Bank's FX reserves</b>	159.1	185.4	207.0	298.3	159.0	126.7	104.9	96.0	105.3	98.9	127.6	87.3
<b>Dollarization***</b>	25.5	33.6	38.6	44.3	51.7	53.0	48.5	50.4	46.7	45.9	45.3	57.6
<b>Total interest payments as % of total budget expenditures</b>	20.8	18.5	18.2	24.0	33.2	33.7	38.0	28.5	39.6	38.2	43.5	50.6
<b>Interest payments on domestic debt as % of total tax revenues</b>	21.2	21.5	21.6	35.0	39.7	43.9	59.2	41.7	61.0	66.4	70.9	94.4
<b>Real interest rates on domestic borrowing</b>	-3.9	8.7	10.4	12.9	28.2	17.4	30.4	22.3	20.5	27.1	-10.9	27.1
<b>CPI (average annual % change)</b>	60.3	66.0	70.0	66.0	106.3	89.1	80.4	85.8	84.6	64.9	54.9	54.4
<b>CPI (annual % change, Dec to Dec)</b>	60.4	71.1	66.0	71.1	125.5	76.0	79.8	99.1	69.7	68.8	39.0	68.5
<b>Real effective exchange rate</b>	117.0	112.9	114.9	125.7	95.7	103.1	101.7	115.9	120.9	127.3	147.6	116.3

Source: Central Bank of Republic of Turkey, Treasury, SIS, Bahmani-Oskooee and Domac (2002)

\* (+) sign indicates surplus

\*\* PSBR is public sector borrowing requirement

\*\*\* FX deposits as a percentage of total deposits (end year)

Real interests on domestic borrowing were obtained from annual average compounded interest rates on domestic borrowing deflated by annual average CPI inflation.

Real effective exchange rate is CPI based and increase denotes appreciation.

**Table.2 Annual Real Rate of Growth (%)**  
(over the same period of the previous year)

	<b>Total consumption</b>	<b>Durables consumption</b>	<b>Semi-durables consumption</b>	<b>Expenditure on services</b>	<b>Imports</b>	<b>GDP</b>	<b>GNP</b>	<b>Real interest rate on Treasury bonds *</b>	<b>Exchange rate (\$/TL) **</b>
<b>2000Q1</b>	4.01	24.15	-1.66	6.49	34.89	5.61	4.17	-15.80	60.70
<b>2000Q2</b>	4.61	26.75	-7.69	7.21	25.26	6.93	5.41	-9.50	49.50
<b>2000Q3</b>	9.63	39.51	8.14	7.86	23.48	7.84	7.24	-7.20	46.60
<b>2000Q4</b>	5.56	19.28	5.37	8.29	19.55	8.55	7.83	6.30	28.60
<b>2001Q1</b>	-2.99	-20.32	3.80	-2.07	-14.47	-0.99	-3.32	117.50	64.60
<b>2001Q2</b>	-11.99	-36.12	-12.46	-12.50	-31.00	-9.79	-12.28	16.50	96.50
<b>2001Q3</b>	-9.86	-31.07	-9.88	-9.28	-26.47	-7.52	-9.14	7.30	116.50
<b>2001Q4</b>	-11.34	-33.25	-19.00	-11.49	-25.95	-10.34	-12.32	-7.80	114.20
<b>2002Q1</b>	-1.86	-7.00	-2.09	2.02	2.49	2.3	0.59	-3.70	41.90
<b>2002Q2</b>	3.17	8.66	4.33	10.04	20.36	8.95	10.44	17.20	25.60

Data source: Central Bank of Republic of Turkey

Consumption figures belong to private sector

\* Real interest rate values are from Table.1 in Yeldan (2002b) and they are compounded interest rate on three-month Treasury bonds, deflated by the WPI

\*\* Annual rate of change over the same period of the previous year

**Table.3 Capital Flows During the ERBS Episode (Million US dollars)**

	<b>Jan 2000 - Oct 2000</b>	<b>Nov 2000 - Sept 2001</b>
<b>Net Capital Flows (non-residents)</b>	15571	-12772
Foreign direct investment	589	2962
Portfolio *	6789	-9063
Long-term flows	3643	-224
Short-term flows	4550	-6447
<b>Net Capital Flows (residents) **</b>	-2466	-1388
Foreign direct investment	-751	-497
Portfolio	-730	69
Short-term flows	-985	-960

Data source: Central Bank of Republic of Turkey

\* Of the 6789 million US dollars net portfolio inflows (non-residents) , 5518 million US dollars came through government's bond issue in foreign markets.

