

# Chapter 14

## Capital inflows\*

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### 1 Introduction

The flow of capital to developing countries follows a marked cyclical pattern. Figure 1 depicts total private capital flows to developing economies since 1980. We can observe four cycles, with peaks in 1981, 1993, 1995, and 2007. The year following the peak is typically a year of financial crises: the 1982 debt crisis, the 1994 Tequila crisis, the East Asian crises in 1997-1998, and the American financial crisis in 2008. This chapter will deal with the macroeconomic causes, consequences, and policy implications of capital flows cycles.

[Figure 1 here]

The chapter begins with Section 2 laying out the main stylized facts associated with capital inflows. Typically, capital inflows episodes are associated with higher aggregate demand and output, real appreciation of the domestic currency, and trade and current account deficits. As we shall see, this “overheating” of the economy – which often includes higher inflation as well – is a cause of concern for policymakers and leads to various policy responses.

A very basic conceptual issue that arises regarding capital flows is whether they are endogenous or exogenous. In all the models that we have seen so far in this book, capital inflows have been an *endogenous* response to some shock. In the endowment economy of Chapter 1, for instance, a temporary negative shock to the endowment leads to a temporary current account deficit that is financed with a capital inflow (i.e., a surplus in the capital account). In the same vein, in the monetary world of Chapter 7, a temporary fall in the world

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nominal interest rate would induce a consumption boom and current account deficit which, again, is financed by a capital inflow. The capital inflow is thus a response to the consumption boom. This way of thinking, however, is at odds with a frequent interpretation in policy circles of capital flows as being *exogenous* to the economy. Clearly, when observers talk about a “sudden stop” (a term coined by Calvo (1998)), they are referring to an exogenous stop in the flow of capital into a country. In other words, the idea is that small emerging economies may be subject to the vagaries of international capital flows, which may stop and restart at the whims of international investors.

Two important conceptual questions then arise. First, how can we think of an “exogenous” capital inflow in our models? Second, will the effects of exogenous capital flows differ from those stemming from endogenous capital flows? Section 3 addresses these questions. It develops a simple two-period real model (à la Chapter 2) and analyzes the economy’s response to three different shocks: a domestic demand shock, a fall in the world real interest rate, and an exogenous capital inflow (modelled as an exogenous change in the capital account balance). We show that – in terms of consumption (and hence welfare) and the current and capital accounts – the response of the economy is identical to all three shocks. Hence, an outside observer that could only see consumption and the external accounts would not be able to tell what was the underlying shock. While this strict equivalence may not hold exactly in more complicated models, it serves to make the point that the macroeconomic effects of capital flows are likely to be similar *regardless* of the specific trigger.<sup>1</sup>

As already mentioned, Calvo (1998) coined the term “sudden stops” to refer to episodes in which capital inflows into a country come to a screeching halt. What will be the macroeconomic effects of sudden stops? Section 4 answers this question in the context of a three-period endowment economy. The endowment is assumed to grow over time (capturing a “growing” economy). In an unconstrained world (i.e., a world without sudden stops), consumption would be flat over time and the economy would borrow in the first two periods and repay in the last one. If we now impose the constraint of a sudden stop in period two (i.e., the current account must be non-negative from period 2 onwards), then consumption will be higher in period one, fall precipitously in period 2, and recover in period 3. The fall in consumption in period 2 will be accompanied by a sharp real depreciation. Intuitively, the sudden stop acts like an intertemporal distortion (à la Chapter 3), making period 2 consumption more expensive relative to period-1 consumption and inducing the boom-bust cycle just described.

Section 5 then presents a cash-in-advance version of the sticky prices model introduced in Chapter 8 to rationalize the stylized facts discussed in Section 2. We solve the model under both predetermined and flexible exchange rates and show the economy’s response to aggregate demand shocks and reductions in world real interest rates. While a real appreciation occurs regardless of the shock

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<sup>1</sup>In monetary models, however, the behavior of inflation may depend on the source of the shock, as analyzed below.

and the exchange rate regime, the bulk of the initial real appreciation takes place through higher inflation of non-tradable goods under predetermined exchange rates and through a fall in the nominal exchange rate under flexible exchange rates. Hence, while policymakers may be unable to prevent a real appreciation accompanying a capital inflows episode, they may be able to choose how this real appreciation is effected.

In the context of the model of Section 5, Section 6 analyzes some of the most common policy responses to episodes of capital inflows: foreign exchange market intervention and fiscal tightening. While these policies go some way toward lessening the initial real appreciation, it comes at the cost of higher inflation in the case of foreign exchange market intervention and an output contraction in the case of fiscal tightening. We also discuss policy responses involving macro-prudential regulation.

Section 7 closes the chapter with some concluding remarks.

## 2 Capital inflows: Stylized facts

The macroeconomic effects of capital inflows to developing countries have been thoroughly reviewed in a chapter in the 2007 *World Economic Outlook* (hereafter WEO). To identify episodes of large capital inflows, the WEO used both a country- and a region-based criterion:

- Country-based criterion: if the ratio of net capital inflows to GDP for a given country is one standard deviation larger than this country's trend, then the episode is identified as a capital inflow episode.
- Region-based criterion: if capital inflows are significantly larger than an arbitrary regional threshold (the 75th percentile of the regional distribution of the ratio of net capital inflows to GDP), then the episode is flagged as a capital inflow episode.

If either of these criteria is met, the event is classified as a capital inflows episode. The WEO chapter identifies 73 recently completed episodes in emerging countries for the period 1987-2006. Figure 2 shows the impact of these inflows on the main macroeconomic variables of interest. In each panel, "before" denotes the average of the variable in the two years prior to the episode; "during" is the average of the variable during the inflow episode; and "after" is the average of the variable in the two years that follow the final year of the event. The scale represents the median of each variable across all episodes.

[Figure 2 here]

Let us look at the impact on different variables:

- By construction, of course, Panel A shows that net capital flows peak at around 4.5 percent of GDP during the episodes.

- Panels B and C show the effect on GDP growth and aggregate demand. Both peak during the capital inflow episode and fall sharply thereafter.
- Panel D illustrates the behavior of inflation. The panel suggests that there is in fact a slight fall in inflation during the capital inflow episode. This evidence, however, is somewhat misleading as it includes many inflation stabilization programs where the fall in inflation was accompanied by capital inflows (as documented in Chapter 13). As the theoretical model in Section 5 will make clear, capital inflows episodes that are triggered by higher domestic demand or a fall in international real interest rates (as opposed to a reduction in the rate of depreciation or the rate of money growth) will be accompanied by an *increase* in the inflation rate. Ideally, then, to analyze empirically the behavior of inflation during capital inflows episodes, one would like to distinguish between the various possible sources of capital inflows, an inherently difficult task.
- Panel E shows that capital inflows episodes are associated with current account deficits. The current account deficit increases sharply during the episodes and falls afterwards.
- Panel F shows that capital inflows go hand in hand with a real appreciation of the domestic currency.<sup>2</sup>

In addition, we should point out that capital inflows episodes are accompanied by a substantial increase in international reserves (see Section 6 below).

These stylized facts will guide our theoretical journey below.

### 3 A simple model

This section develops a simple two period model (as in Chapter 2) to illustrate the idea that, while the trigger of a capital inflow may vary from case to case (see Box 1), the macroeconomic consequences will be very similar. In particular, we will illustrate how three different shocks – a domestic demand shock, a fall in international real interest rates, and an exogenous capital flow – will all give rise to the same outcome: higher consumption, a trade deficit that is financed by a capital inflow, and an increase in the relative price of non-tradable goods.

Formally, consider a two period, real model of a small open economy. Consumers derive utility from consuming both tradable ( $c^T$ ) and non-tradable ( $c^N$ ) goods. The economy is endowed with a constant stream of tradables ( $y^T$ ) and non-tradable goods ( $y^N$ ).

#### 3.1 Consumer's problem

Preferences are given by

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<sup>2</sup>Note that here the definition of the real exchange rate follows the IMF's practice of defining it as  $P^N/EP^*$ . Hence, a rise in this measure signals a real appreciation.

$$\alpha [u(c_1^T) + v(c_1^N)] + \beta [u(c_2^T) + v(c_2^N)], \quad (1)$$

where  $\alpha \geq 1$  is a preference parameter that will be used to capture demand shocks in period 1,  $\beta > 0$  is the discount factor, and  $u(\cdot)$  and  $v(\cdot)$  are strictly increasing and strictly concave functions.

Assuming, for simplicity, that initial net foreign assets are zero, the first period budget constraint takes the form

$$b_1 = y^T + p_1 y^N - c_1^T - p_1 c_1^N, \quad (2)$$

where  $p$  denotes the relative price of non-tradable goods in terms of the numeraire (tradable goods) and  $b_1$  denotes net foreign assets at the end of period 1. Since the transversality condition requires that  $b_2 = 0$ , we can write period 2's budget constraint as

$$0 = y^T + p_2 y^N + (1+r)b_1 - c_2^T - p_2 c_2^N. \quad (3)$$

Combining constraints (2) and (3), we can derive the intertemporal budget constraint:

$$\frac{2+r}{1+r} y^T + p_1 y^N + \frac{p_2 y^N}{1+r} = c_1^T + p_1 c_1^N + \frac{c_2^T}{1+r} + \frac{p_2 c_2^N}{1+r}$$

The consumer chooses  $\{c_1^T, c_1^N, c_2^T, c_2^N\}$  to maximize lifetime utility – given by (1) – subject to constraints (2) and (3). Setting up the Lagrangean:

$$\begin{aligned} \mathcal{L} = & \alpha [u(c_1^T) + v(c_1^N)] + \beta [u(c_2^T) + v(c_2^N)] \\ & + \lambda \left[ y^T + p_1 y^N + \frac{y^T}{1+r} + \frac{p_2 y^N}{1+r} - c_1^T - p_1 c_1^N - \frac{c_2^T}{1+r} - \frac{p_2 c_2^N}{1+r} \right]. \end{aligned}$$

The first-order conditions are given by

$$\alpha u'(c_1^T) = \lambda, \quad (4)$$

$$\alpha v'(c_1^N) = \lambda p_1, \quad (5)$$

$$\beta u'(c_2^T) = \frac{\lambda}{1+r}, \quad (6)$$

$$\beta v'(c_2^N) = \frac{\lambda p_2}{1+r}. \quad (7)$$

Combining first-order conditions (4) and (6) on the one hand and (5) and (7) on the other, we obtain

$$\frac{\alpha u'(c_1^T)}{u'(c_2^T)} = \beta(1+r), \quad (8)$$

$$\alpha \frac{v'(c_1^N)}{v'(c_2^N)} = \beta(1+r) \frac{p_1}{p_2}. \quad (9)$$

### 3.2 Equilibrium conditions

Equilibrium in the non-tradable goods market requires that

$$c_1^N = c_2^N = y^N.$$

Imposing equilibrium in the non-tradable goods markets, we can rewrite (9) as

$$\alpha = \beta(1+r) \frac{p_1}{p_2}. \quad (10)$$

For further reference, notice that imposing non-tradable goods market equilibrium in (2) and (3), we get

$$b_1 = y^T - c_1^T, \quad (11)$$

$$-b_1 = rb_1 + y^T - c_2^T. \quad (12)$$

Equation (11) is the trade balance (and current account) for period 1, while equation (12) is the current account for period 2. Combining these two expressions yields the economy's resource constraint:

$$\frac{2+r}{1+r} y^T = c_1^T + \frac{c_2^T}{1+r}. \quad (13)$$

We now solve the model under three different scenarios.

### 3.3 Scenario 1: Demand shock

Suppose  $\beta(1+r) = 1$  and  $\alpha > 1$ . This captures a situation in which a domestic shock (in the form of higher demand) will cause a temporary boom in consumption. From (8), it follows that

$$\alpha u'(c_1^T) = u'(c_2^T),$$

which, since  $\alpha > 1$ , implies that  $c_1^T > c_2^T$ . Then, from (13),  $c_1^T > y^T$ . The economy thus runs a trade deficit in period 1. Then, from (10), it follows that  $p_1 > p_2$ .

In sum, in period 1 – and relative to period 2 – the economy experiences high tradables consumption, high relative price of non-tradables goods, and a trade deficit. Intuitively, the higher demand for consumption in period 1 relative to period 2 leads to a trade deficit and, given that the supply of non-tradable goods is completely inelastic, to a higher relative price of non-tradable goods.

### 3.4 Scenario 2: Lower world real interest rate

Suppose now that  $\alpha = 1$  but

$$\frac{1}{1+r} > \beta.$$

In other words, the real interest rate is lower than the rate of time preference (recall that, by definition,  $\beta = 1/(1 + \rho)$ , where  $\rho$  is the rate of time preference). Then, from (8),  $c_1^T > c_2^T$ . Hence, from (13),  $c_1^T > y^T$  and the economy runs a trade deficit in period 1. And, from (10),  $p_1 > p_2$ . The low real interest rate (relative to the rate of time preference) thus leads to higher consumption, a trade deficit, and a higher relative price of non-tradable goods. The results are identical to the case of a demand shock analyzed above.

### 3.5 Scenario 3: Exogenous capital inflow

Continue to assume that  $\alpha = 1$ . To think of an exogenous capital inflow, suppose that  $b_1$  is exogenously given to this economy at a level  $\bar{b}_1 < 0$ . As a result,  $r$  will now be endogenously determined. From (11), it follows that  $c_1^T > y^T$ . Hence, from (13),  $c_2^T < y^T$ . Since  $c_1^T > c_2^T$ , first-order condition (8) implies that  $\beta(1 + r) < 1$ . Equation (10) then implies that  $p_1 > p_2$ .

Intuitively, by increasing available resources in period 1, the exogenous capital inflow “forces” the economy to consume more tradable goods in period 1. For this to be an equilibrium, the real interest rate must fall below the rate of time preference. This, in turn, generates an excess demand for non-tradable goods in period 1 (relative to period 2), which leads to an increase in their relative price.

In sum, we have seen that the three different scenarios – a shock to aggregate demand, a fall in the international real interest rate, and an exogenous capital flow – lead to the same outcome: higher consumption, trade deficits, and an increase in the relative price of non-tradable goods. Hence, while the origin of capital inflows (“push or pull,” in the language of Box 1) may vary from case to case, the macroeconomic consequences are likely to be very much the same.

## 4 The simple economics of sudden stops

As Figure 1 illustrates, capital flows into developing countries go through marked cyclical patterns and may fall precipitously from one year to the next. For instance, capital inflows fell by about 60 percent in 1982, 66 percent in 1998, and 45 percent in 2008. Guillermo Calvo (1998) coined the term “sudden stops” to describe such episodes.<sup>3</sup> These sudden stop episodes are typically characterized by sharp drops in consumption and reversals in trade deficits. This section uses a simple model to think about the consequences of a sudden stop.

Consider a 3-period endowment economy perfectly integrated into goods and capital markets. The endowment of tradables and non-tradables goods are denoted by  $y_i^T$  and  $y_i^N$ ,  $i = 1, 2$ , and 3, respectively. To capture a growing

<sup>3</sup>The WEO chapter reports that of the 87 episodes of capital inflows that it identified (73 in emerging countries and 14 in advanced open economies), 34 ended in a sudden stop and 13 with a currency crisis. In seven cases, a sudden stop coincided with a currency crisis. (A sudden stop is defined as a fall in capital inflows of more than 5 percentage points of GDP when the episode ends.)

economy, we will assume that the endowment path of tradable goods is rising over time; that is,  $y_1^T < y_2^T < y_3^T$ . On the other hand, the path of the endowment of non-tradable goods will be assumed to be constant over time; that is,  $y_1^N = y_2^N = y_3^N = y^N$ . Consumers will, of course, smooth consumption of tradables over time.

## 4.1 Consumers

For simplicity, assume logarithmic preferences given by

$$\log(c_1^T) + \log(c_1^N) + \beta[\log(c_2^T) + \log(c_2^N)] + \beta^2[\log(c_3^T) + \log(c_3^N)]. \quad (14)$$

The corresponding flow constraints take the form (notice that we are assuming initial net foreign assets equal to zero and imposing the condition that consumers “die” with no assets)

$$b_1 = y_1^T + p_1 y_1^N - c_1^T - p_1 c_1^N, \quad (15)$$

$$b_2 = (1+r)b_1 + y_2^T + p_2 y_2^N - c_2^T - p_2 c_2^N, \quad (16)$$

$$0 = (1+r)b_2 + y_3^T + p_3 y_3^N - c_3^T - p_3 c_3^N. \quad (17)$$

Combining these last three expressions yields the intertemporal constraint:

$$y_1^T + p_1 y_1^N + \frac{y_2^T + p_2 y_2^N}{1+r} + \frac{y_3^T + p_3 y_3^N}{(1+r)^2} = c_1^T + p_1 c_1^N + \frac{c_2^T + p_2 c_2^N}{1+r} + \frac{c_3^T + p_3 c_3^N}{(1+r)^2}. \quad (18)$$

The representative consumer chooses  $\{c_1^T, c_1^N, c_2^T, c_2^N, c_3^T, c_3^N\}$  to maximize lifetime utility (14) subject to (18). The corresponding first-order conditions (under our usual assumption that  $\beta(1+r) = 1$ ) imply that

$$c_1^T = c_2^T = c_3^T, \quad (19)$$

$$p_i c_i^N = c_i^T, \quad i = 1, 2, 3. \quad (20)$$

## 4.2 Equilibrium conditions

Equilibrium in the non-tradables goods market implies that

$$c_1^N = c_2^N = c_3^N = y^N.$$

Taking into account these equilibrium conditions, we can rewrite constraints (15), (16), and (17) as

$$CA_1 \equiv b_1 = y_1^T - c_1^T, \quad (21)$$

$$CA_2 \equiv b_2 - b_1 = r b_1 + y_2^T - c_2^T, \quad (22)$$

$$CA_3 \equiv -b_2 = r b_2 + y_3^T - c_3^T, \quad (23)$$

which, as indicated, correspond to the economy’s current account.

By the same token, using the above equilibrium conditions, we can derive the economy's resource constraint:

$$Y^T = c_1^T + \frac{c_2^T}{1+r} + \frac{c_3^T}{(1+r)^2}, \quad (24)$$

where

$$Y^T \equiv y_1^T + \frac{y_2^T}{1+r} + \frac{y_3^T}{(1+r)^2}.$$

denotes the present discounted value of the endowment of tradable goods.

### 4.3 Solution

Denote the constant level of consumption of tradable goods – characterized by condition (19) – by  $\bar{c}^T$ . Then, using (24),

$$\bar{c}^T = \frac{Y^T}{1+R+R^2}, \quad (25)$$

where  $R \equiv 1/(1+r)$ .

We now compute the path of the trade balance. Recalling that, by definition,  $TB_i \equiv y_i^T - c_i^T$ ,  $i = 1, 2, 3$  and using (25), we obtain

$$\begin{aligned} TB_1 &= \frac{1}{1+R+R^2} \left[ \underbrace{R(y_1^T - y_2^T)}_{-} + \underbrace{R^2(y_1^T - y_3^T)}_{-} \right] < 0, \\ TB_2 &= \frac{1}{1+R+R^2} \left[ \underbrace{(y_2^T - y_1^T)}_{+} + \underbrace{R^2(y_2^T - y_3^T)}_{-} \right] \\ TB_3 &= \frac{1}{1+R+R^2} \left[ \underbrace{(y_3^T - y_1^T)}_{+} + \underbrace{R(y_3^T - y_2^T)}_{+} \right] > 0. \end{aligned}$$

Since the constant level of consumption will fall somewhere  $y_1^T$  and  $y_3^T$ , it comes as no surprise that  $TB_1 < 0$  and  $TB_3 > 0$ . Hence,  $CA_1 < 0$ . The sign of  $TB_2$  is, in principle, ambiguous but we will assume that parameters are such that  $TB_2$  is negative (i.e.,  $\bar{c}^T > y_2^T$ ). Therefore, since both  $TB_2 < 0$  and  $b_1 < 0$ , then  $CA_2 < 0$ . This, in turn, implies that  $b_2 < 0$  and hence  $CA_3 > 0$ .

The path of the relative price of non-tradable goods,  $p$ , follows from (20) and the equilibrium in the home goods market:

$$p_1 = p_2 = p_3 = \frac{\bar{c}^T}{y^N}.$$

#### 4.4 Constrained equilibrium

Let us now solve the model under the assumption that the economy experiences a sudden stop in period 2, in the sense that – for some reason that we take as given – starting in period 2 foreigners decide not to lend to this economy any longer. Formally, we impose the constraints that  $CA_2 \geq 0$  and  $CA_3 \geq 0$ .

To simplify, we will solve the planner's problem. (We will later derive the intertemporal prices that would sustain the competitive equilibrium.) The planner thus chooses  $\{c_1^T, c_1^N, c_2^T, c_2^N, c_3^T, c_3^N, b_1, b_2\}$  to maximize the consumer's lifetime utility (14) subject to the flow constraints (15), (16), and (17) and the constraints  $b_2 - b_1 \geq 0$  and  $-b_2 > 0$ . Clearly, one or both of the constraints will be binding because the unconstrained path that we derived above violates the constraint that  $CA_2 \geq 0$ .

To solve this constrained problem, we can write the following Lagrangean:

$$\begin{aligned} \mathcal{L} = & \log(c_1^T) + \log(c_1^N) + \beta[\log(c_2^T) + \log(c_2^N)] + \beta^2[\log(c_3^T) + \log(c_3^N)] \\ & + \lambda_1 (y_1^T + p_1 y_1^N - c_1^T - p_1 c_1^N - b_1) \\ & + \lambda_2 [(1+r)b_1 + y_2^T + p_2 y_2^N - c_2^T - p_2 c_2^N - b_2] \\ & + \lambda_3 [(1+r)b_2 + y_3^T + p_3 y_3^N - c_3^T - p_3 c_3^N] \\ & + \psi(b_2 - b_1). \end{aligned}$$

To simplify the maximization, we have conjectured that the constraint  $-b_2 > 0$  will not bind in equilibrium and, hence, have omitted it from the problem. Once we derive the optimal solution, we will, of course, verify that this indeed the case in equilibrium.

First-order conditions are given by

$$\frac{1}{c_1^T} = \lambda_1, \tag{26}$$

$$\frac{\beta}{c_2^T} = \lambda_2, \tag{27}$$

$$\frac{\beta^2}{c_3^T} = \lambda_3, \tag{28}$$

$$\frac{1}{c_1^N} = p_1 \lambda_1,$$

$$\frac{\beta}{c_2^N} = p_2 \lambda_2,$$

$$\frac{\beta^2}{c_3^N} = p_3 \lambda_3,$$

$$\lambda_2(1+r) = \lambda_1 + \psi, \tag{29}$$

$$\lambda_3(1+r) = \lambda_2 - \psi, \tag{30}$$

$$b_2 - b_1 \geq 0, \quad \psi(b_2 - b_1) = 0 \tag{31}$$

Clearly,  $\psi = 0$  cannot be a solution because we would obtain the unconstrained solution derived above, which violates the constraint  $CA_2 \geq 0$ . Hence,  $\psi > 0$  and  $b_2 = b_1$ . To solve the model for  $\psi > 0$ , combine first-order conditions (26), (27), (28), (29), and (30) to obtain:

$$\frac{c_1^T}{c_2^T} = \frac{\lambda_1 + \psi}{\lambda_1}, \quad (32)$$

$$\frac{c_3^T}{c_1^T} = \frac{\lambda_1}{\lambda_1 - r\psi}. \quad (33)$$

Combining these two equations, we obtain

$$\frac{c_2^T}{c_3^T} = \frac{\lambda_2 - \psi}{\lambda_2}. \quad (34)$$

Since  $\psi > 0$ , conditions (32) and (33) imply, respectively, that  $c_1^T > c_2^T$  and  $c_3^T > c_1^T$ . In other words,

$$c_3^T > c_1^T > c_2^T.$$

Further, notice that it must be the case that  $c_2^T < \bar{c}^T$ , where  $\bar{c}^T$  is the value given by (25). If this were not the case, the present discounted value of the path of consumption would be higher than the present discounted value of the endowments. Finally, we can show (see Claims 1 and 2 in Appendix 8.1) that  $c_2^T < y_2^T$  and  $c_3^T < y_3^T$ .

Figure 3 illustrates the path of consumption of tradables in the unconstrained and constrained cases.<sup>4</sup> In the unconstrained case,  $c^T$  is flat over time (so that  $c_1^T = c_2^T = c_3^T = \bar{c}^T$  in the figure). In the constrained case, first-period consumption is higher ( $(c_1^T)^s > c_1^T$ ), second-period consumption is lower ( $(c_2^T)^s < c_2^T$ ) and third-period consumption is higher ( $(c_3^T)^s > c_3^T$ ).<sup>5</sup>

[Figure 3 here]

Intuitively, the constraint requiring that  $CA_2 \geq 0$  is binding and therefore implies that the shadow value of second-period consumption is higher – as captured by the fact that  $\psi > 0$  in equations (32) and (33). The shadow value is higher because, in addition to its direct cost, an additional unit of consumption contributes to making the constraint binding. This introduces an intertemporal distortion in consumption, as in Chapter 3. The shadow price of period 2 consumption is correspondingly higher, which induces consumers to reduce second-period consumption relative to both first and third-period consumption.

What about the behavior of  $p_t$ ? From (20),

<sup>4</sup>In the constrained case, we have denoted equilibrium values with a superscript “s”.

<sup>5</sup>We have established numerically that a solution exists in which  $(c_1^T)^s > \bar{c}^T$ , as depicted in Figure 3.

$$p_t = \frac{c_t^T}{y^N}, \quad t = 1, 2, 3.$$

Hence, compared to the unconstrained equilibrium,  $p_1$  is higher,  $p_2$  is lower, and  $p_3$  is higher, as illustrated in Figure 4.

[Figure 4 here]

The effects of a sudden stop are thus to provoke a consumption boom and real appreciation in the period preceding the sudden stop followed by a drastic fall in consumption of tradables and a real depreciation in the sudden stop period.<sup>6</sup>

## 5 Sticky prices model

Section 2 above has reviewed the main stylized facts associated with capital inflows. This section will develop a sticky-prices model – along the lines of Chapter 8 – that will be able to account for, and shed light on, these stylized facts. Instead of introducing real money balances in the utility function as in Chapter 8, however, we will postulate a cash-in-advance constraint in the spirit of the models of Chapter 7. We do so because we would like to incorporate potential interactions between the monetary and real side of the model stemming from changes in the effective price of consumption.

We will develop this model in discrete time because our aim is to solve it numerically with the help of the computer.<sup>7</sup> We will assume that goods markets open first followed by asset markets which, as discussed in Chapter 7, introduces an intertemporal distortion in consumption.

### 5.1 Consumers

Let preferences be given by

$$\sum_{t=0}^{\infty} \beta^t \alpha_t \{ \log(c_t^T) + \log(c_t^N) \}, \quad (35)$$

where  $\beta$  is the discount factor,  $\alpha_t$  is a preference shock, and  $c_t^T$  and  $c_t^N$  denote consumption of tradable and non-tradable goods, respectively.

The consumer's flow is given by

$$b_t + \frac{M_t}{P_t^T} = (1 + r_{t-1})b_{t-1} + \frac{M_{t-1}}{P_t^T} + \tau_t + y_t^T + \frac{y_t^N}{e_t} - c_t^T - \frac{c_t^N}{e_t}, \quad (36)$$

<sup>6</sup>As Exercise 1 at the end of the Chapter analyzes, if the sudden stop in period 2 were unanticipated, then the period 2 implications would be the same (fall in consumption and real depreciation) but the consumption boom in period 1 would naturally not take place.

<sup>7</sup>While we could solve the model analytically along the lines of the temporary stabilizations analyzed in Chapter 13 on inflation stabilization, the main economic insights will be readily apparent from the numerical solution.

where  $b_t$  denotes holding of net foreign assets by the private sector (denominated in unit of the tradable goods, the numeraire),  $M_t$  are nominal money balances,  $r_{t-1}$  is the world real interest rate,  $\tau_t$  are lump-sum transfers from the government,  $y_t^T$  and  $y_t^N$  stand for output of tradable and non-tradable goods, respectively, and  $e_t$  is the relative price of tradable goods.

The cash-in-advance constraint requires that today's consumption bundle be purchased with nominal money balances acquired yesterday:<sup>8</sup>

$$M_{t-1} = P_t^T \left( c_t^T + \frac{c_t^N}{e_t} \right). \quad (37)$$

Since the nominal money balances relevant for period  $t$  are chosen in period  $t-1$  (that is,  $M_{t-1}$ ), it will prove convenient to define real money balances as follows:

$$m_t \equiv \frac{M_{t-1}}{P_t^T}. \quad (38)$$

Using equation (38), we can rewrite the cash-in-advance constraint as

$$m_t = c_t^T + \frac{c_t^N}{e_t}. \quad (39)$$

In the same vein, we can use equation (38) to rewrite the flow constraint (36) as

$$b_t + m_{t+1} (1 + \pi_t^T) = (1 + r_{t-1})b_{t-1} + m_t + \tau_t + y_t^T + \frac{y_t^N}{e_t} - c_t^T - \frac{c_t^N}{e_t}, \quad (40)$$

where

$$\pi_t^T \equiv \frac{P_{t+1}^T}{P_t^T} - 1,$$

denotes the rate of inflation of tradable goods between periods  $t$  and  $t+1$ .

Consumers choose  $\{c_t^T, c_t^N, m_{t+1}, b_t\}_{t=0}^{\infty}$  to maximize lifetime utility, given by (35), subject to a sequence of flow constraints, given by (40), and the cash-in-advance constraint (39). In terms of the Lagrangean,

$$\begin{aligned} \mathcal{L} = & \sum_{t=0}^{\infty} \beta^t \alpha_t \{ \log(c_t^T) + \log(c_t^N) \} \\ & + \sum_{t=0}^{\infty} \beta^t \lambda_t \left[ (1 + r_{t-1})b_{t-1} + m_t + \tau_t + y_t^T + \frac{y_t^N}{e_t} - c_t^T - \frac{c_t^N}{e_t} - b_t - m_{t+1} (1 + \pi_t^T) \right] \\ & + \sum_{t=0}^{\infty} \beta^t \Psi_t \left[ m_t - \left( c_t^T + \frac{c_t^N}{e_t} \right) \right], \end{aligned}$$

<sup>8</sup>Since the nominal interest rate will be positive along all the equilibrium paths that we will consider, we already impose that the cash-in-advance constraint hold with strict equality.

where  $\lambda_t$  and  $\Psi_t$  are the Lagrange multipliers associated with constraints (40) and (39), respectively. The first-order conditions are given by

$$\frac{\alpha_t}{c_t^T} = \lambda_t + \Psi_t, \quad (41)$$

$$\frac{\alpha_t}{c_t^N} = \frac{\lambda_t}{e_t} + \frac{\Psi_t}{e_t}, \quad (42)$$

$$\beta(\lambda_{t+1} + \Psi_{t+1}) = \lambda_t(1 + \pi_t^T), \quad (43)$$

$$\lambda_{t+1}\beta(1 + r_t) = \lambda_t. \quad (44)$$

To rewrite the first-order conditions in more familiar terms, notice that perfect capital mobility implies that interest parity holds:

$$1 + i_t = (1 + r_t)(1 + \pi_t^T). \quad (45)$$

Lagging expression (43), substituting it into equation (41), and using (44) and (45), we obtain:

$$\frac{\alpha_t}{c_t^T} = \lambda_t(1 + i_{t-1}). \quad (46)$$

This expression should remind the reader of the discrete-time cash-in-advance model of Chapter 7. At an optimum, the marginal utility of consuming tradables is equated to the Lagrange multiplier times the effective price of consumption,  $1 + i_{t-1}$ .

Leading equation (46) and taking the ratio in two consecutive periods enables us to write the Euler equation as

$$\frac{c_{t+1}^T}{c_t^T} = \left(\frac{\alpha_{t+1}}{\alpha_t}\right) \left(\frac{1 + i_{t-1}}{1 + i_t}\right) \beta(1 + r_t). \quad (47)$$

This expression makes clear the three channels that will govern the dynamics of tradable goods consumption.<sup>9</sup> The first,  $\alpha_{t+1}/\alpha_t$ , captures changes in preferences (i.e., temporary demand shocks). The second one,  $(1 + i_{t-1}) / (1 + i_t)$ , reflects variations over time in the effective price of consumption. The third one,  $\beta(1 + r_t)$ , captures intertemporal substitution in consumption stemming from differences between the discount rate and the world real interest rate.

Finally, combining (41) and (42), we obtain the familiar intratemporal condition:

$$c_t^T = \frac{c_t^N}{e_t}. \quad (48)$$

For further reference, notice that by substituting this last equation into the cash-in-advance constraint (39), we can rewrite the latter as

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<sup>9</sup>This term,  $\beta(1 + r_t)$ , did not show up in Chapter 7 because we assumed that  $r$  was constant and that  $\beta(1 + r) = 1$ . In the present case, we will allow for temporary deviations of  $1 + r$  from  $1/\beta$ .

$$m_t = 2c_t^T. \quad (49)$$

As in Chapter 8, let  $n$  denote real money balances in terms of non-tradable goods (i.e.,  $n_t \equiv M_{t-1}/P_t^N$ ). It then follows that

$$e_t m_t = n_t. \quad (50)$$

Hence, we can rewrite (49) as

$$n_t = 2c_t^N. \quad (51)$$

## 5.2 Supply side

The supply side follows our standard set-up for sticky-prices introduced in Chapter 8 and used already, in a discrete time set-up, in Chapters 12 and 13. There is an exogenous (and constant) endowment of tradables goods:

$$y_t^T = y^T.$$

In contrast, non-tradable goods output is demand-determined. The nominal price of the non-tradable good is sticky (i.e., predetermined at each point in time) and follows the discrete-time version of Calvo's (1983) staggered prices:

$$\pi_{t+1}^N - \pi_t^N = \theta(y_f^N - c_t^N),$$

where  $y_f^N$  is the full employment level of output of non-tradable goods.

## 5.3 Government

The government's budget constraint is given by

$$h_t = (1 + r_{t-1})h_{t-1} + \frac{M_t - M_{t-1}}{P_t^T} - \tau_t.$$

Taking into account (38), we can rewrite this constraint as

$$h_t = (1 + r_{t-1})h_{t-1} + m_{t+1} (1 + \pi_t^T) - m_t - \tau_t. \quad (52)$$

## 5.4 Equilibrium conditions

Equilibrium in the non-tradable goods market requires that

$$c_t^N = y_t^N. \quad (53)$$

As already mentioned, perfect capital mobility implies that the interest parity condition, given by (45), holds.

By definition,  $e_t = P_t^T/P_t^N$ . Hence:

$$\frac{e_{t+1}}{e_t} = \frac{(1 + \varepsilon_t)(1 + \pi_t^*)}{1 + \pi_t^N}.$$

Let  $k_t$  denote the economy's net stock of foreign assets (i.e.,  $k_t = h_t + b_t$ ). Solving for  $\tau$  from (52), substituting it into the household's flow constraint (40), and using (45) and (53), we obtain the economy's flow constraint:

$$k_t = (1 + r_{t-1})k_{t-1} + y_t^T - c_t^T.$$

For further reference, let us rewrite this last equation as

$$\underbrace{h_t - h_{t-1}}_{\Delta IR} = \underbrace{-(b_t - b_{t-1})}_{KA} + \underbrace{r_{t-1}(h_{t-1} + b_{t-1}) + y_t^T - c_t^T}_{CA}, \quad (54)$$

where  $\Delta IR$ ,  $KA$ , and  $CA$  denote the increase in international reserves, the capital account, and the current account, respectively. Hence, expression (54) states the familiar identity that the increase in international reserves is equal to the sum of the capital and current accounts.

## 5.5 Predetermined exchange rates

We first solve the model under predetermined exchange rates. As in previous chapters, we linearize the model around a steady-state using the King-Plosser-Rebelo method. We then analyze the economy's response to two temporary shocks: a positive demand shock and a fall in world real interest rates.

### 5.5.1 Temporary demand shock

Figure 5 illustrates the economy's response to a temporary and positive demand shock; that is, an increase in the parameter  $\alpha$  at time  $t = 1$  that lasts until period  $t = 10$  (Panel A).<sup>10</sup> As the Euler equation (47) makes clear for the case of tradable goods, the temporary increase in  $\alpha$  raises the demand for both goods at  $t = 1$  and reduces it at  $t = 10$ . The higher demand for both goods is reflected in higher consumption of both tradables and non-tradables until the shock is reversed (Figure 5, Panels B and D).

[Figure 5 here]

How is the rise in the demand for both goods accommodated? As always, the economy procures the additional tradable goods from the rest of the world by running a trade deficit (Panel C). What about non-tradable goods? In an endowment economy, the higher demand for non-tradable goods would get fully reflected on impact in an increase in the relative price of non-tradable goods (i.e., a fall in  $e$ ). The exact opposite is true in this case: since  $e$  cannot change on impact under predetermined exchange rates (because the nominal exchange

<sup>10</sup>The parameterization is as follows:  $r = 0.015$ ,  $k = 5$ ,  $\theta = 0.5$ ,  $y_f^N = 1$ ,  $y^T = 1$ ,  $\varepsilon = 0.1$ ,  $\pi^* = 0.1$  and  $\alpha = 1$ .

rate is controlled by policymakers and  $P^N$  is sticky), the higher demand for non-tradable goods is fully reflected in an increase in output of non-tradable goods.<sup>11</sup> Starting in period 2, however, the real exchange rate begins to fall (Panel G) and thus partly accommodates the higher demand for non-tradable goods. Given that the economy is operating under predetermined exchange rates, this real appreciation must be effected through higher inflation of non-tradable goods (Panel F).<sup>12</sup> The higher consumption of both goods increases real money demand (recall equation (49)) which, under predetermined exchange rates, is passively accommodated by the central bank (Panel E).