\*\* (-) sign indicates capital outflows through residents



**Table.4 Indicators of Consumption Spending**  
(Percentage change over the same period of the previous year)

	<b>Sales of durables</b>	<b>Sales of cars</b>	<b>Production of durables</b>
<b>Dec-99</b>	4.3	29.0	23.3
<b>Jan-00</b>	62.0	107.4	37.0
<b>Feb-00</b>	77.0	94.7	36.6
<b>Mar-00</b>	19.3	77.0	21.6
<b>Apr-00</b>	15.7	49.0	23.8
<b>May-00</b>	22.7	86.0	23.9
<b>Jun-00</b>	13.0	67.4	11.4
<b>Jul-00</b>	14.3	86.0	21.0
<b>Aug-00</b>	52.1	148.4	48.7
<b>Sep-00</b>	26.7	77.2	26.4
<b>Oct-00</b>	14.7	105.0	17.6
<b>Nov-00</b>	n.a.	n.a.	n.a.
<b>Dec-00</b>	n.a.	n.a.	n.a.
<b>Jan-01</b>	12.9	-29.4	19.3
<b>Feb-01</b>	-18.3	-64.3	-12.0
<b>Mar-01</b>	-15.6	-78.8	-19.7
<b>Apr-01</b>	-31.0	-72.6	-24.2
<b>May-01</b>	-19.1	-72.3	-25.0
<b>Jun-01</b>	-28.8	-70.9	-27.4
<b>Jul-01</b>	-4.1	-68.0	-19.4
<b>Aug-01</b>	-22.6	-72.2	-18.6
<b>Sep-01</b>	-14.1	-85.0	-16.5
<b>Oct-01</b>	-10.9	-85.5	-13.5
<b>Nov-01</b>	-4.7	-75.6	-2.0
<b>Dec-01</b>	3.3	-42.9	12.9

Source: Turkish State Planning Organization and the Treasury

**Table 5. Calibration of the Model**

Parameter	Base value	Alternative
Length of ERBS ( $t_1$ )	1	—
Elasticity of substitution between tradable and nontradable nondurable consumer goods ( $\delta$ )	.40	—
The elasticity of substitution between foreign and domestic currency ( $\sigma$ )	2	.75
Convexity of the transactions costs function ( $\beta$ )	.25	.10
Intertemporal elasticity of substitution for nondurables ( $\tau$ )	.25	.50
Intertemporal elasticity of substitution for durables ( $\psi$ )	.25	.50
Depreciation rate for durables ( $c$ )	.10	—
Time preference rate ( $\rho$ )	.10	—
Speed of price adjustment in the nontradables sector ( $\alpha$ )	2	1 and 3
q-elasticity of durables spending ( $\Omega$ )	3	5
Ratio of domestic currency to national income ( $m_0$ )	.08	—
Ratio of foreign currency to national income ( $F_0$ )	.12	—
Ratio of domestic debt to national income ( $b_0$ )	.30	—
Consumption share of durables ( $\bar{\gamma}_d$ )	.20	—
Share of nontradables in nondurables expenditure and in durables expenditure ( $\gamma_{nd}, \gamma_{ne}$ )	.70	—
Rate of crawl before vs. during ERBS ( $\chi_0, \chi_1$ )	60% vs. 20%	—
Path of currency depreciation in the post-ERBS period	crawl jumps from 20% to 40% at $t_1$ ; $\nu=3$	
Path government spending in the post-ERBS period	transfer payments decrease by 6% of initial GDP at $t_1$ ; $y=5$	

**Table 6: Summary of solutions for the paths of total consumption, total durables spending, and non-durables consumption\***

Base Case

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	6.27	-3.20	-3.97	-3.24	-1.53
Durables	23.03	-5.89	-7.72	-6.75	-2.25
Non-durables	2.15	-2.54	-3.05	-2.37	-1.36

$\beta = 0.10$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	10.08	-3.68	-4.57	-3.64	-1.73
Durables	37.06	-7.82	-9.92	-8.30	-3.06
Non-durables	3.44	-2.66	-3.25	-2.50	-1.41

$\Omega = 5$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	8.33	-3.64	-4.65	-3.64	-1.54
Durables	34.34	-8.41	-11.44	-9.15	-2.40
Non-durables	1.92	-2.46	-2.98	-2.28	-1.32

$\tau = 0.50$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	9.26	-4.74	-6.36	-3.98	-1.46
Durables	26.75	-9.07	-13.07	-7.35	-1.37
Non-durables	4.95	-3.68	-4.71	-3.15	-1.48

$\psi = 0.50$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	5.73	-2.84	-3.42	-3.09	-1.57
Durables	20.26	-3.77	-4.60	-5.65	-2.34
Non-durables	2.15	-2.62	-3.13	-2.46	-1.38

$\sigma = 0.75$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	1.30	-3.22	-3.84	-2.64	-1.08
Durables	4.74	-5.95	-7.41	-4.53	-0.52
Non-durables	0.44	-2.55	-2.96	-2.17	-1.22

$\alpha = 3$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	6.25	-2.75	-3.54	-2.71	-1.15
Durables	22.76	-5.03	-6.86	-5.82	-1.82
Non-durables	2.2	-2.2	-2.72	-1.93	-0.98

$\alpha = 1$

	t = 0	t = 1	t = 1	t = 2	t = 3
Total	6.31	-3.9	-4.67	-4.18	-2.34
Durables	23.57	-7.21	-9.04	-8.43	-3.30
Non-durables	2.06	-3.1	-3.6	-3.14	-2.1

\* Percentage deviations from the pre-ERBS value.

In the table, first t = 1 are pre-jump values and second t = 1 are post-jump values.

**Table 7. Model Predictions vs Actual Numbers from Turkey**

**Highest real rate of growth observed in 2000**

Total consumption	9.60%
Durables consumption	39.50%
Current account deficit	5%

**Peak values from the numerical simulations**

Total consumption	10.08%
Durables consumption	37.06%
Current account deficit	5.50%

**Average real rate of growth in 2000**

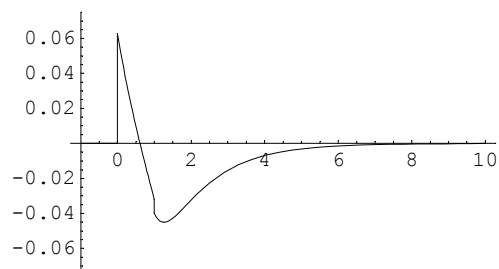
Total consumption	6%
Durables consumption	27.40%

**Average values from the numerical simulations**

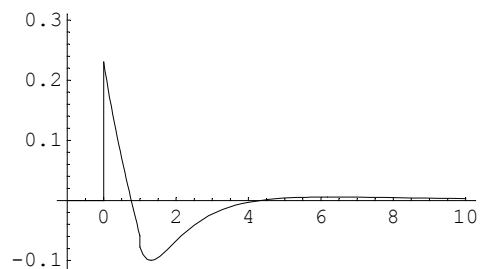
Total consumption	6.69%
Durables consumption	24.06%

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun18}}]]
```

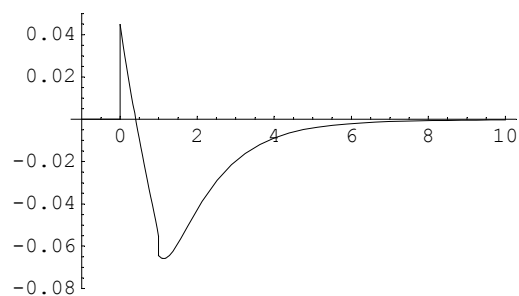
total real consumption



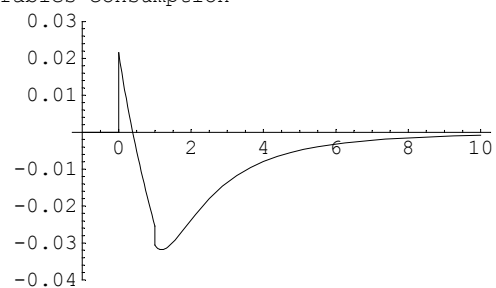
total durables spending



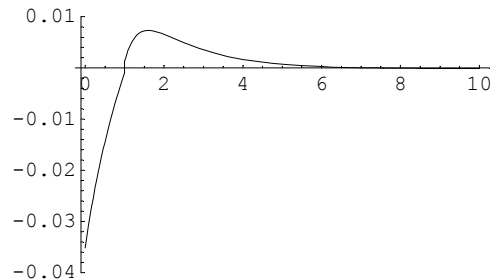
nontradables output



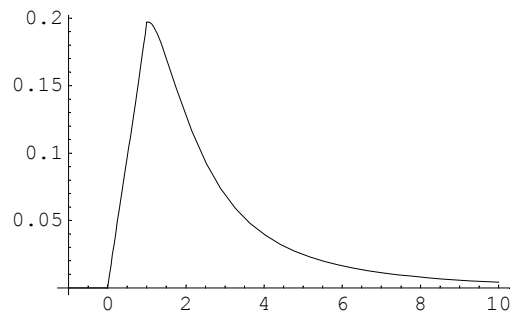
nondurables consumption



current account balance



Real exchange rate

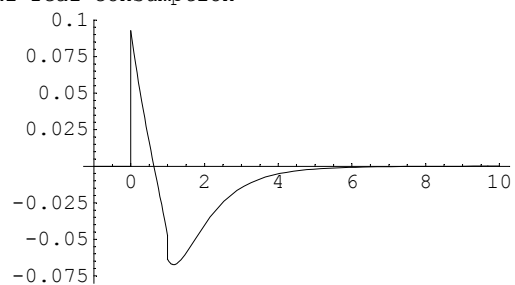


- GraphicsArray -

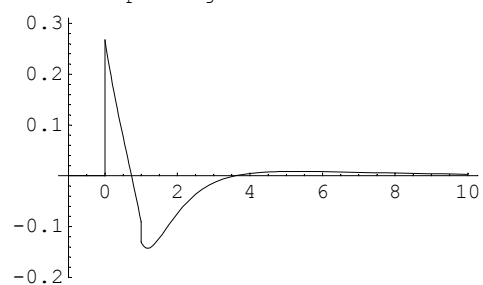
Figure1 : Transition path in the base run

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun18}}]]
```