As expected, Panel H indicates that the economy's aggregate debt increases steadily until the shock is reversed, which implies that the current account is in deficit throughout. Further, from the central bank's balance sheet ( $h_t + d_t = m_t$ ) and the fact that, as usual under predetermined exchange rates, we assume that real domestic credit is constant, it follows that

$$h_1 - h_0 = m_1 - m_0.$$

Hence, the increase in real money balances at time  $t = 1$  implies that the central bank gains international reserves.

Finally, we can use the balance of payments identity (54) to infer that in period 1 the capital account shows a surplus because there is an increase in international reserves and the current account is in deficit. Further, the capital account continues to show a surplus until the shock is reversed because, even though international reserves are constant, the current account is in deficit throughout. In other words, the economy is financing the current account deficit by a capital inflow (i.e., by the private sector getting indebted abroad).

### 5.5.2 Temporary fall in world real interest rate

Figure 6 shows how very similar dynamics arise when the economy responds to a temporary fall in world real interest rates (Panel A). Since today's consumption becomes cheaper relative to tomorrow's due to the fall in the world real interest rate (recall equation (47)), consumption of both tradables and non-tradables increases (Panel B and D, respectively). Qualitatively speaking, the way in which this increased demand for both goods is accommodated is the same as above. This qualitatively identical response of the economy to either a demand shock or to a fall in world real interest rates is thus fully consistent with the theoretical example provided in Section 3.

[Figure 6 here]

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<sup>11</sup>Since output of non-tradables is demand-determined, Panel D can also be read as depicting the path of non-tradable output.

<sup>12</sup>Recall from Figure 2 that the data indicate that inflation actually falls slightly but, as already mentioned, this reflects the presence of many inflations stabilization programs. As made clear in Chapter 13, an exchange rate-based inflation stabilization program will lead to the same dynamics (consumption boom, trade and current account deficits, real appreciation) except for the behavior of inflation.

### 5.5.3 Temporary fall in devaluation rate

To illustrate the idea that the behavior of inflation will depend on the source of the shock, Figure 7 illustrates the case of a temporary reduction in the rate of devaluation.<sup>13</sup> Remarkably, the behavior of all variables with the exception of inflation is qualitatively the same as in Figure 5 (positive demand shock) and Figure 6 (temporary fall in world real interest rate). Inflation, however, increases in Figures 5 and 6, but falls in this case.

[Figure 7 here]

We thus conclude that, depending on the source of the shock, we may see capital inflows episodes accompanied by either lower or higher inflation.

## 5.6 Flexible exchange rates

We now turn to how the economy responds to the same two shocks (a temporary positive demand shock and a temporary fall in the world real interest rate) under flexible exchange rates.

### 5.6.1 Temporary demand shock

Figure 8 illustrates the case of a temporary positive demand shock. Remarkably, while consumption of tradables goods increases (Panel B), consumption of non-tradable goods does not respond at all (Panel D). In other words, the increase in the demand for non-tradable goods is fully absorbed by an increase in the relative price of non-traded goods (i.e., a fall in  $e$ ; Panel G). To understand this, think of equation (51) as capturing money market equilibrium. Since real money supply, given by  $n_t$ , does not change on impact, consumption of non-traded goods cannot change either. To induce households to keep consumption of non-tradables constant, the relative price of non-tradables must increase (i.e.,  $e$  must fall) equi-proportionately with  $c^T$  (recall equation (48)). Since prices of non-tradable goods are sticky, this initial real appreciation takes place through a fall in the nominal exchange rate. Inflation of non-tradables remains constant throughout (Panel F). While the behavior of non-tradable consumption and the inflation rate depend critically on the assumption of separable preferences and a cash-in-advance constraint, it captures the fact that, under flexible exchange rates, monetary policy is a powerful nominal anchor. While consumption of non-tradable goods will no longer be constant under non-separable preferences, it will change by a relatively small amount compared to tradable consumption.<sup>14</sup>

[Figure 8 here]

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<sup>13</sup>This experiment corresponds, of course, to the temporary exchange rate-based stabilization analyzed in Chapter 13 and depicted in Figure 9 of the same chapter.

<sup>14</sup>To gain further insights into this experiment and next, Exercise 2 asks you to solve analytically the continuous-time version of this model.

### 5.6.2 Temporary fall in world real interest rate

Figure 9 depicts the case of a temporary fall in the world real interest rate. Once again, the non-tradable goods sector is insulated from the shock by the increase in the relative price of non-tradable goods.<sup>15</sup>

[Figure 9 here]

## 5.7 Comparison

While somewhat extreme in its implications for flexible exchange rates, the separable case enables us to isolate the critical difference between a capital inflow episode under predetermined exchange rates and one under flexible exchange rates. In both cases, the increase in aggregate demand that results either from a preference shock or from a fall in the world real interest rate leads in the short-term to an increase in the relative price of non-tradable goods. The key difference, however, is how this real appreciation is effected. Under predetermined exchange rates, the real appreciation must come about through higher inflation of non-tradable goods. In contrast, under flexible exchange rates, it comes about through a fall in the nominal exchange rate. In other words, flexible exchange rates allow policymakers to keep domestic inflation under control whereas predetermined exchange rates do not.

## 5.8 Non-separable case

Suppose now that preferences are given by

$$\sum_{t=0}^{\infty} \beta^t \alpha_t \left( \frac{c_t^{1-\frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}} \right), \quad (55)$$

where

$$c_t = z_t^{\frac{\rho}{\rho-1}}$$

and

$$z_t = \gamma (c_t^T)^{\frac{\rho-1}{\rho}} + (1-\gamma) (c_t^N)^{\frac{\rho-1}{\rho}}.$$

The rest of the model remains the same as above. As before, we proceed to solve it using the linearization method of King-Plosser-Rebelo.

We then repeat the two experiments carried out above.<sup>16</sup> Figures 10 and 11 illustrate the effects of a temporary demand shock and a temporary fall in the

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<sup>15</sup>Exercise 3 at the end of the chapter asks you to illustrate the economy's response to a reduction in the rate of monetary growth. Note, as expected, the different behavior of inflation.

<sup>16</sup>The parameters for the non-separable case are the same as for the separable case and, in addition,  $\rho = 0.8$  and  $\sigma = 0.5$ . These are "realistic" values of these parameters (see Ostry and Reinhart (1992), and Reinhart and Vegh (1995)).

world real interest rate, respectively, under predetermined exchange rates. As is clear, the results are essentially the same as those obtained in Figures 5 and 6 for the separable case.<sup>17</sup>

[Figure 10 here]

[Figure 11 here]

Figures 12 and 13 illustrate the results for the same two experiments under flexible exchange rates. The key difference relative to the separable case illustrated in Figures 8 and 9 lies in the fact that the non-tradable goods sector is no longer insulated. In other words, the increase in the demand for non-tradable goods is now reflected in both an increase in the relative price of non-traded goods and an increase in output of non-tradable goods. Notice, however, that for the temporary positive demand shock the increase in output (and consumption) of non-tradable goods (0.3 percent) is about ten times smaller than the increase in consumption of tradable goods (2.7 percent). The same is true in the case of a fall in the world real interest rate. Quantitatively, therefore, it is still true that the non-tradable goods sector is little affected by these shocks.

[Figure 12 here]

[Figure 13 here]

In terms of comparing the outcomes under flexible and predetermined rates, the key observation made above regarding the different inflationary effects remains valid. Comparing Figures 10 and 12, on the one hand, and Figures 11 and 13 on the other, we can see that the same shock leads to an increase in the inflation rate of non-tradable goods that is roughly ten times higher under predetermined exchange rates than under flexible rates.<sup>18 19</sup>

## 6 Policy responses to capital inflows

The empirical evidence of Section 2 clearly shows that capital inflows episodes are associated with an overheating of the economy (higher aggregate demand and output), current account deficits, and real appreciation. While the effects on inflation are less clear cut, abundant anecdotal evidence suggests that many episodes are also associated with higher inflation. Furthermore, all these stylized

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<sup>17</sup>In comparing, say, Figures 5 and 10, the different orders of magnitude regarding the response of consumption of both tradables and non-tradables are due to the fact that, in Figure 5, the implicit value of  $\sigma$  is one, whereas in Figure 10 the value is 0.5. Since the intertemporal elasticity of substitution is lower in Figure 10, the response of consumption is smaller.

<sup>18</sup>In fact, inflation even falls under flexible exchange rates for some parameterizations (try, for instance,  $\sigma = 1.5$  and  $\rho = 1.5$ ). (Programs are posted on the book website.)

<sup>19</sup>Exercise 3 at the end of the chapter asks you to illustrate the economy's response to a fall in the rate of money growth and a fall in the devaluation rate. Notice that the response is similar to the cases illustrated in the text except for the behavior of inflation.

facts are broadly consistent with the predictions of our sticky-prices model in Section 5. While policymakers typically welcome capital inflows as beneficial for the economy’s medium and long-run growth prospects, they are weary of such adverse macroeconomic consequences and attempt to fight them off by means of various policy measures. The most common policy responses are the following:

- Foreign exchange market intervention (non-sterilized and sterilized)
- Fiscal contraction
- Capital controls

We analyze each of these policies in turn.<sup>20</sup>

## 6.1 Foreign exchange rate market intervention

### 6.1.1 Non-sterilized intervention

We have seen analytically that, under a clean float, a given shock will cause the real exchange rate to fall faster (i.e., will cause the currency to appreciate faster in real terms) than under predetermined exchange rates. Consider, for instance, the case of a temporary positive demand shock. Comparing Panel G in Figures 10 and 12, we can see that the real exchange rate falls by 3 percent in the first period already under flexible rates whereas it remains put in the predetermined exchange rate case. In fact, it takes 5 periods for the real exchange rate to fall by 3 percent under predetermined exchange rates. Panel C in Figures 10 and 12 reveals that this larger real appreciation is associated with a larger trade deficit under flexible rates than under predetermined (a fall in the trade balance of 38.5 percent under flexible rates compared to 31.5 percent under predetermined exchange rates).

To prevent nominal – and hence, real – appreciation, the central bank often buys foreign exchange (typically dollars) to increase the nominal price of a dollar (i.e., the nominal exchange rate), which results in the accumulation of international reserves. Figure 14, Panel A depicts an index of foreign exchange market intervention, which varies between 0 and 1 (0 representing no intervention and 1 representing full intervention), for capital inflows episodes in three different periods.<sup>21</sup> <sup>22</sup> We can clearly see that foreign exchange market intervention increases in every case suggesting that central banks have been actively trying to prevent nominal appreciation of the domestic currency.

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<sup>20</sup>Other, but less common, policy responses include trade policy (for instance, subsidizing exports) and marginal reserve requirements on bank deposits. The reader is referred to Calvo, Leiderman, and Reinhart (1993) for a detailed discussion.

<sup>21</sup>The foreign exchange market intervention index is computed by dividing the change in international reserves by an index of “exchange rate market pressures” (a combination of movements in the nominal exchange rate and international reserves). Thus, the foreign exchange market intervention index would take a value of 0 for a clean float and of 1 for a fixed exchange rate.

<sup>22</sup>Figure 14 is based on the 73 episodes mentioned above for Figure 2.

[Figure 14 here]

To capture this idea in the simplest possible way, let us focus on the non-separable and flexible exchange rate case analyzed above. Specifically, let us assume that, in response to a temporary fall in the world real interest rate, the monetary authority increases the nominal money supply as much as needed to prevent the nominal exchange rate from changing on impact.<sup>23</sup> While, strictly speaking, this does not entail foreign exchange market intervention (the counterpart of the increase in the nominal money supply is an increase in domestic credit and not international reserves), it captures the effect of monetary policy on the level of the nominal exchange rate. The impact of this type of intervention is illustrated in Figure 15 where, as a reference point, the full line depicts the case of non-intervention while the circled line indicate the case of intervention. Panel G indicates that the intervention policy indeed achieves its objective of lessening the initial real appreciation. Indeed, while in the non-intervention case, the initial fall in  $e_t$  is 1.5 percent, in the intervention case the real exchange stays put in  $t = 1$  and reaches a maximum fall of 1 percent in  $t = 3$ . As Panel C makes clear, this is associated with a smaller trade deficit. Policymakers achieve the objective of a smaller real appreciation, however, at the cost of more overheating (Panel D) and higher inflation (Panel F). Intuitively, since the real exchange rate is kept constant on impact, then all the increase in aggregate demand gets reflected in higher output, which leads to higher inflation.

[Figure 15 here]

### 6.1.2 Sterilized intervention

Our discussion so far assumes that the foreign exchange market intervention is *non-sterilized* in the sense that the increase in international reserves is fully reflected in a corresponding increase in the monetary base. In practice, however, policymakers often fear the consequences of additional liquidity in the economy since, as we have seen, it will tend to be associated with higher inflation and overheating of the economy. One way of attempting to deal with these undesirable consequences is to sell government (or Central Bank) bonds to absorb this additional liquidity. This is referred to as *sterilized intervention*. Full sterilization amounts to the Central Bank reducing domestic credit such that the monetary base is unchanged. This is tantamount to the Central Bank acquiring foreign bonds (i.e., international reserves) in exchange for domestic bonds. Since, in practice, foreign bonds carry a lower interest rate than domestic bonds (after adjusting for the change in the exchange rate), sterilization operations result in Central Bank losses (typically referred to as a “quasi-fiscal cost”).

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<sup>23</sup>To see that this is always possible, think of solving the model for a value of  $e_1$  (i.e., the value of the real exchange rate in the period that the shock occurs) equal to  $e_0$  (the value just before the shock occurs) and then backing out the value of  $M$  consistent with that equilibrium.

Figure 14, Panel B shows a sterilization index before and during the two sets of capital inflows episodes mentioned above.<sup>24</sup> The picture makes clear that, on average, sterilization has not increased during capital inflows episodes. Based on anecdotal evidence, this probably reflects the fact that sterilization efforts are typically short-lived due to (i) the fact that, as explained below, they tend to actually encourage further capital flows by increasing domestic interest rates and (ii) the substantial quasi-fiscal costs involved.

To capture sterilized intervention in terms of our model, we would need to introduce imperfect asset substitutability between domestic and foreign bonds.<sup>25</sup> The effectiveness of sterilized intervention will critically depend on the degree of substitution between domestic and foreign bonds. If the degree of substitution is low, then the higher supply of domestic bonds will lead to an increase in the nominal interest rate, which will reduce real money demand and thus tend to depreciate the domestic currency. The higher the degree of substitution, the less effective the policy will be.<sup>26</sup> Empirically, the evidence on the effectiveness of sterilized intervention in affecting nominal exchange rates is mixed at best (see, for instance, Craig and Humpage (2001)).

## 6.2 Fiscal contraction

Another common policy measure in response to a capital inflows episode is to tighten fiscal policy. In particular, policymakers often reduce government spending (which is typically biased towards spending on non-tradables goods) in order to induce a real depreciation that would at least partly offset the real appreciation associated with the capital inflows episode. Indeed – and as discussed in Chapter 4 – the direct effect of a reduction in government spending on non-tradable goods in an endowment economy would be to reduce the relative price of non-tradable goods (i.e., a real depreciation).

Figure 14, Panel C shows the growth in real government expenditure before and during each set of episodes. The evidence clearly shows that government expenditure goes up during episodes of capital inflows. This is hardly surprising given that fiscal policy in developing countries is strongly procyclical (see Chapter 10). The procyclicality of government spending is likely to more than offset individual cases in which a contractionary fiscal response has indeed been observed.

The simplest model to illustrate the effectiveness of contracting government spending in order to fight real appreciation would be a flexible prices, cash-in-advance model à la Chapter 7. In fact, Exercise 4 at the end of this chapter

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<sup>24</sup>This sterilization index indicates the extent to which the monetary authority contracted domestic credit to offset the increase in the monetary base associated with foreign exchange market intervention (see IMF (2007) for details). A value of one (or higher) indicates full sterilization, whereas a value of 0 (or negative) implies no sterilization.

<sup>25</sup>For models of imperfect asset substitutability, see Flood and Jeanne (2005) and Lahiri and Vegh (2003).

<sup>26</sup>In the extreme case of perfect substitution, the effect is nil because the nominal interest rate is not affected at all.

shows that a reduction in  $g^N$  could completely offset the real appreciation induced by a capital inflows episode. While extreme, this example shows the power of fiscal policy in this context.

To address this issue in the context of the sticky prices model used in this chapter, suppose that policymakers follow the fiscal policy rule given by

$$g^N = \overline{g^N} + \phi(e_t - e_{ss}), \quad (56)$$

where  $\overline{g^N}$  is the exogenously-given component of government spending on non-tradable goods,  $g^N$  is total government spending on non-tradable goods, and  $\phi$  is a positive parameter that captures the degree of “leaning against the wind” embedded in the fiscal policy rule. Equation (56) calls for policymakers to reduce government spending on non-tradable goods whenever the current real exchange rate,  $e_t$ , is below its steady state level,  $e_{ss}$ . The opposite is true when the current real exchange rate is above its steady-state level.

Figure 16 illustrates the effects of putting into effect the fiscal policy rule (56) when there is a temporary fall in the world real interest rate for the non-separable case analyzed above under predetermined exchange rates.<sup>27</sup> As a benchmark, the full line denotes the no fiscal intervention case depicted in Figure 11. The circled path, on the other hand, corresponds to the case  $\phi = 10$ . In response to the initial real appreciation,  $g^N$  is reduced following policy rule (56) (Panel I). The contraction in government spending reaches its peak in  $t = 3$  at 5.5 percent.<sup>28</sup> This, in turn, reduces the fall in  $e_t$  in  $t = 2$  by around 35 percent (from 0.74 percent under non-intervention to 0.48 percent). The smaller real appreciation, however, comes at the cost of a substantial contraction in output starting in  $t = 2$ .<sup>29</sup>

[Figure 16 here]

Figure 17 illustrates the effectiveness of a fiscal contraction in lessening the initial real appreciation under flexible exchange rates.<sup>30</sup> On impact, the fall in  $e_t$  is reduced by around 7 percent and in  $t = 2$  by about 60 percent. As under predetermined exchange rates, this comes at the cost of a substantial contraction in output in  $t = 1$  (Panel J) and, in this case, of deflation (Panel F).

[Figure 17 here]

### 6.3 Capital controls

Yet another way of dealing with the unwanted consequences of capital inflows (including the possibility of financial crises once the direction of capital flows reverses) is to impose controls on short-term capital inflows, as discussed in

<sup>27</sup>We keep the same parameterization as above and set  $\overline{g^N} = 0.5$ .