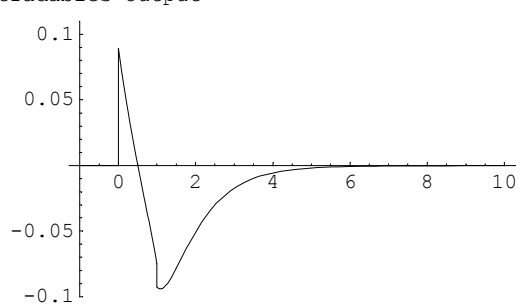
total real consumption



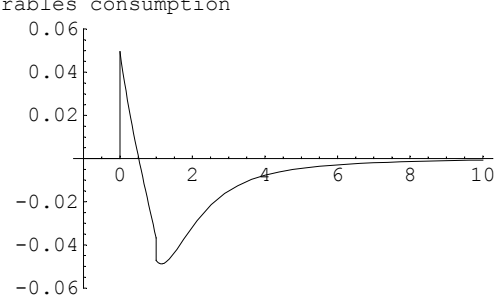
total durables spending



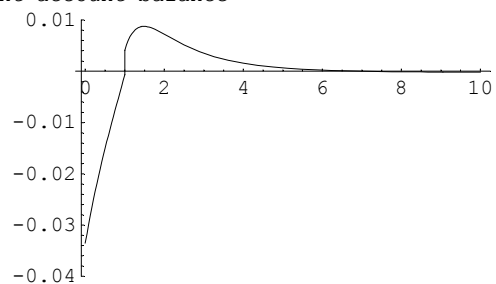
nontradables output



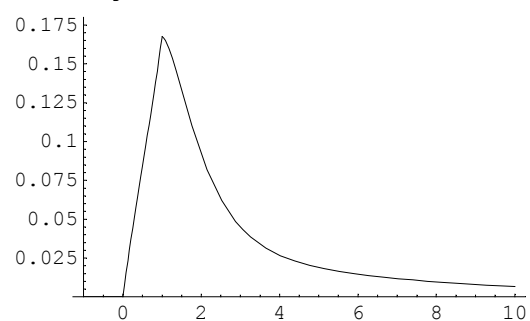
nondurables consumption



current account balance



Real exchange rate

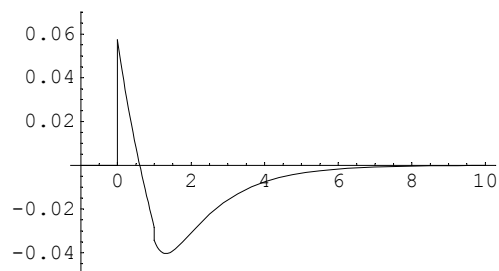


- GraphicsArray -

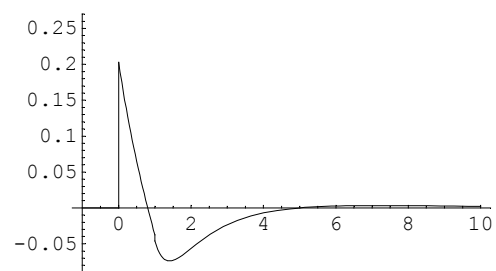
**Figure 2 : Transition path when  $\tau = 0.5$**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun14}}]]
```

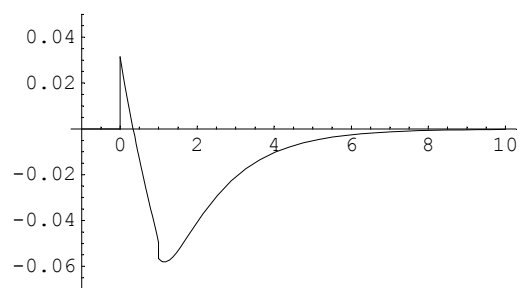
total real consumption



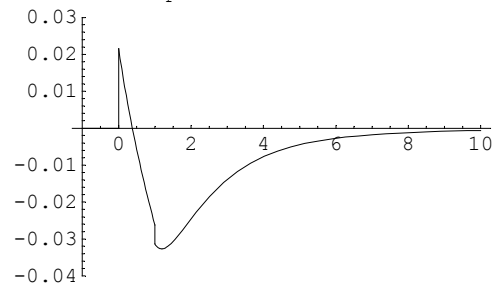
total durables spending



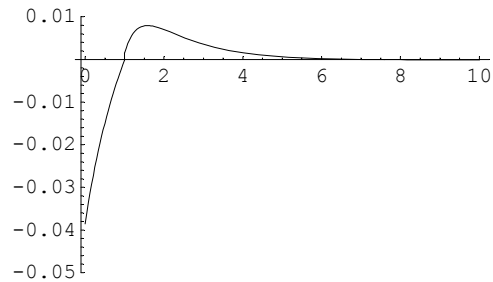
nontradables output



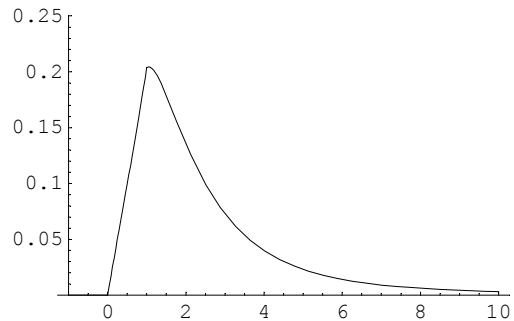
nondurables consumption



current account balance



Real exchange rate

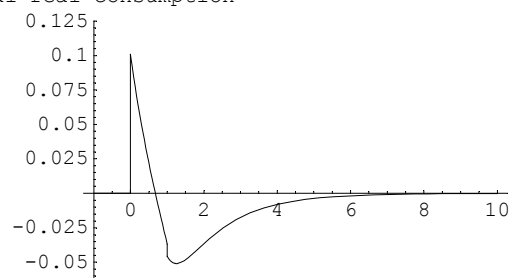


- GraphicsArray -

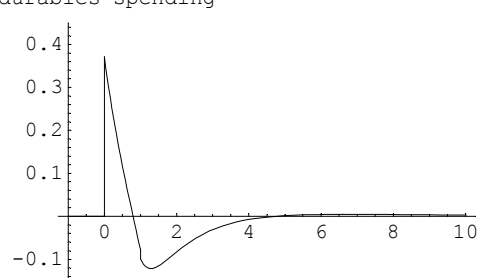
**Figure 3 : Transition path when  $\psi = 0.5$**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun14}}]]
```