<sup>28</sup>If government spending were 20 percent of GDP, this would correspond to a peak contraction of around 1 percent of GDP.

<sup>29</sup>We know from Exercise 2 in Chapter 8 that, in a sticky prices model, a reduction in  $g^N$  is contractionary.

<sup>30</sup>Here we set  $\phi = 0.9$ .

Box 2. This idea goes back to Tobin's (1978) celebrated suggestion of throwing some sand in the wheels of well-oiled global capital markets. The best-known example of this type of policy is the case of Chile during the period 1991-1998 where controls took the form of unremunerated reserve requirements on short-term capital inflows. Capital controls, however, may take various other forms as discussed in Box 2. The effectiveness of capital inflows is, at best, decidedly mixed. Capital controls seem to alter the composition of capital flows towards longer term flows and give policymakers some monetary autonomy. It is arguable, therefore, that the costs of such controls – particularly when it comes to making credit more expensive to small and medium-size firms that are less able to circumvent these controls – have typically outweighed the benefits.

## 7 Concluding remarks

Emerging markets go through recurrent cycles of capital inflows and subsequent outflows. Capital outflows – particularly if sudden – are typically associated with balance of payments and financial crises, which we will cover in Chapters 16 and 17. Capital inflows, on the other hand, are clearly beneficial from a long-term perspective as they provide much needed finance for projects that might not be otherwise undertaken. However, when they are short-term and/or take the form of portfolio investment, capital inflows present a host of short-term macroeconomic problems that pose serious dilemmas for policymakers.

This chapter has both characterized the macroeconomic consequences of capital inflows and analyzed some of the possible policy responses. We first showed that the macroeconomic scenario typically associated with capital inflows – consumption booms, trade and current account deficits, and real appreciation of the domestic currency – is likely to arise regardless of whether capital inflows are triggered by domestic or external factors. This is conceptually important because while in most models capital inflows are an endogenous response to some shock, in policy circles capital inflows are often implicitly or explicitly thought of as exogenous and reflecting the vagaries of international capital markets. Our analysis thus suggests that, to a first approximation, the source of the capital inflows is not relevant when it comes to understanding their macroeconomic implications.

If one views capital flows cycles as driven mainly by external factors, then one can ask the question: what are the macroeconomic effects of a sudden stop (defined as an exogenous end to capital inflows)? We saw how the anticipation of a sudden stop may be interpreted as introducing an intertemporal distortion, a la Chapter 3, and thus lead to a consumption boom and real appreciation followed by a consumption bust and real depreciation cycle.

We then compared the economy's response to a capital inflow depending on whether the economy is operating under predetermined or flexible exchange rates. We saw that, even though a real appreciation of the currency will occur regardless of the exchange rate regime, policymakers do have a choice as to how this real appreciation will come about. Under predetermined exchange rates,

the real appreciation will occur mainly through higher inflation of non-tradables whereas under flexible exchange rates it will occur mainly through a fall in the nominal exchange rate.

Finally, we analyzed two key policy responses aimed at alleviating the initial real appreciation: foreign exchange intervention and fiscal tightening. While both may lessen the initial real appreciation, this comes about at the cost of higher inflation in the case of foreign exchange intervention and an output contraction in the case of fiscal tightening.

## 8 Appendices

### 8.1 Proofs of claims in Section 4

**Claim 1:**  $y_2^T - c_2^T > 0$ . We proceed by contradiction.

Suppose  $y_2^T - c_2^T = 0$ . Then, since  $b_2 - b_1 = 0$ , it follows from (22) that  $b_1 = 0$ . Hence, from (21),  $y_1^T - c_1^T = 0$ . Further, since  $b_1 = 0$ , it follows that  $b_2 = 0$ . Hence, from (23),  $y_3^T - c_3^T = 0$ . This implies that consumption always equal the endowment and hence  $c_3^T > c_2^T > c_1^T$ , which is a contradiction since we have established that  $c_1^T > c_2^T$ .

Suppose  $y_2^T - c_2^T < 0$ . Then, since  $b_2 - b_1 = 0$ , it follows from (22) that  $b_1 > 0$ . Hence, from (21),  $y_1^T > c_1^T$ . Since  $y_2^T > y_1^T$ , this implies that  $c_2^T > c_1^T$ , which is a contradiction. **QED.**

Since  $TB_2 > 0$  and  $b_1 = b_2$ , then, by (22),  $b_1 < 0$ . Then, by (21),  $y_1^T < c_1^T$  and hence  $TB_1 < 0$ .

**Claim 2:**  $c_3^T < y_3^T$ . We proceed by contradiction.

Suppose  $c_3^T = y_3^T$ . Since  $y_3^T - c_3^T = -(1+r)b_2$ , this implies that  $b_2 = 0$ . But since  $y_2^T - c_2^T = -rb_1$ ,  $b_1 = 0$  implies that  $c_2^T = y_2^T$ , which is a contradiction because we have shown that  $c_2^T < y_2^T$ .

Suppose  $c_3^T > y_3^T$ . Since  $y_3^T - c_3^T = -(1+r)b_2$ , this implies that  $b_2 > 0$ . Since  $y_2^T - c_2^T = -rb_1$ ,  $b_1 > 0$  implies that  $c_2^T > y_2^T$ , which is a contradiction.

**QED**

**Claim 3:**  $c_3^T > \bar{c}^T$ . Recall from the text that  $c_3^T > c_1^T > c_2^T$ . We have also established that  $c_2^T < \bar{c}^T$ . Suppose that  $c_1^T \geq \bar{c}^T$ , then clearly  $c_3^T > \bar{c}^T$ . Suppose that  $c_1^T < \bar{c}^T$ . Then it must also be the case that  $c_3^T > \bar{c}^T$  because otherwise the present discounted value of the path of consumption would be lower than the present discounted value of the endowments. **QED**

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## Box 1. Capital inflows: Push or pull?

What triggers capital inflows? The literature has broken down possible explanations into two main categories:

- External or “push” factors: factors associated with a common set of favorable external factors, such as low interest rates in industrial countries and the world business cycle;
- Domestic or “pull” factors: country-specific factors, such as demand shocks, inflation stabilization programs, capital account liberalization, debt reduction agreements, non-credible reforms, and improvements in the institutional environment (for example, enforcement of property rights).

While, as the text makes clear, the macroeconomic effects of capital inflows are essentially the same regardless of their origin, the distinction between push and pull factors is still important for policy considerations. Clearly, capital inflows that are due to push factors are outside the policymaker’s reach and their frequency and intensity will be dictated by industrial countries’ business cycles and international credit conditions.<sup>31</sup> In contrast, when pull factors are at play, policymakers may have the possibility of enacting policies that will smooth the capital flows cycle. Hence, whether capital inflows are due to domestic shocks in developing countries or to a common set of external factors remains an important empirical question. Table 1 summarizes several econometric studies that intend to shed light on this matter.

[Table 1 here]

Calvo, Leiderman, and Reinhart (1993) was one of the first formal studies that looked at this issue. They find that external factors are mainly responsible for the capital inflows to Latin American countries during 1988-1992. In a similar vein, Fernandez-Arias (1996) assesses the relative importance of push and pull factors for a sample of emerging economies for 1989-1992 and also concludes that, once the effect of external factors on country creditworthiness is taken into account, external factors are mainly responsible for the surge of capital inflows to developing countries. Kim (2000) reports that domestic factors have recently become relatively less important than global factors in explaining capital flows towards developing countries.

On the other hand, several studies – Taylor and Sarno (1997) and Chuhan, Claessens, and Mamingi (1998) – document that both push and pull factors are relevant in explaining these flows, and that different types of flows (short- or long-term flows, bond or equity flows) are more responsive to different factors. For example, Taylor and Sarno (1997) report that short-term bond flows are mainly affected by changes in U.S. interest rates. Chuhan, Claessens, and Mamingi (1998), on the other hand, find that equity flows, rather than bond flows, are more sensitive to push factors.

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<sup>31</sup>Though policymakers can certainly try to influence how much actually comes into the country by imposing capital controls (see below).

The impact of push and pull factors appears to differ across regions. Baek (2006) finds that capital inflows into Asia are primarily due to push factors, including investor's appetite for risk and that domestic economic conditions have a negligible role. Capital inflows into Latin America are somewhat "pulled" by strong domestic growth, and pushed into the region by global financial factors but not by shifts in the market mood. The role of capital controls is also different between Latin America and Asia: Edison and Warnock (2003) find that a reduction in capital controls results in higher equity flows to emerging Asia but not to Latin America. Institutions also seem to play a role in capital flows. Alfaro, Kalemli-Ozcan and Volosovych (2007) find that institutional quality and historical legal origins have a direct effect on capital inflow mobility during the period 1970-2000.

Finally, the financial crisis that started in the United States in 2008 and led to an extremely loose monetary policy on the part of the Federal Reserve (with the Federal Funds rate close to zero) has resulted in a tremendous incentive for speculative money to flow into emerging markets through the so-called "carry trade," which involves borrowing at very low interest rates in the United States and investing in emerging markets.

## Box 2. Throwing sand in the wheels

Many emerging economies have resorted to capital controls in response to large and temporary surges in capital inflows. Broadly speaking, the idea behind the implementation of capital controls is to slow down the inflow of short-term capital and hence prevent a large real appreciation of the domestic currency and overheating of the economy (i.e., higher inflation and current account deficits). In principle, as well, capital controls would enhance the monetary authority's ability to conduct an independent monetary policy in the presence of fixed or predetermined exchange rates. An additional goal that is often mentioned is to decrease the vulnerability of the domestic banking system to a sudden outflow of capital (i.e., a sudden stop).

While controls on capital inflows can take numerous forms, the most common are the following:

- unremunerated reserve requirements on both bank and portfolio flows
- direct tax on portfolio inflows and non-resident deposits on banks
- restrictions on foreign liability positions of banks

How effective have capital controls been? As suggested by Magud and Reinhart (2007), the effectiveness of capital controls can be assessed based on their ability to

- limit capital inflows
- shifting the composition of flows towards long-term flows
- alleviating real exchange rate pressures
- preserving some monetary policy autonomy by severing the link between domestic and international interest rates

Table 2 presents a summary of findings in the literature, which has employed a variety of empirical techniques (ranging from sophisticated econometric models to descriptive and comparative analysis of time-series) to test the effectiveness of controls on capital inflows. The general finding seems to be that capital controls have been most successful in achieving the second and fourth goals above, while evidence on the first and third is decidedly mixed.

[Table 2 here]

It should be noted that most of the tools summarized in Table 2 were designed to act as a much stronger deterrent to short-term rather than long-term capital inflows. In the case of the tax on portfolio investment, the tax is typically a one-time tax charged upon entrance, thus penalizing relatively more short-term inflows (for a given interest rate differential). In the case of unremunerated reserve requirements, the central bank keeps the unremunerated reserves usually for a year regardless of the time horizon of the capital inflow which, again,

implies that the effect is larger on short-term inflows while barely affecting incentives regarding long-term inflows. In fact, the idea of penalizing short-term inflows has been taken to an extreme in the cases of taxes on financial transactions that have applied only to inflows that leave the country within less than a year, thus having no effect at all on long-term inflows.

While traditionally there was a consensus against the use of capital controls, this received wisdom has been challenged recently as financial crises have become commonplace and policymakers and international organizations such as the IMF struggle to come up with effective policy tools. As of 2011, Brazil is the latest example of a major emerging country that has not only imposed capital controls (see Table 2) but also enacted measures to directly restrict domestic borrowing such as raising the tax on consumer credit from 1.5 to 3 percent. In fact, the IMF itself has argued that, in circumstances in which the usual macroeconomic policy remedies are not appropriate (because of inflation concerns, an overvalued currency or a more-than-adequate level of reserves) or when it might not be possible to quickly address financial fragility concerns through the domestic prudential framework, capital controls may be a legitimate component of the policy response to surges in capital inflows (see Ostry *et al* (2010)).

In a lucid critique of the IMF position, however, Calvo (2010) has argued that, even as a last resort, countercyclical reserve requirements are bound to be more effective than capital controls in smoothing out the credit cycle and hence the undesirable macroeconomic consequences of capital inflows. An additional argument against capital controls – seldom mentioned – is the numerous rent-seeking activities that they are likely to generate fostering an environment of potential corruption and crony capitalism, which leads to substantive, if hard to measure, efficiency costs.

## Exercises<sup>32</sup>

### 1. Unanticipated sudden stop

Consider the 3-period model of Section 4. Initially, the economy is characterized by the unconstrained solution discussed in the text. When period 2 comes along, however, there is an unanticipated sudden stop that requires that the current account in periods 2 and 3 be non-negative. In this context:

- (a) Solve for consumption of tradables, the real exchange rate, the trade balance, and the current account in periods 2 and 3.
- (b) How does this solution compare to the solution for an anticipated sudden stop discussed in the text? Explain the differences, if any.

### 2. Shocks under flexible exchange rates

To gain intuition behind the results illustrated in Figures 8 and 9, this exercise asks you to solve the continuous-time version of the model of Section 5.

Let preferences be given by

$$\int_0^{\infty} \alpha_t [\log(c_t^T) + \log(c_t^N)] e^{-\beta t} dt. \quad (57)$$

The intertemporal budget constraint takes the form:

$$a_0 + \int_0^{\infty} \left( y_t^T + \frac{y_t^N}{e_t} + \tau_t \right) e^{-rt} dt = \int_0^{\infty} \left( c_t^T + \frac{c_t^N}{e_t} + i_t m_t \right) e^{-rt} dt. \quad (58)$$

The cash-in-advance constraint is given by

$$m_t = c_t^T + \frac{c_t^N}{e_t},$$

where, for notational simplicity, we have set to one the parameter associated with the continuous-time cash-in-advance constraint. The supply side of the model follows Chapter 8 with Calvo-pricing. In this context:

- (a) Derive the first-order conditions and set-up a dynamic system in  $n$  and  $\pi$ .
- (b) Analyze the effects of an unanticipated and temporary increase in  $\alpha_t$ .
- (c) Analyze the effects of an unanticipated and temporary fall in  $r_t$ .

### 3. Inflation dynamics and capital inflows

Using the Matlab programs posted on the book website, perform the following experiments:

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<sup>32</sup> An answer key is available from the author upon request.

- (a) Temporary reduction in rate of money growth under flexible exchange rates for the separable case
- (b) Temporary reduction in rate of money growth under flexible exchange rates for the non-separable case
- (c) Temporary reduction in rate of devaluation rate under predetermined exchange rates for the non-separable case

4. Contractionary fiscal policy as a policy response to capital inflows

This exercise illustrates the use of contractionary fiscal policy as a way of alleviating the real exchange rate appreciation that accompanies episodes of capital inflows. Consider a small-open economy operating under predetermined exchange rates with fixed endowment of tradables ( $y^T$ ) and non-tradables ( $y^N$ ) and perfectly integrated into world goods and capital markets. Preferences are given by

$$\int_0^\infty [\log(c_t^T) + \log(c_t^N)] e^{-\beta t} dt,$$

where  $c^T$  and  $c^N$  denote consumption of tradables and non-tradables, respectively, and  $\beta$  is the positive discount rate. The intertemporal constraint takes the form:

$$a_0 + \int_0^\infty \left( y^T + \frac{y^N}{e_t} - \tau_t \right) e^{-rt} dt = \int_0^\infty \left( c_t^T + \frac{c_t^N}{e_t} + i_t m_t \right) e^{-rt} dt,$$

where  $a_0$  are initial real financial assets,  $r(= \beta)$  is the world real interest rate,  $e_t$  is the real exchange rate (i.e., the relative price of tradables in terms of non-tradables),  $\tau_t$  denotes lump-sum taxes,  $i$  is the nominal interest rate, and  $m$  are real money balances in terms of tradable goods.

The cash-in-advance constraint is given by

$$m_t = \alpha \left( c_t^T + \frac{c_t^N}{e_t} \right).$$

where  $\alpha$  is a positive parameter. The government's flow budget constraint is given by

$$\dot{h}_t = r h_t + \dot{m}_t + (\varepsilon_t + \pi_t^*) m_t + \tau_t - \frac{g_t^N}{e_t}, \quad (59)$$

where  $g_t^N$  is government spending on non-tradables (which we take as the policy instrument). The government sets a constant rate of devaluation,  $\bar{\varepsilon}$ . Lump-sum taxes adjust endogenously to ensure that the government's budget constraint holds.

Equilibrium in the non-tradable goods market requires that

$$y^N = c_t^N + g_t^N.$$

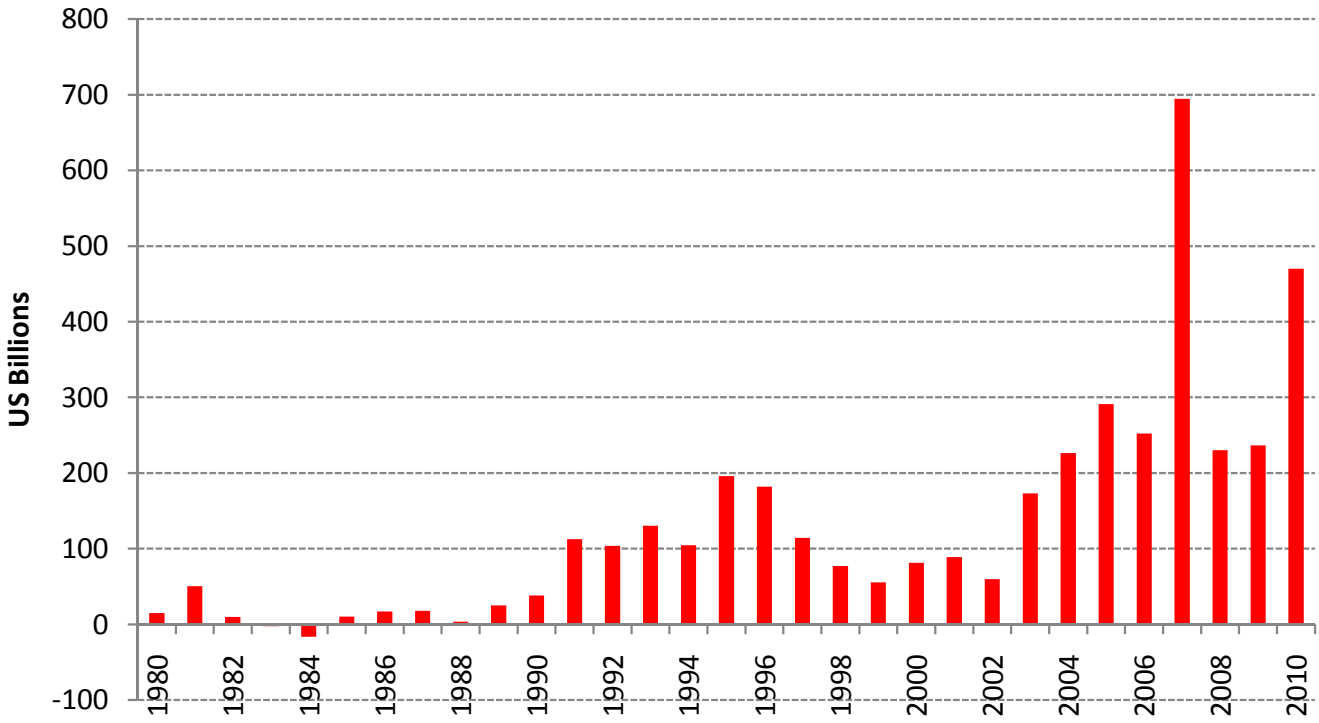
Interest parity holds:

$$i_t = i_t^* + \bar{\varepsilon}.$$

In the context of this model:

- (a) Suppose that, starting from an initial stationary equilibrium, there is an unanticipated and temporary reduction in  $i_t^*$  between time 0 and time  $T$ . (Assume  $g_t^N$  is constant.) Show that this will lead to a consumption boom in the tradable sector and to real appreciation. Plot the time paths of the different variables. Explain the intuition behind the results.
- (b) Suppose now that, in response to the temporary reduction in  $i_t^*$ , the government reduces  $g_t^N$  temporarily by as much as needed to keep the real exchange rate between time 0 and time  $T$  at its pre-shock level. Compute a reduced form solution for the level of  $g_t^N$  that will keep  $e_t$  constant. Plot the time paths of the different variables. Explain the intuition behind the results.

**Figure 1. Emerging and Developing Economies: Private Capital Flows**



Source: International Monetary Fund, World Economic Outlook Database

Figure 2. Capital inflows: Stylized facts

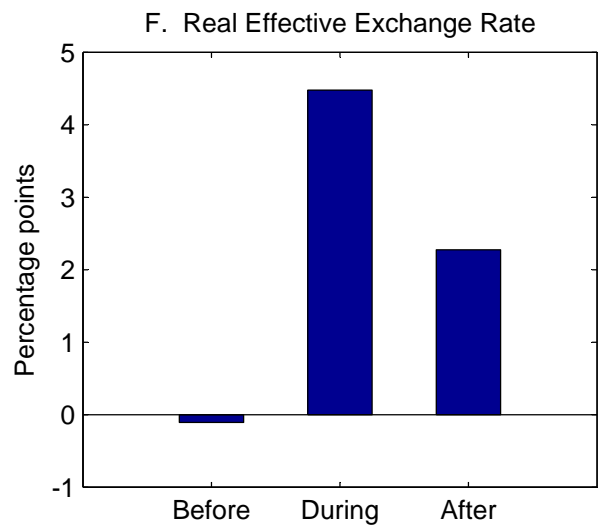
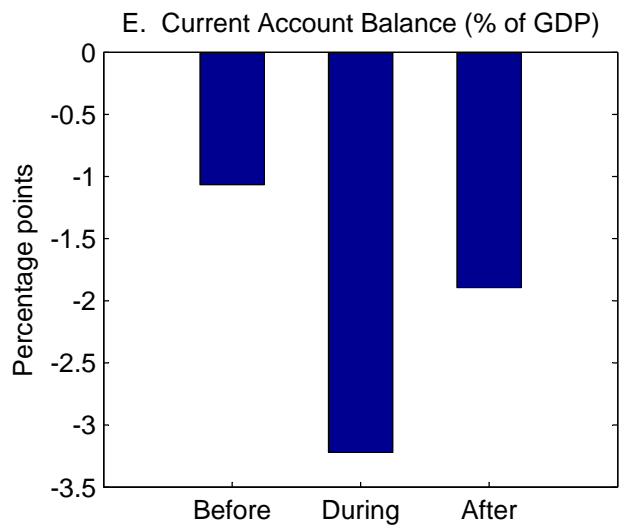
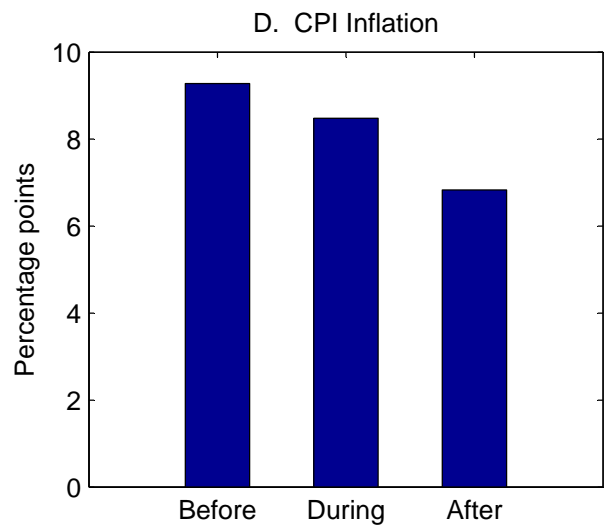
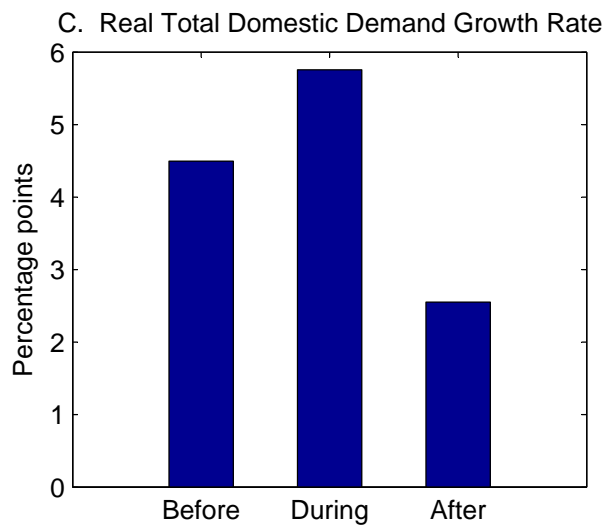
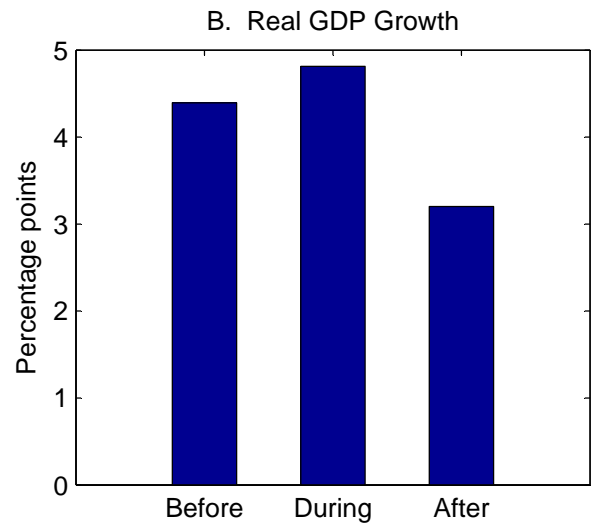
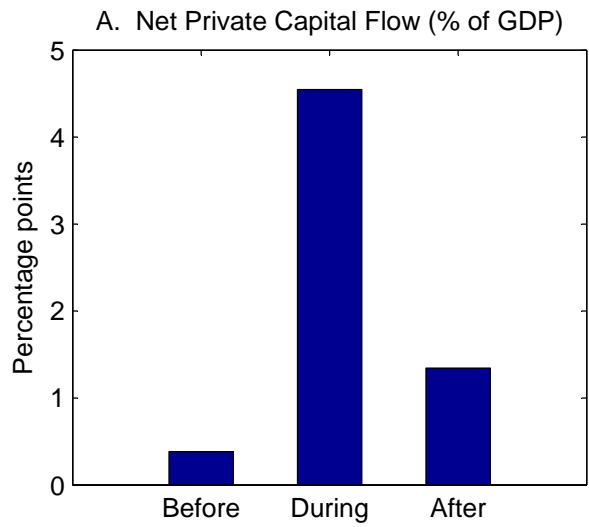




Figure 4. Sudden stop: Relative price of non-tradables

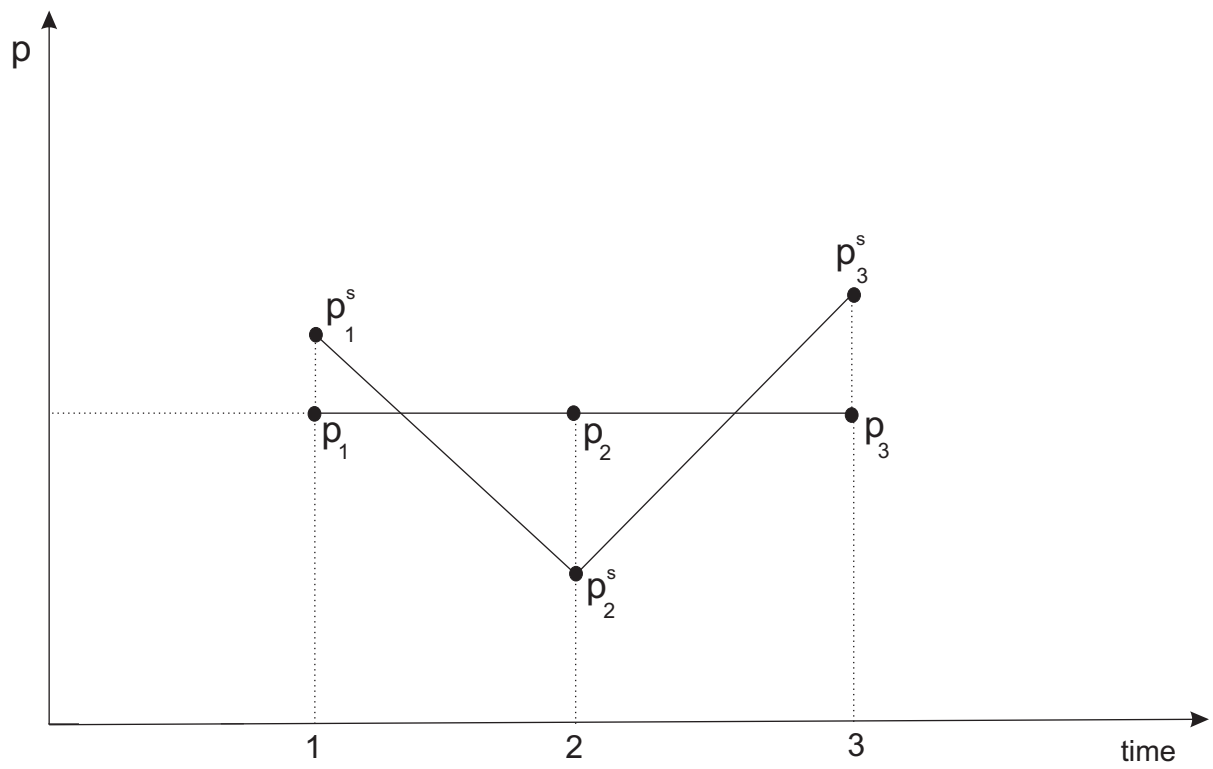


Figure 5. Temporary positive demand shock under predetermined exchange rates (separable case)

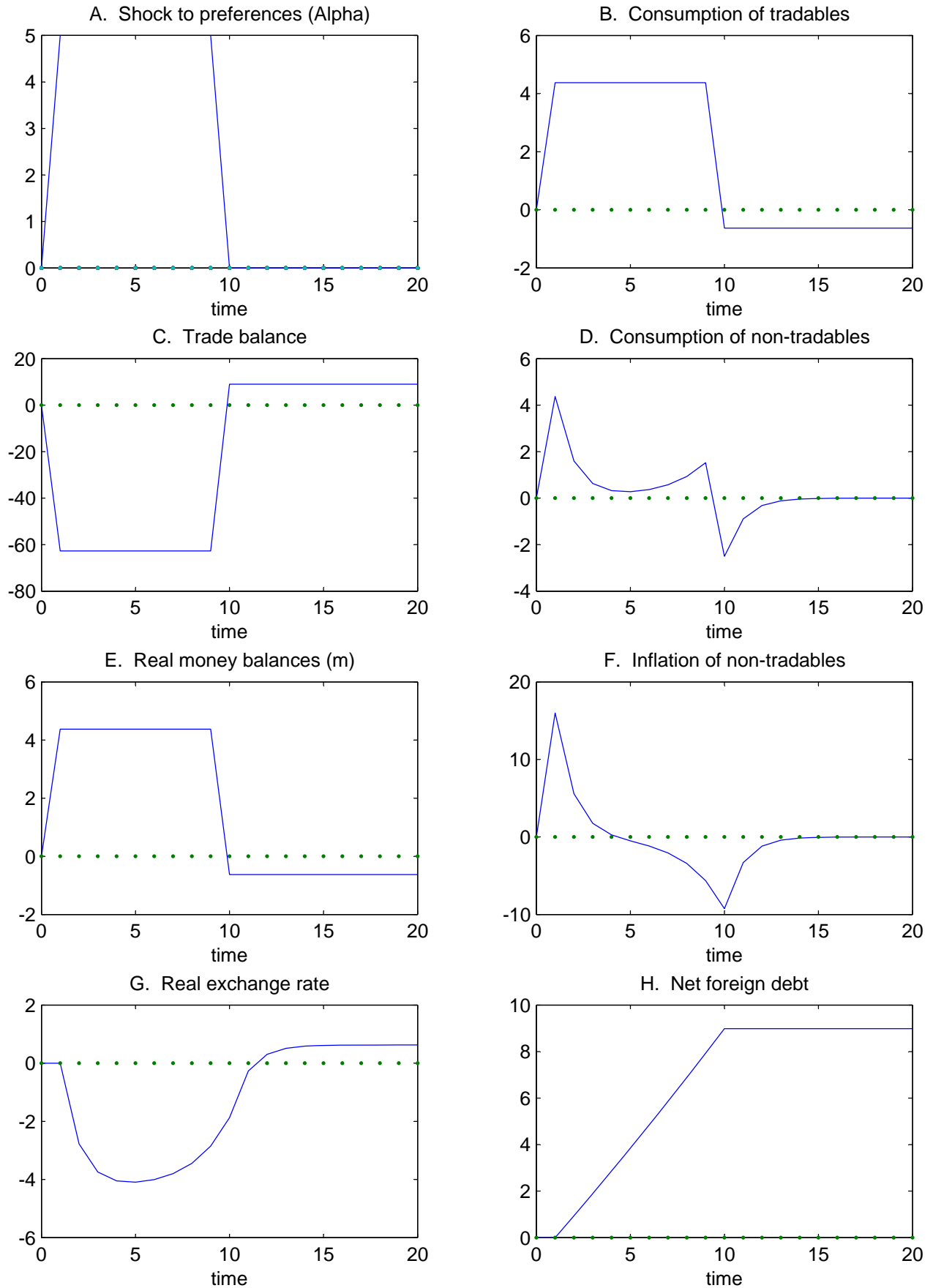


Figure 6. Temporary fall in world real interest rate under predetermined exchange rates (separable case)

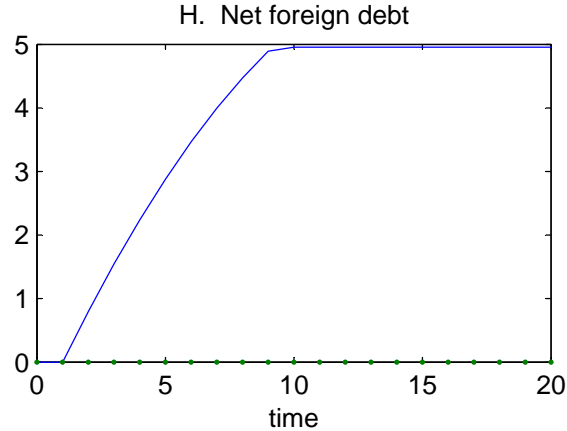
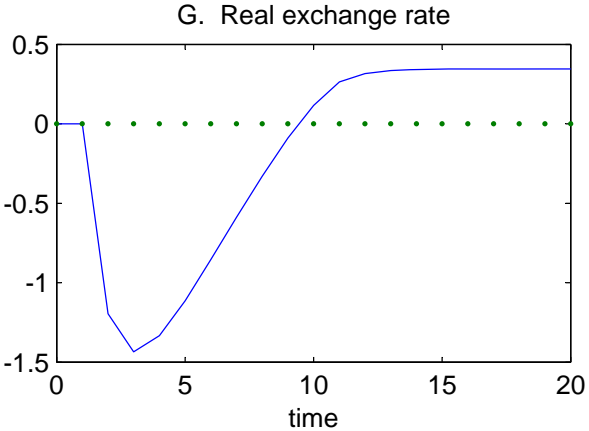
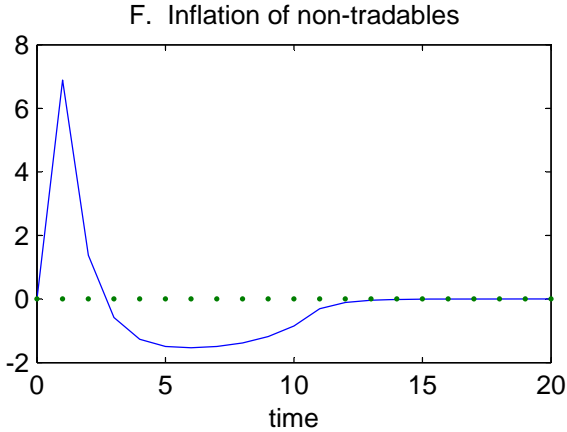
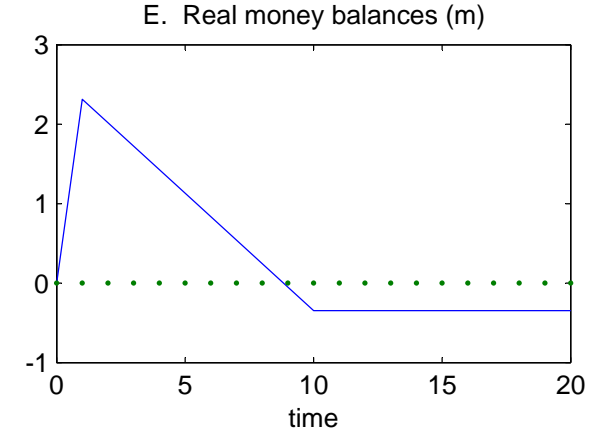
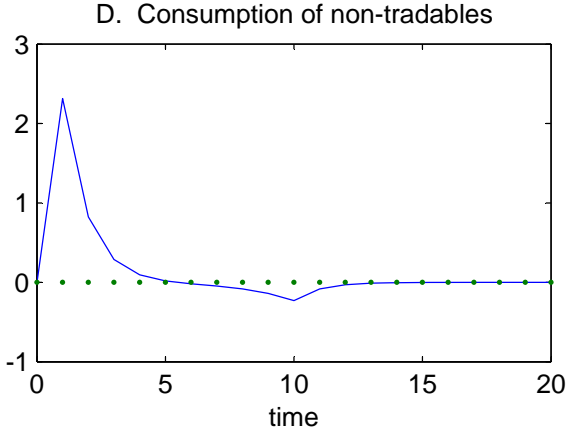
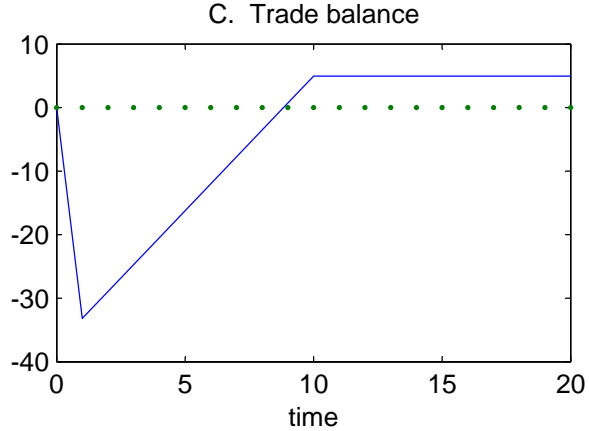
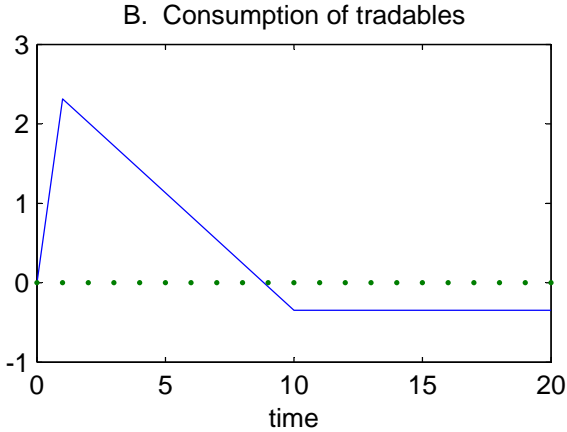
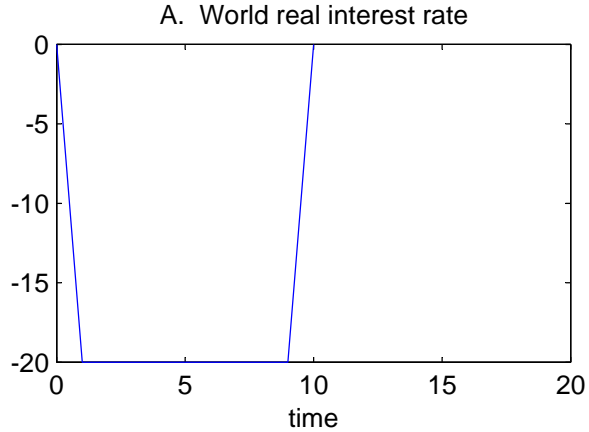