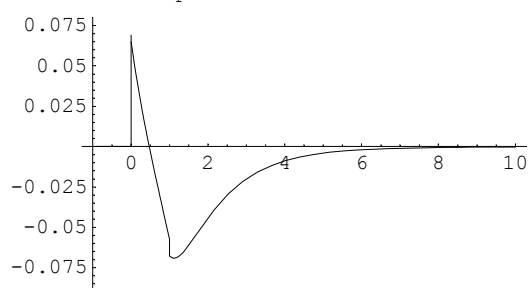
total real consumption



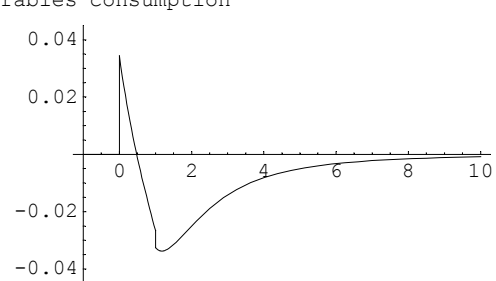
total durables spending



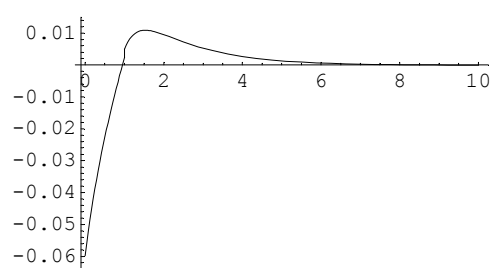
nontradables output



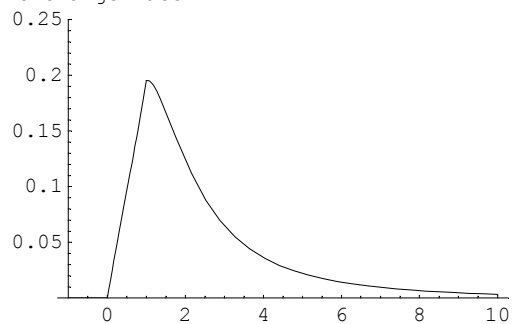
nondurables consumption



current account balance



Real exchange rate

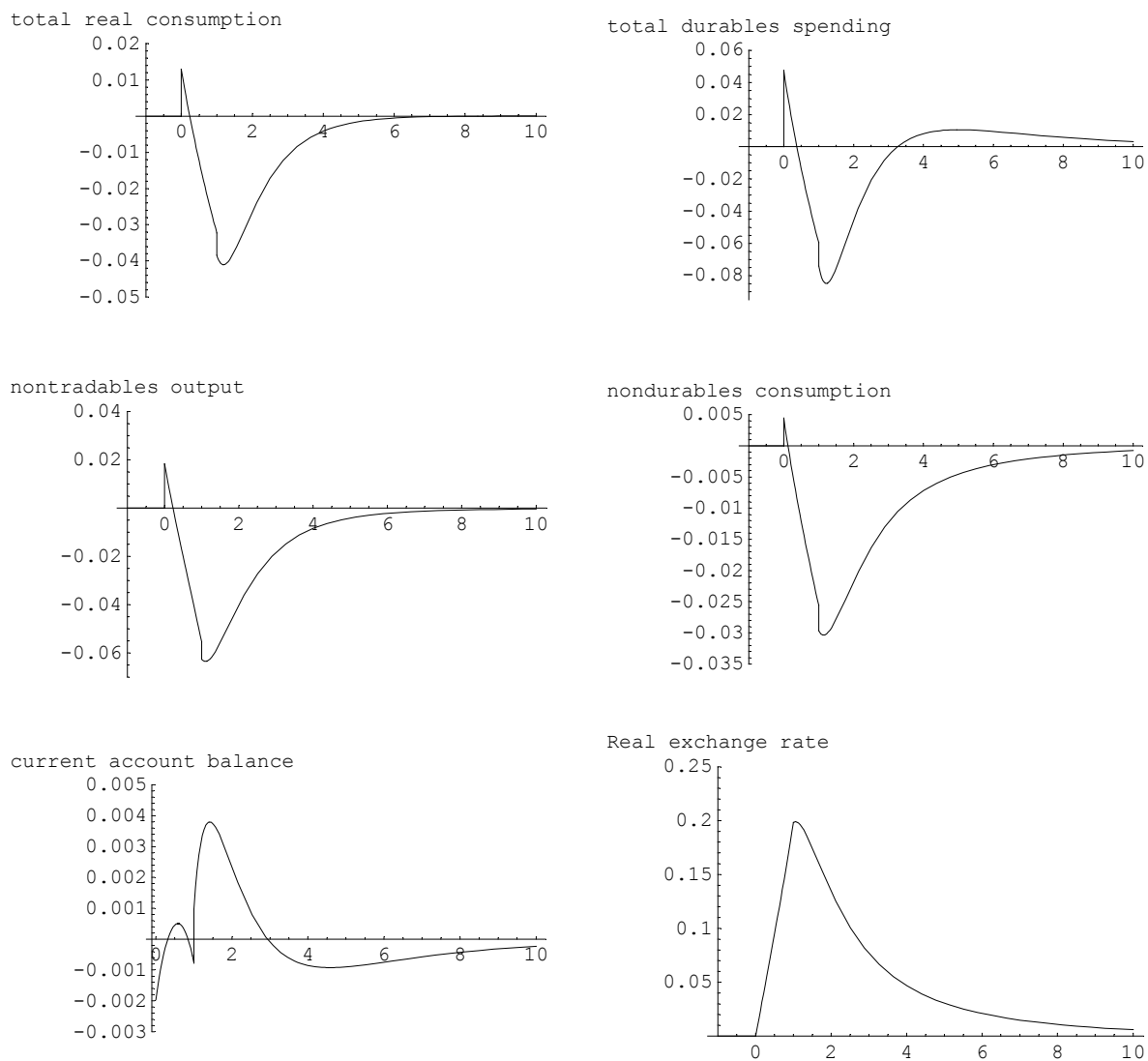


- GraphicsArray -

**Figure 4 : Transition path when  $\beta = 0.10$**



```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun14}}]]
```

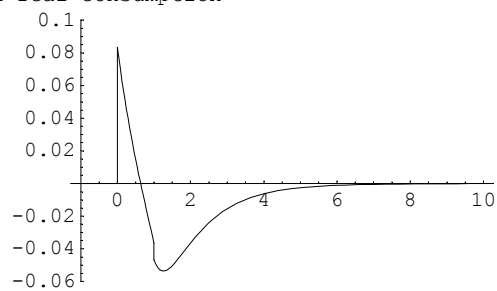


- GraphicsArray -

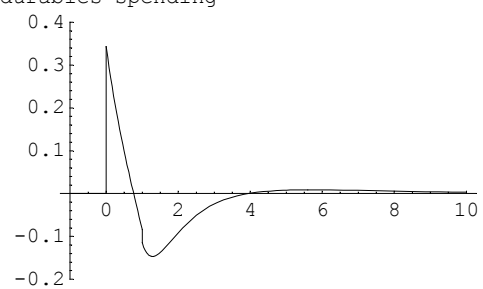
**Figure 5 : Transition path when  $\sigma = 0.75$**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun14}}]]
```

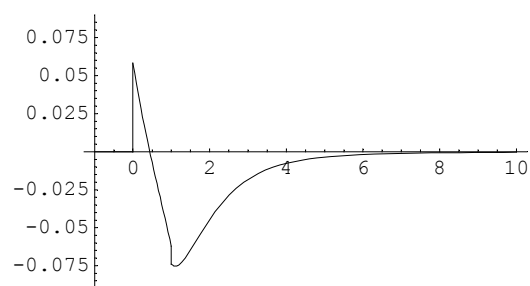
total real consumption



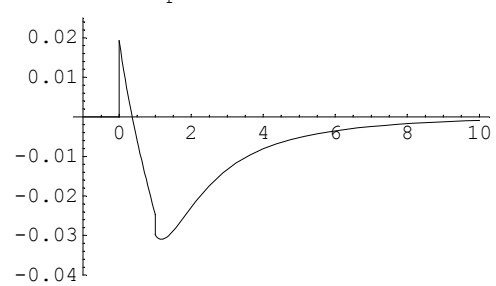
total durables spending