Figure 7. Temporary fall in devaluation rate under predetermined exchange rates (separable case)

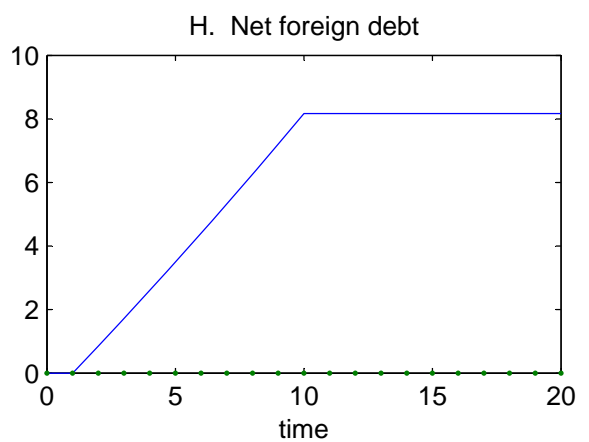
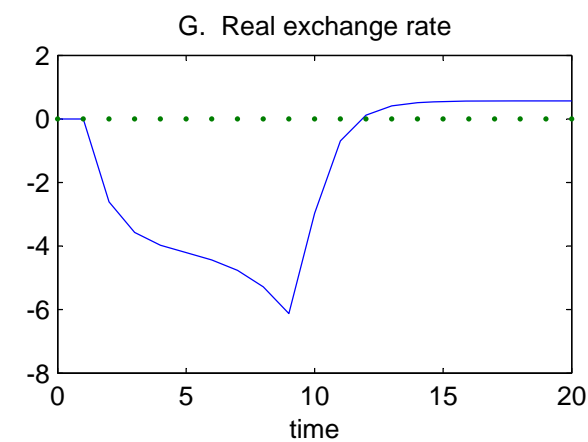
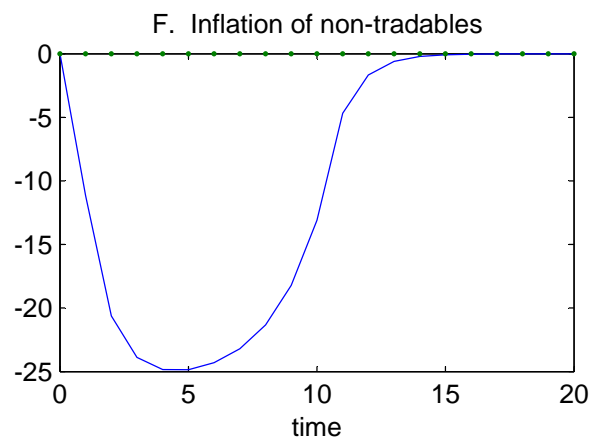
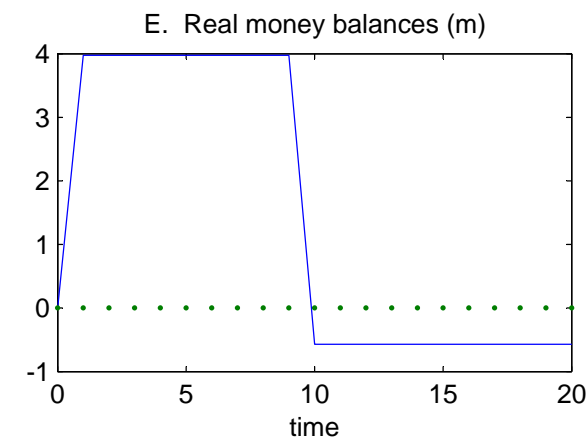
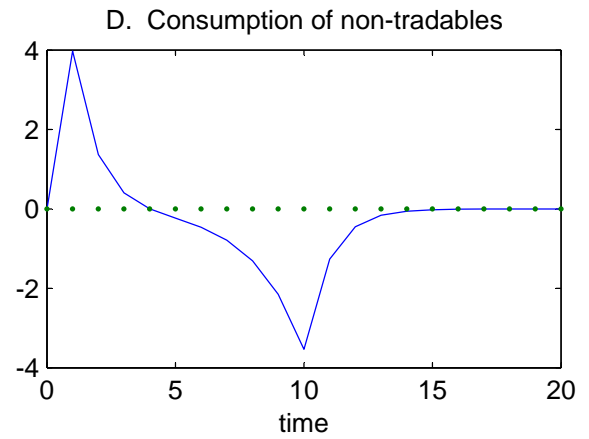
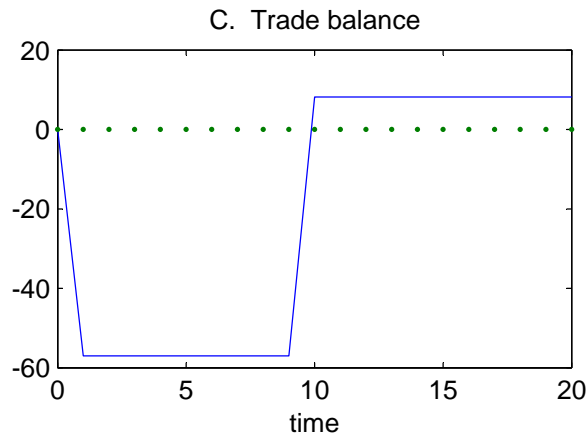
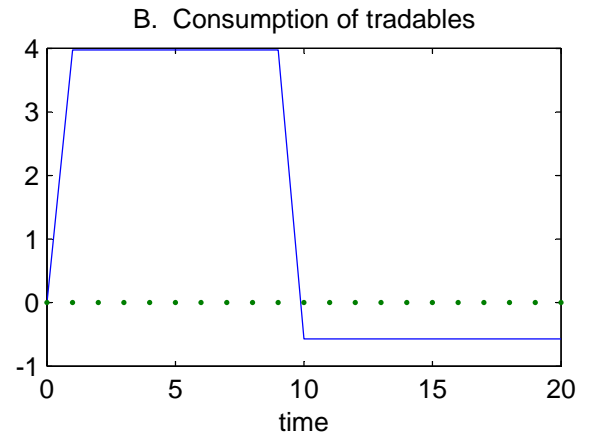
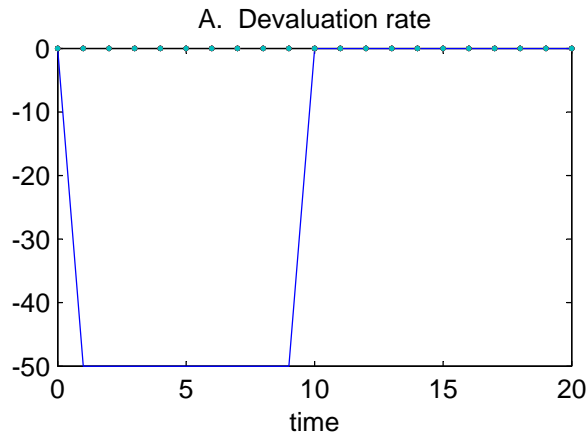


Figure 8. Temporary positive demand shock under flexible exchange rates (separable case)

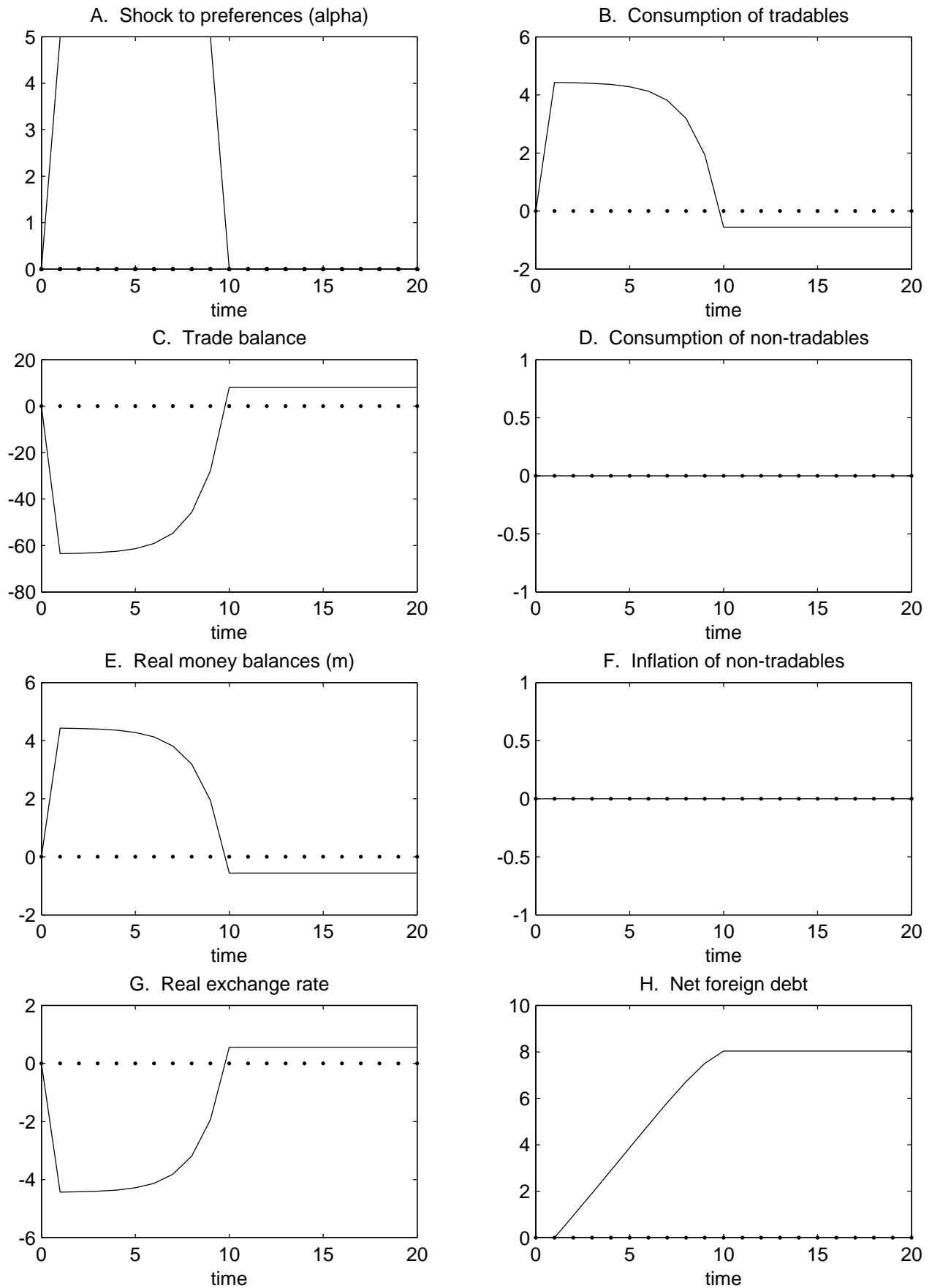


Figure 9. Temporary fall in world real interest rate under flexible exchange rates (separable case)

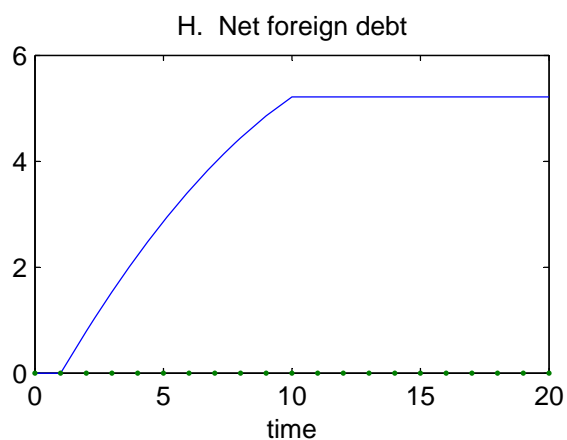
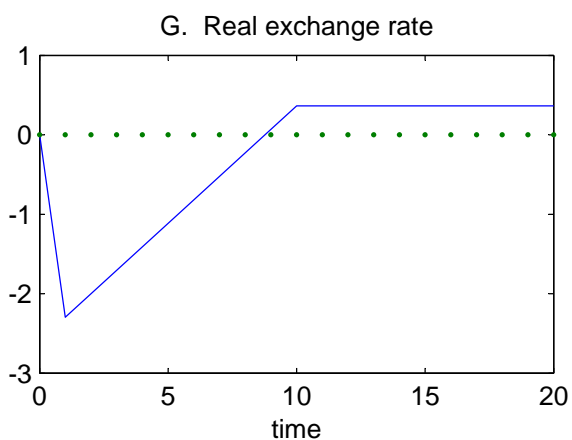
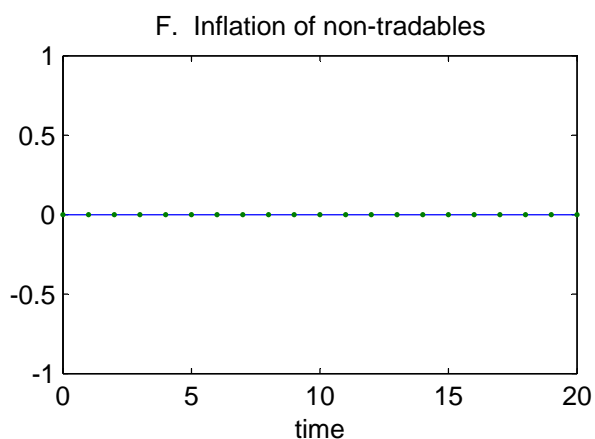
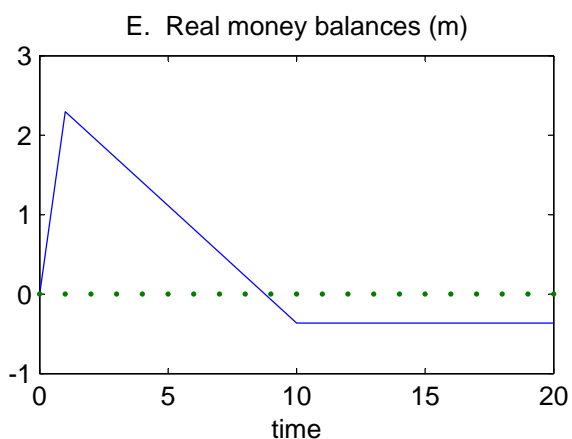
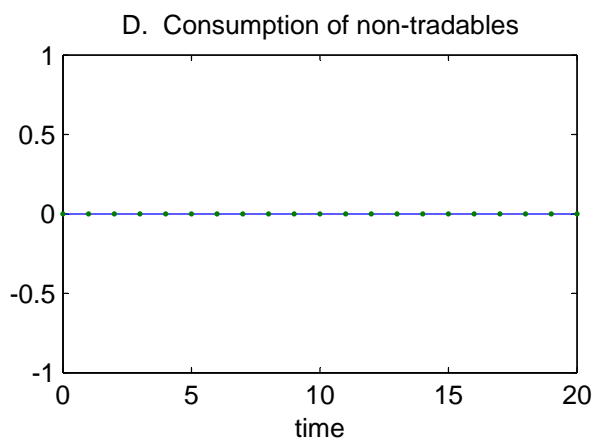
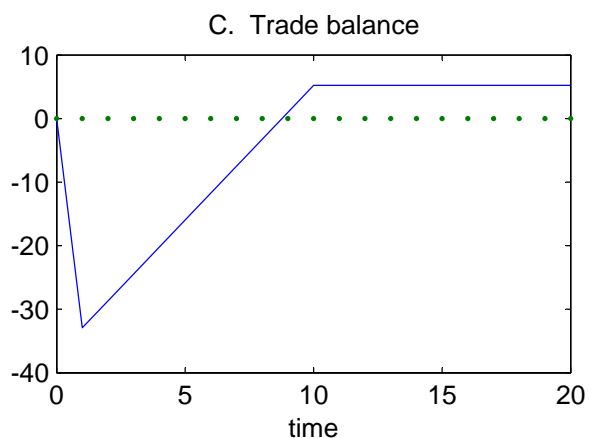
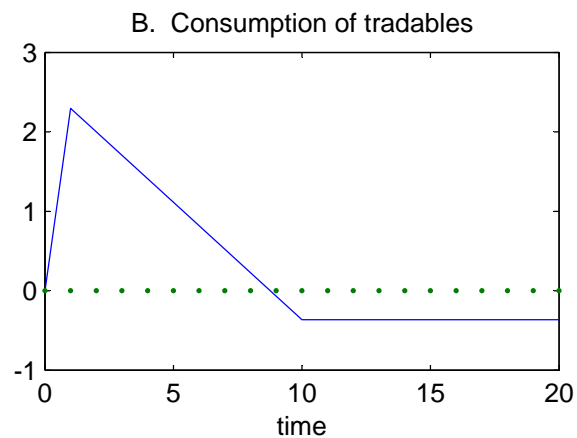
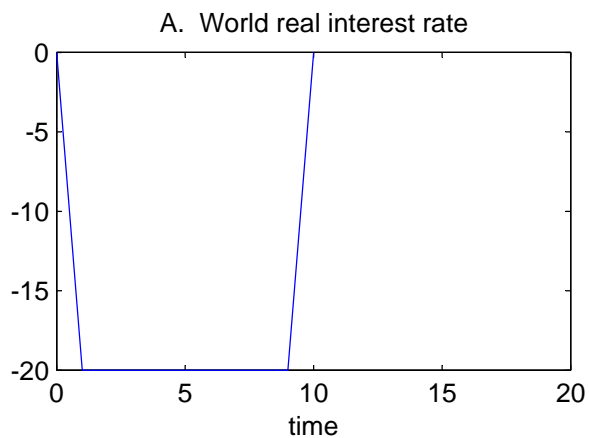