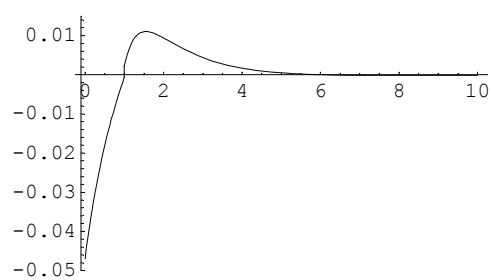
nontradables output



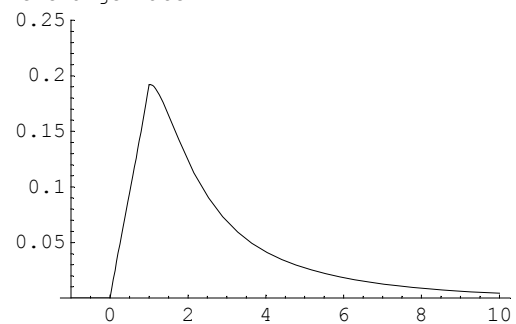
nondurables consumption



current account balance



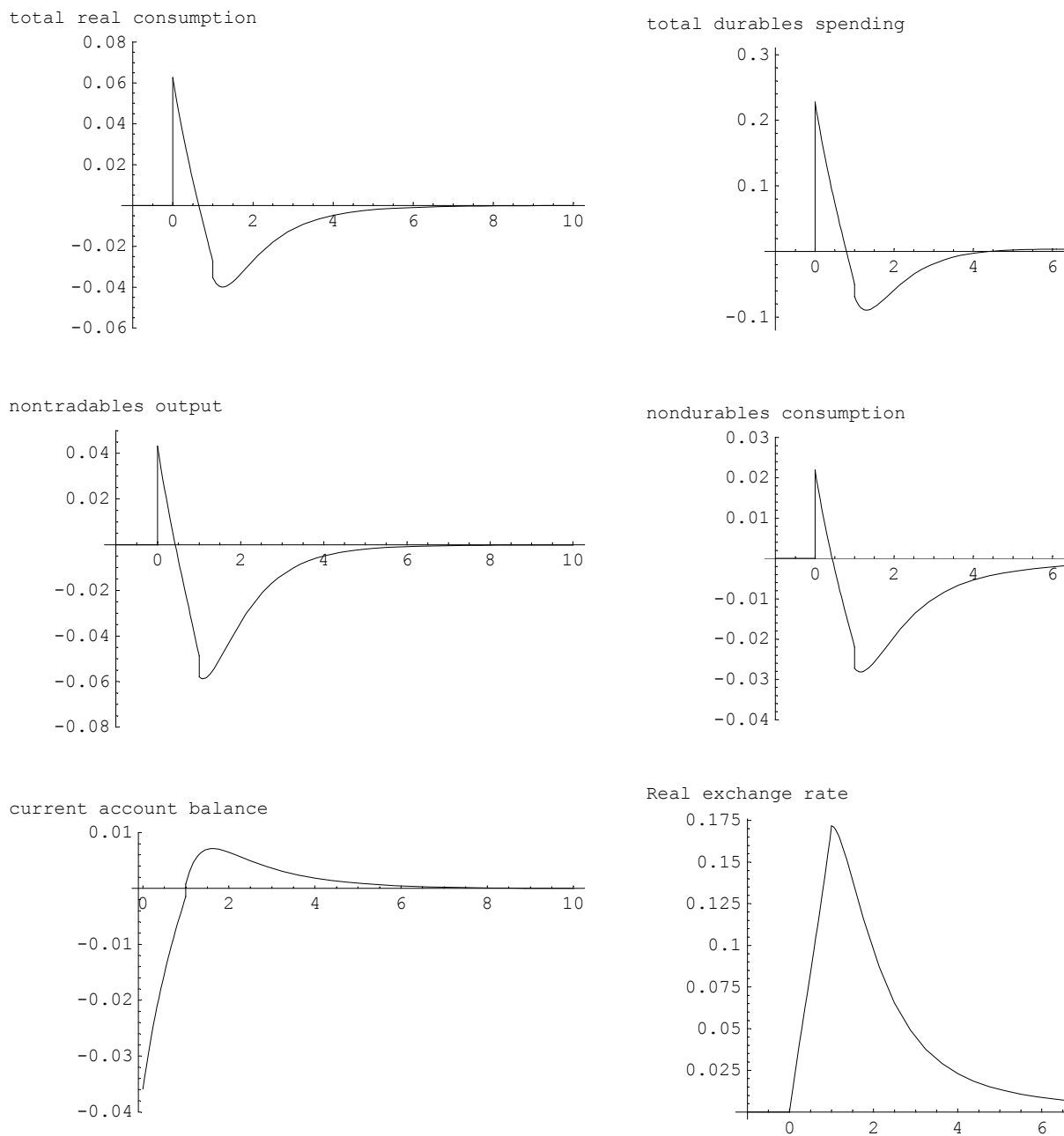
Real exchange rate



- GraphicsArray -

**Figure 6 : Transition path when  $\Omega = 5$**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun18}}]]
```