Figure 10. Temporary positive demand shock under predetermined exchange rates (non-separable case)

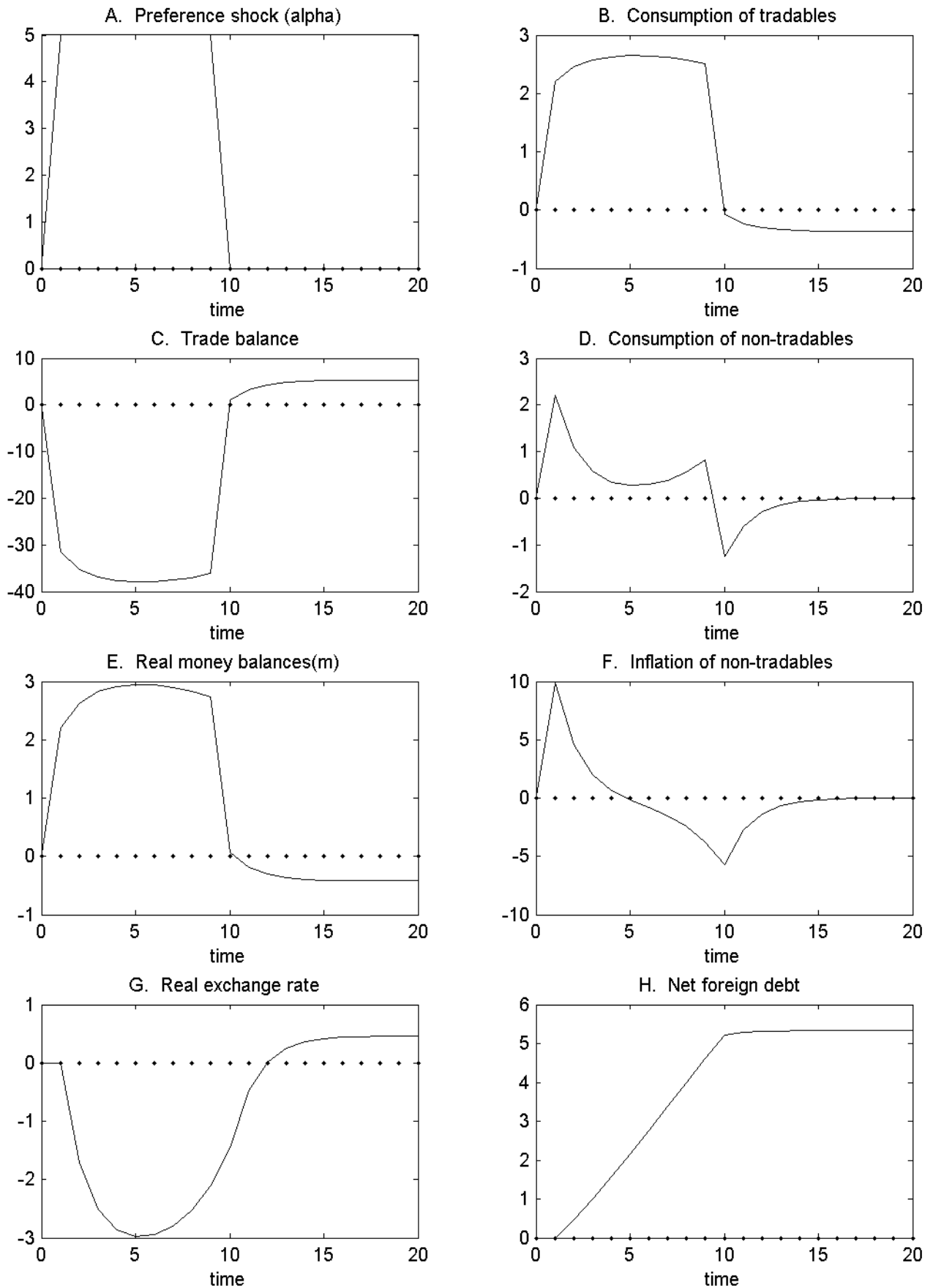


Figure 11. Temporary fall in world real interest rate under predetermined exchange rates (non-separable case)

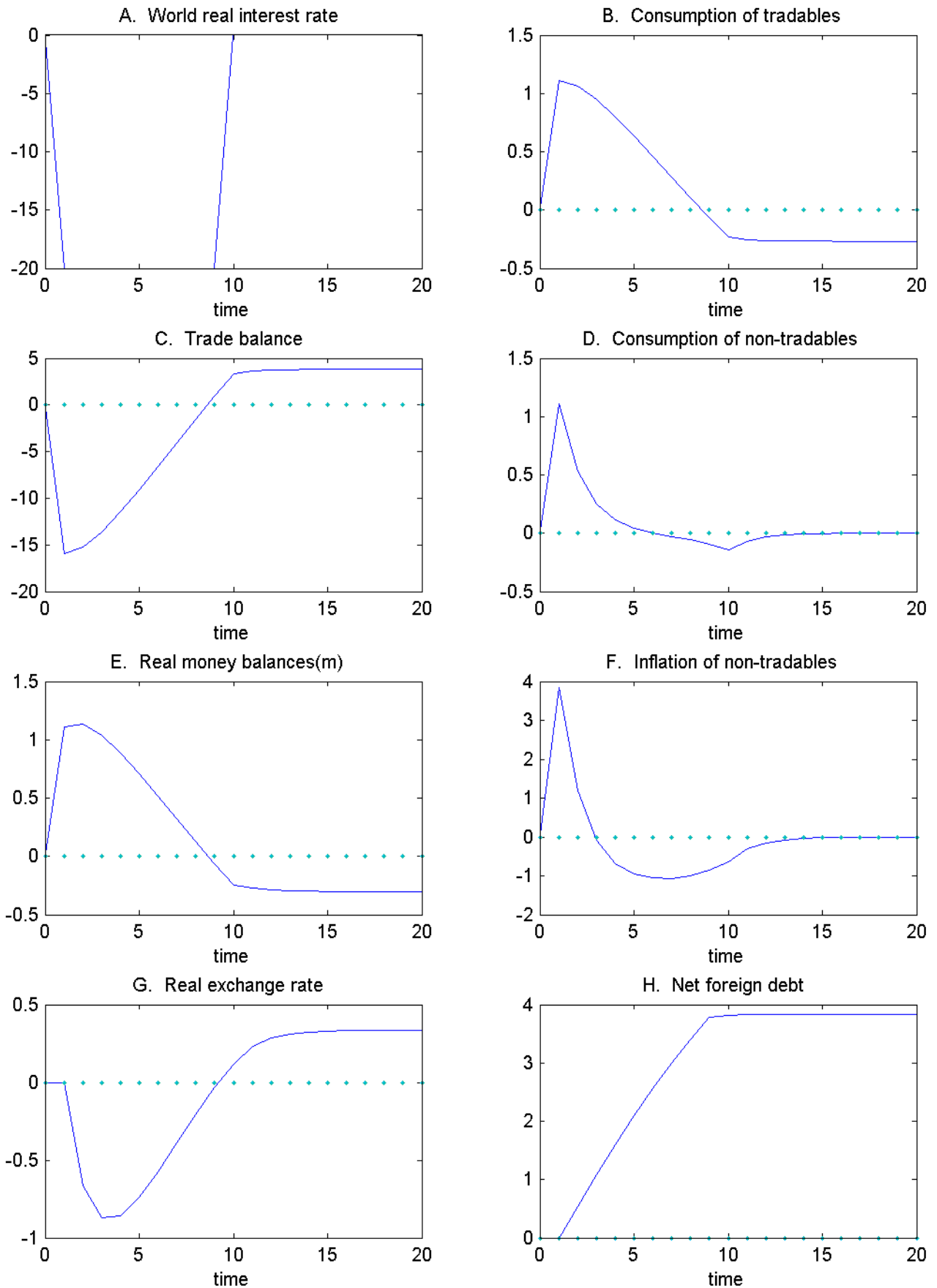


Figure 12. Temporary positive demand shock under flexible exchange rates (non-separable case)

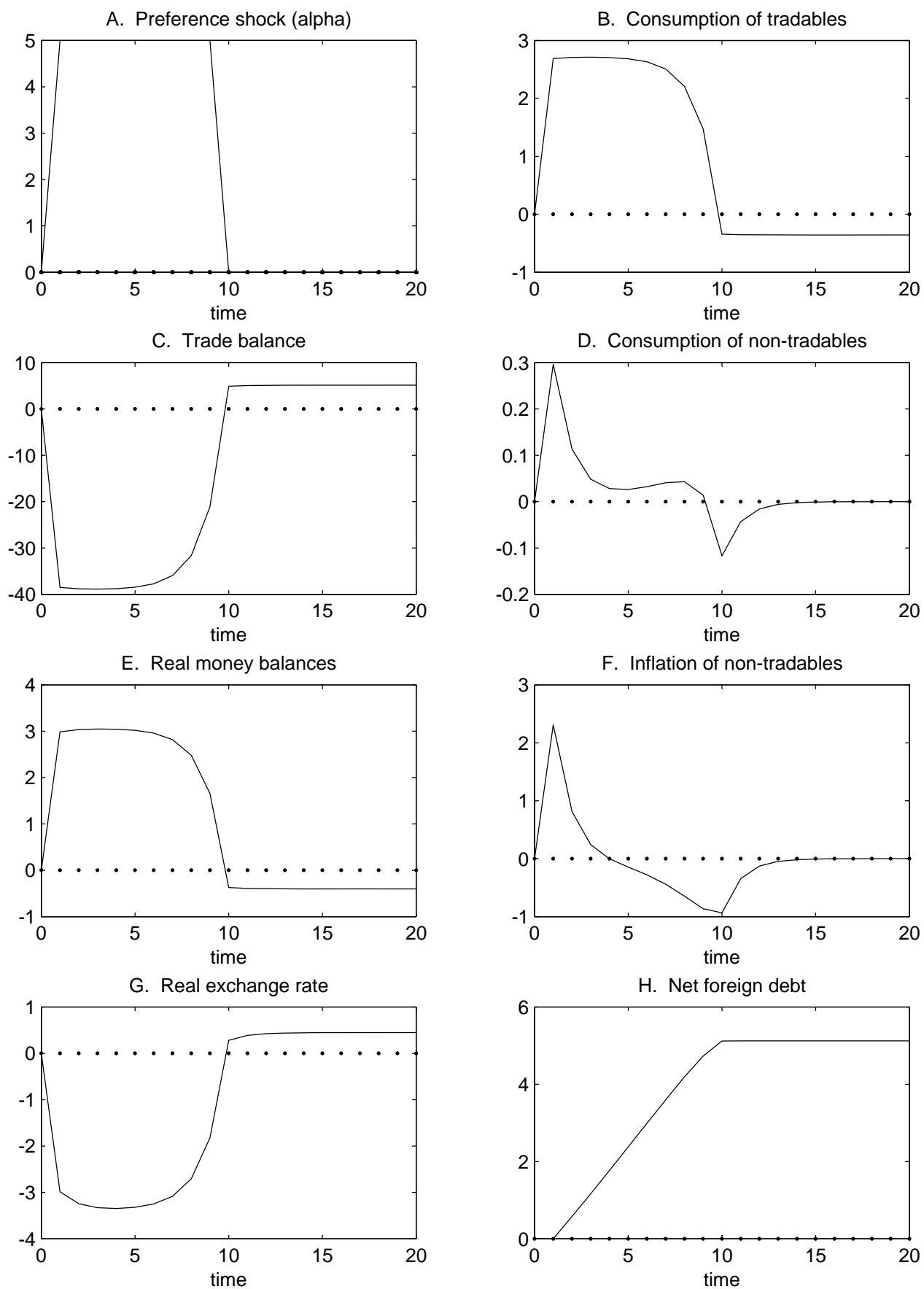
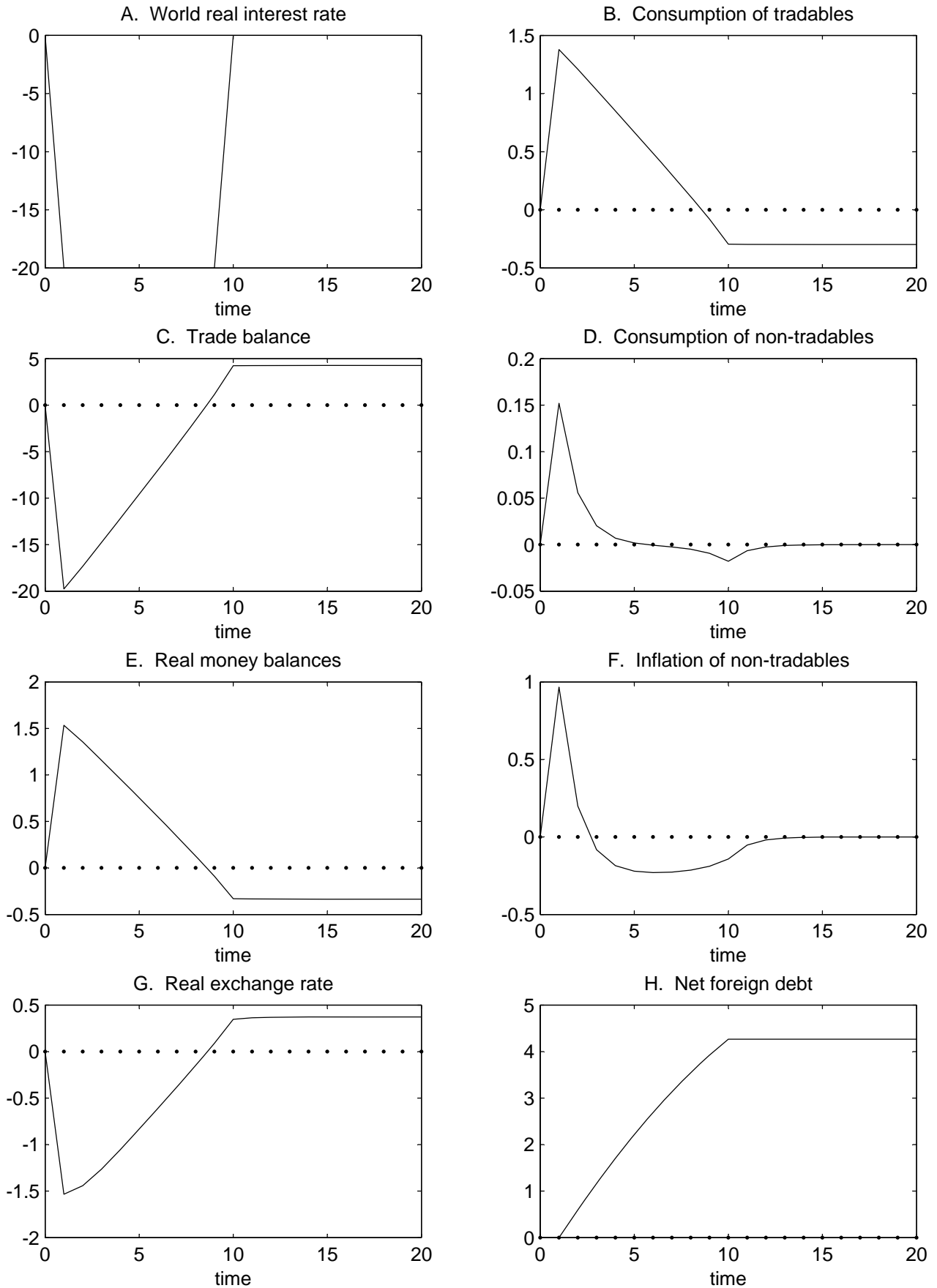
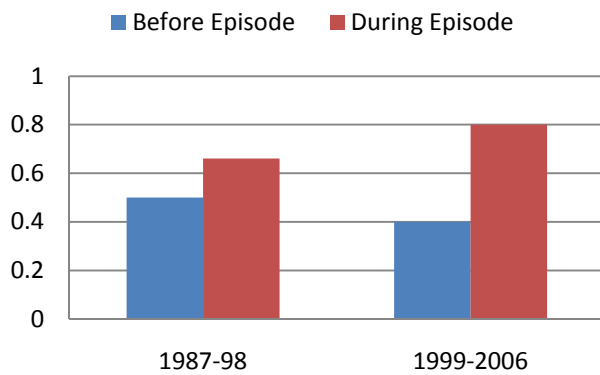


Figure 13. Temporary fall in real interest rate under flexible exchange rates (non-separable case)

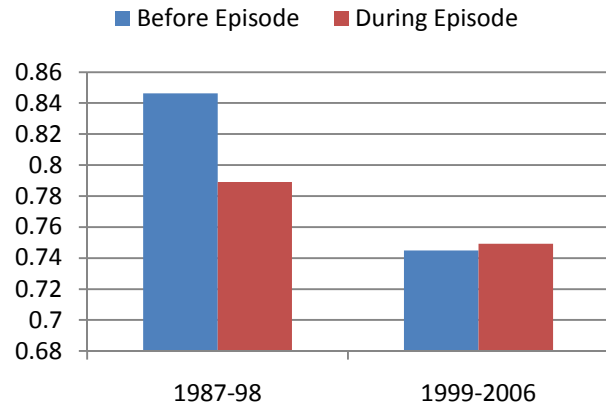


**Figure 14. Policy responses to capital inflows episodes**

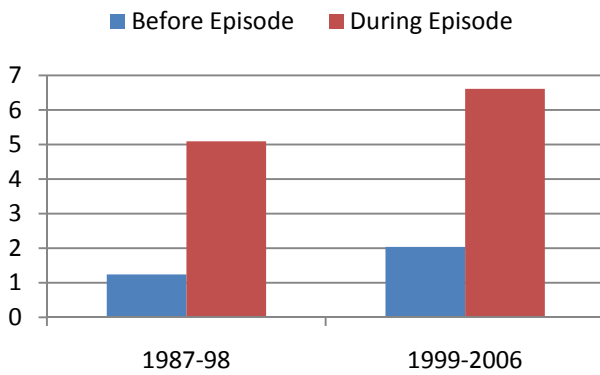
**A. Index of Foreign Exchange Market Intervention**



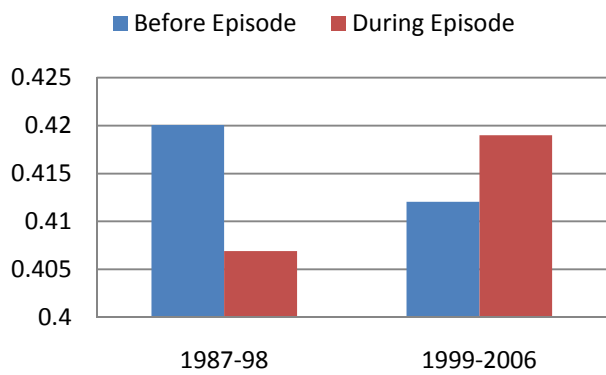
**B. Sterilization Index**



**C. Growth of Real Government Expenditures (percent)**



**D. Index of Controls on Capital Inflows**



Note: Based on 73 episodes of capital inflow episodes in developing countries.

Source: WEO (2007)

Figure 15. Temporary fall in world real interest rate under flexible rates with intervention (non-separable)

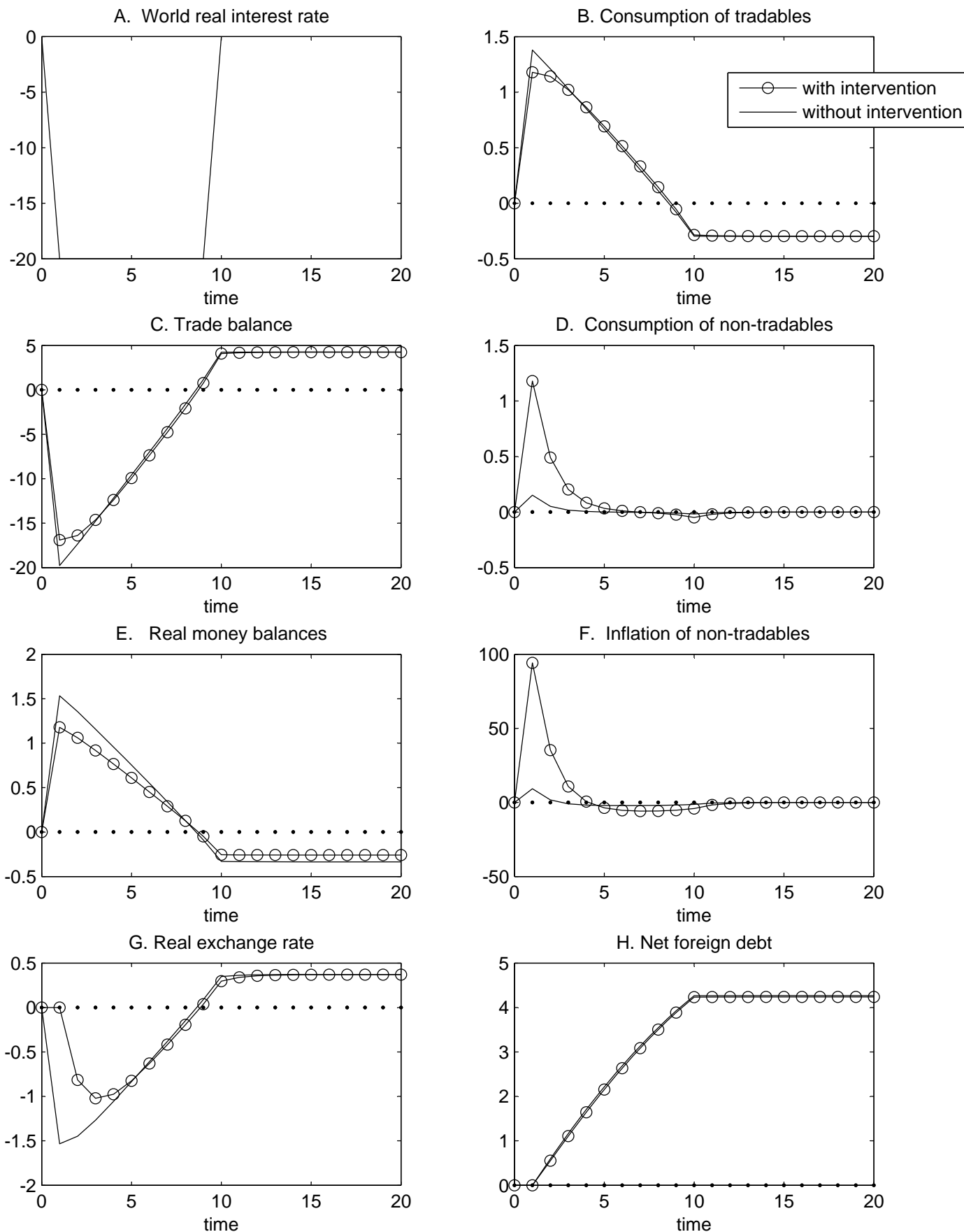


Figure 16. Temporary fall in world real interest rate under predetermined exchange rates and fiscal rule (non-separable)

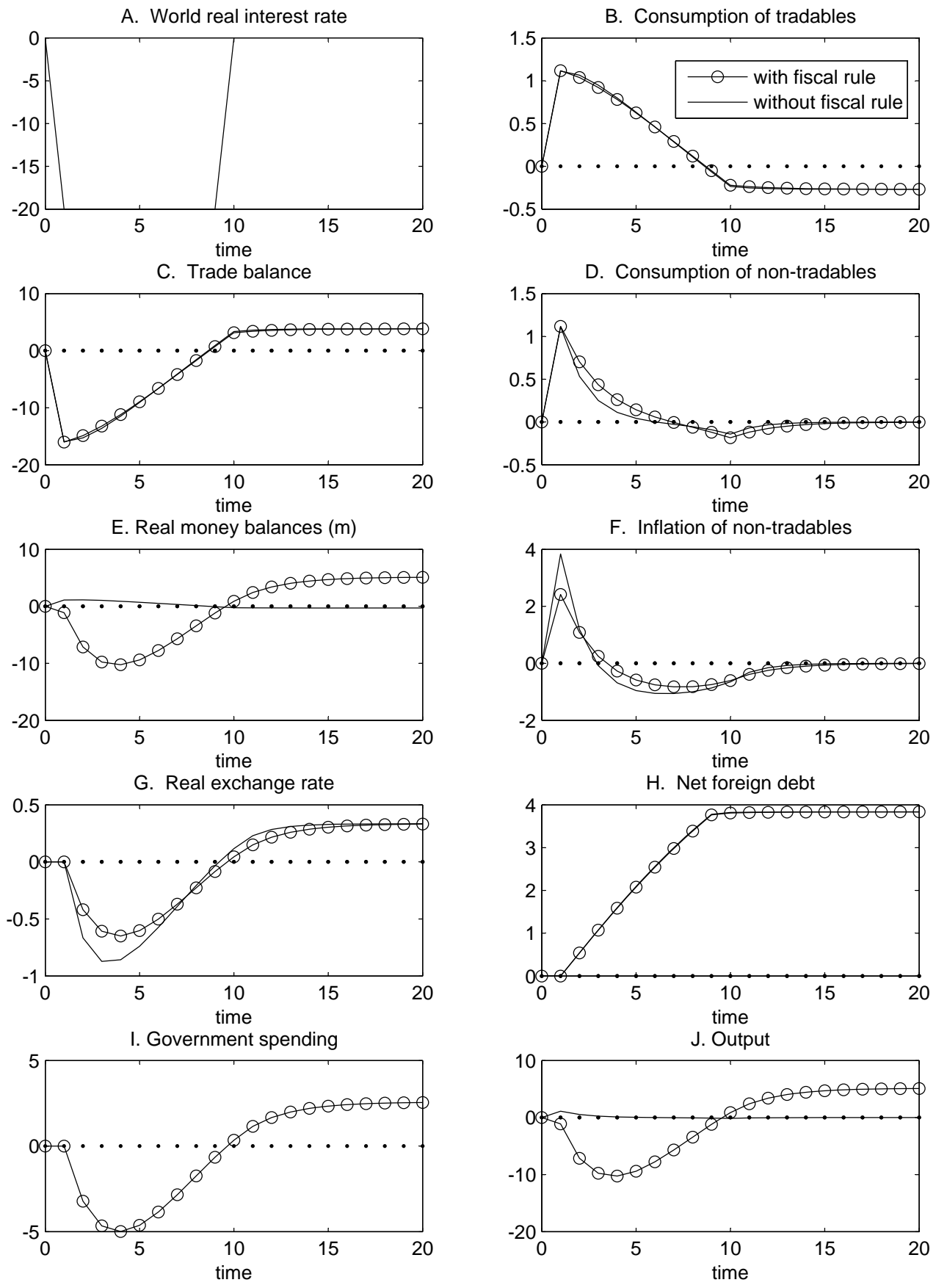
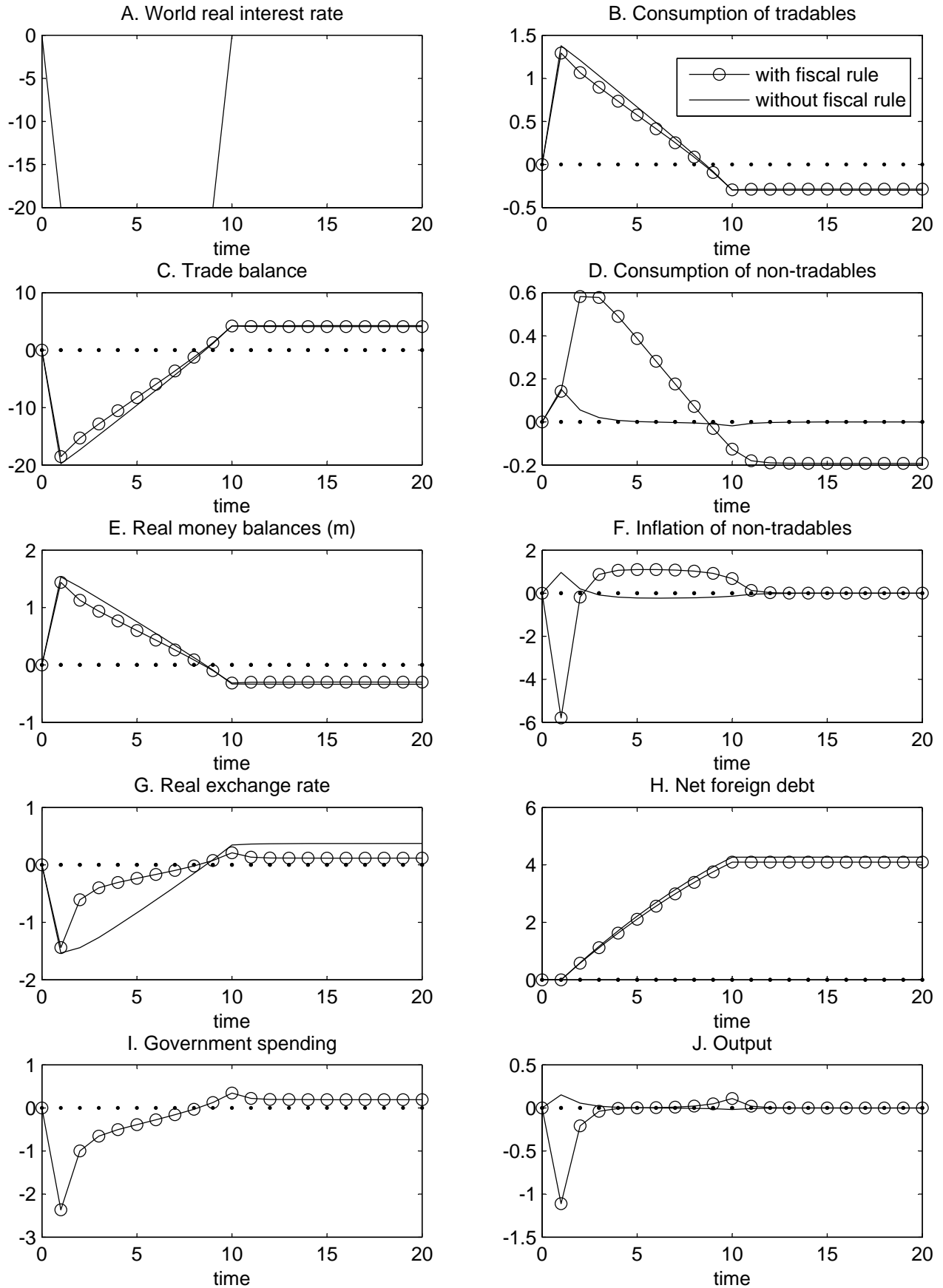


Figure 17. Temporary fall in world real interest rate under flexible rates and fiscal rule (non-separable)



**Table 1. Capital Inflows: Push or Pull?**

Author/s	Sample	Methodology	Main findings
Calvo, Leiderman, and Reinhart (1993)	Monthly data for 10 Latin American countries, 1988-1992	Principal components analysis, structural VAR	<ul style="list-style-type: none"> <li>- External factors account for around 50 percent of the monthly forecast error variance of the real exchange</li> <li>- External factors seem to be main driving force behind capital inflows to developing countries</li> </ul>
Fernandez-Arias (1996)	Quarterly data for 13 middle-income developing countries, 1989-1992	OLS estimation	<ul style="list-style-type: none"> <li>- External factors (international interest rates) are main driving force behind capital flows, minor role for domestic factors</li> <li>- Domestic and external factors played an equally important role for larger countries (Argentina, Korea and Mexico)</li> <li>- Country creditworthiness seems to play an important role, but this variable is mainly driven by external factors</li> </ul>
Taylor and Sarno (1997)	Monthly US capital flow data from 9 Latin American and 9 Asian countries, 1988-1992	Cointegration techniques and seemingly unrelated error correction system	<ul style="list-style-type: none"> <li>- Domestic and external factors found to be important in explaining long-run bond and equity flows to developing countries</li> <li>- External factors (mainly changes in US interest rates) are much more important to explain the short-run dynamics of bond flows to developing countries</li> <li>- Push and pull factors equally important in determining short-run equity flows for Asian and Latin American economies</li> </ul>
Chuhan, Claessens, and Mamingi (1998)	Monthly US capital flow data from 9 Latin American and 9 Asian countries, 1988-1992	Panel data, fixed effects	<ul style="list-style-type: none"> <li>- Both external factors (changes in US interest rates and US industrial activity) and country-specific factors are found to be relevant explaining capital inflows</li> <li>- Equity flows found to be more sensitive than bond flows to external factors</li> <li>- Bond flows more sensitive than equity flows to credit ratings and secondary market debt prices</li> </ul>
Kim (2000)	Quarterly data for Mexico (1958-1995), Chile (1981-1995), Korea (1977-1995), and Malaysia (1972-1995)	Structural VAR	<ul style="list-style-type: none"> <li>- Recent capital movements (last 10 years of the sample) are mainly due to external factors (changes in the world interest rate or recession in industrial countries)</li> <li>- Domestic factors relatively less important</li> <li>- Increase in the role of external factors explaining capital inflows in the past 10 years</li> </ul>
Ying and Kim (2001)	Quarterly data for Korea and Mexico, 1960-1996	Structural VAR	<ul style="list-style-type: none"> <li>- US business cycles is found to be a dominant factor in capital inflows to Mexico and Korea (explains more than 50% of the variation of capital flows for both countries)</li> <li>- Changes in the foreign interest rate became an important factor for capital inflows during 1980-1996</li> <li>- External factors are more important than domestic factors in explaining capital flows to both countries</li> </ul>
Edison and Warnock (2003)	Monthly US capital flow to 4 Latin American and 5 emerging Asian countries, 1989-1999	Panel data, fixed effects	<ul style="list-style-type: none"> <li>- In both Latin America and emerging Asia, US interest rates and economic activity matter for the capital inflow.</li> <li>- A reduction in capital controls results in higher equity flows to emerging Asia, but not to Latin America.</li> <li>- A cross-border listing has a positive long-term effect on equity flows to Latin America but not emerging Asia.</li> </ul>
Baek (2006)	Quarterly data for 5 Latin American countries and 4 Asian countries, 1989-2002	Panel data, fixed effects	<ul style="list-style-type: none"> <li>- For Latin American countries, domestic economic growth, US interest rate and world stock market performance play a significant role in capital inflows. But market appetite for risk has no impact.</li> <li>- For Asian countries, domestic economic fundamentals have little impact while all external factors (US interest rate, appetite for risk, world income growth and world stock market performance) have a significant impact in capital inflows.</li> </ul>
Alfaro, Kalemli-Ozcan and Volosovych (2007)	Annual capital flow data for 47 countries, 1970-2000	Cross country data	<ul style="list-style-type: none"> <li>- Institutional quality and macroeconomic policy play an important role for capital inflows, both in the level and in their volatility.</li> <li>- A country that improves institutions, decreases capital controls, and increases its growth receives more capital inflows.</li> </ul>

**Table 2. Country experiences with capital controls**

Country	Period	Tool	Medium term goals			
			Reduce the volume of net inflows	Shift the composition of inflows towards longer-term	Reduce real exchange rate pressures	More independent monetary policy
Chile	1991-1998	- Unremunerated reserve requirements on bank and portfolio flows	No	Yes	No	Yes
Brazil	1993	- Extended minimum term of external borrowing - Restricted portfolio investment by foreign investors - Financial transaction tax	No	No	No	No
Malaysia	1994	- Prohibition against residents selling money market funds to non-residents - Limits on banks external liability with non-residents - Unremunerated reserve requirements on bank flows	Yes	Yes	Yes	Yes
Colombia	2007	- Unremunerated reserve requirements on bank flows - Restriction on derivative position of banks	No	Yes	No	No
Brazil	2009-2011	- Tax on portfolio investment by foreign investors - Unremunerated reserve requirements on bank flows	?	?	?	?

Source: Cardoso and Goldfajn (1997), Ariyoshi et al (2000), De Gregorio *et al* (2000), Magud and Reinhart (2007), Clements and Kamil (2009), Ostry et al (2010), and Gallaher (2011).