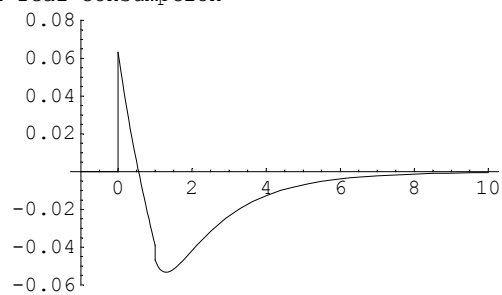


- GraphicsArray -

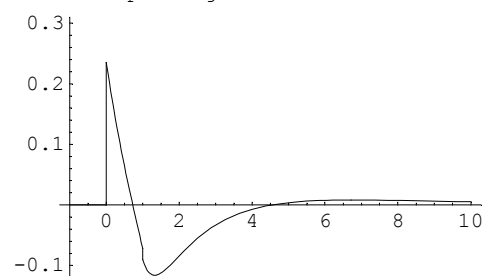
**Figure 7 : Transition path when price adjustment is faster ( $\alpha = 3$ )**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun18}}]]
```

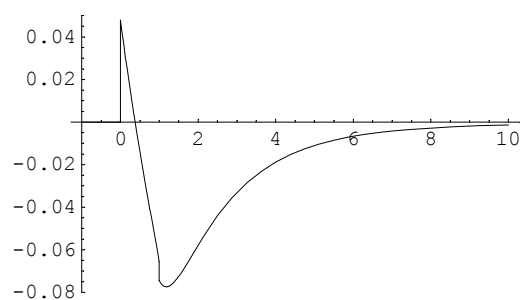
total real consumption



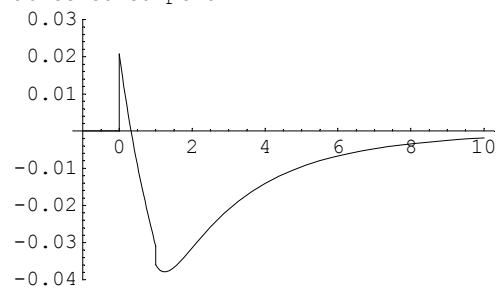
total durables spending



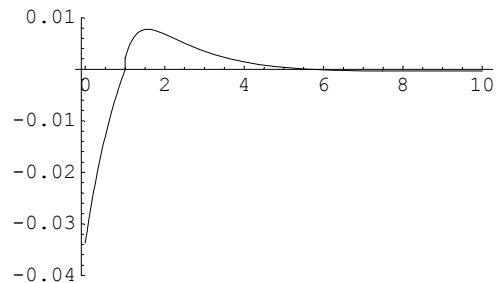
nontradables output



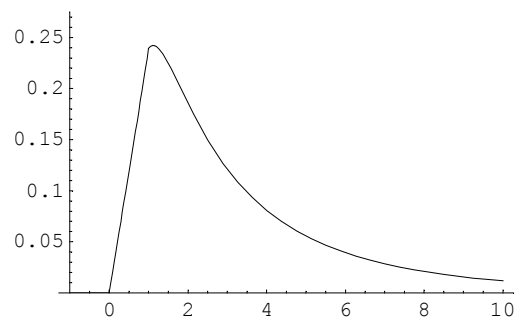
nondurables consumption



current account balance



Real exchange rate

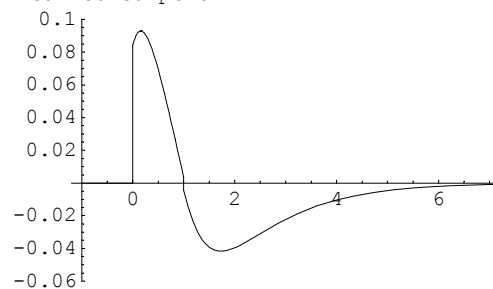


- GraphicsArray -

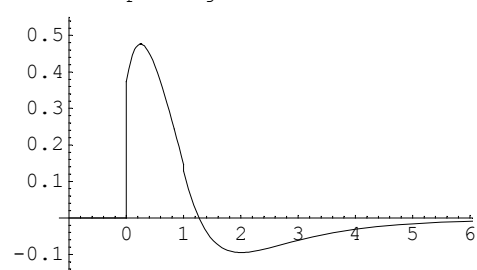
**Figure 8 : Transition path with stickier prices ( $\alpha = 1$ )**

```
Show[GraphicsArray[{{tanju2, tanju4}, {tanju10, tanju8}, {tanju6, arun20}}]]
```

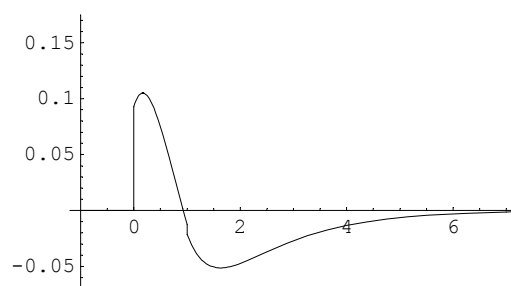
total real consumption



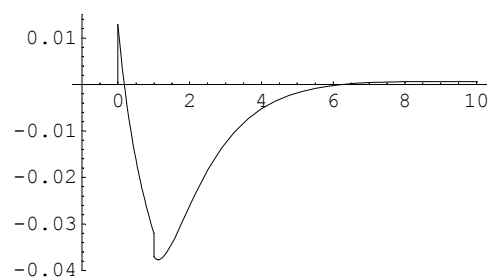
total durables spending



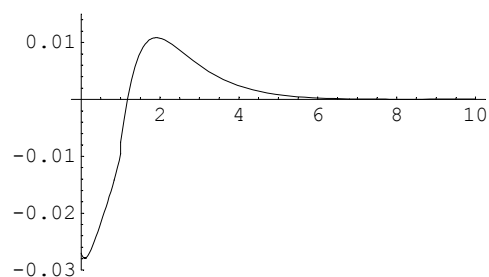
nontradables output



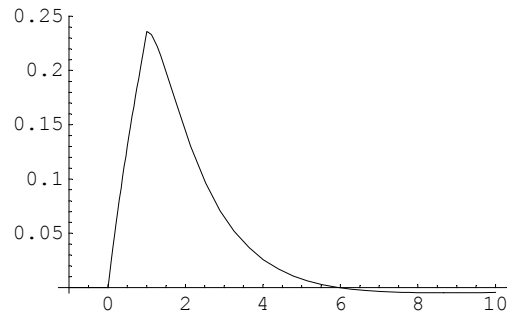
nondurables consumption



current account balance



Real exchange rate



- GraphicsArray -

**Figure 9 : Base run transition path when habit affects deliberation costs**