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Country-Specific Risk Premium, Taylor Rules, and Exchange Rates*

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Abstract

The adoption of a Taylor-type monetary policy rule and an inflation target for emerging market economies that choose a flexible exchange rate regime is often advocated. This paper investigates the issue of exchange rate determination when interest-rate feedback rules are implemented in a continuous-time optimizing model of a small open economy facing an imperfect global capital market. It is demonstrated that when a risk premium on external debt affects the monetary policy transmission mechanism, the Taylor principle is not a necessary condition for determinacy of equilibrium. On the other hand, it is shown that exchange rate dynamics critically depends on whether monetary policy is active or passive. In terms of optimal monetary policy, it is demonstrated that the degree of responsiveness of the nominal interest rate to inflation should be related to the stock of foreign debt. Specifically, it is optimal to implement a more passive monetary policy stance in response to larger levels of the outstanding foreign-currency-denominated debt.

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1 Introduction

Modern research on monetary policy provides strong theoretical foundations for the use of simple interest-rate feedback rules, that specify the setting of the nominal interest rate as a function of endogenous variables, such as inflation and output. The standard literature emphasizes the stabilizing role of 'active' interest rate rules, that respond to increases in inflation with a more than one-to-one increase in the nominal interest rate (e.g., Taylor, 1999; King, 2000; Woodford 2003; McCallum, 2003; Galí, 2008). These policy rules à la Taylor (1993) have originally been designed for developed economies. An important related issue that has attracted growing attention in the recent policy debate is the design of monetary policy in emerging market and developing economies. The occurrence of exchange rate crises in emerging economies during the 1990s has warned against the adoption of 'soft' peg exchange rate regimes, as pointed out by Fischer (2001). In particular, Taylor (2001) argues that 'for those emerging market economies that do not choose a policy of a 'permanently' fixed exchange rate (perhaps through a currency board or a common currency (dollarization)), then the only sound monetary policy is one based on the trinity of a flexible exchange rate, an inflation target, and a monetary policy rule'.

This paper presents an investigation of the dynamic effects of interest-rate feedback policies of Taylor's style within a small open economy facing an imperfect world capital market. Specifically, the analysis is derived in a continuous-time optimizing general equilibrium framework with flexible exchange rates and an upward-sloping supply curve of foreign debt. Our model is an extension of the continuous-time closed-economy monetary framework employed by Benhabib, Schmitt-Grohé and Uribe (2001) to an open-economy environment. A discrete-time theoretical setup would not alter the results of our analysis, but would complicate the analysis due the issue concerning the timing convention in the definition of the stock variables and of real money balances (see, e.g., Carlstrom and Fuerst, 2001). Our focus on the implications of financial externalities, associated with the upward-sloping supply schedule of external debt, is motivated by the fact that emerging market and developing countries are subject to credit risk, which constrains their borrowing opportunities. The existence of a risk premium on foreign indebtedness in emerging market and developing economies constitutes a fairly well-established stylized fact (e.g., Agénor and Montiel, 1999; Montiel 2003).

The model considered in this paper is used to examine three relevant issues in monetary theory. First, we investigate dynamic stability to evaluate whether uniqueness of equilibrium requires that the central bank reacts to inflation with a more than proportional increase in the nominal interest rate (the so-called 'Taylor principle'), as predicted by the standard theory on Taylor rules (e.g., Woodford 2003). Second, we reconsider the issue of exchange rate dynamics in response to exogenous changes in the domestic nominal interest rate, government spending, the level of productivity, the subjective discount rate, the foreign nominal interest rate, and the foreign inflation rate. Third, we explore the properties of the welfare-maximizing interest rate rules and derive the implications for the optimal policy.

We demonstrate that when a risk premium on external debt affects the monetary policy transmission mechanism, the Taylor principle is not a necessary condition for determinacy of equilibrium. That is, 'passive' interest rate policies, that underreact to inflation by increasing the nominal interest rate by less than a raise in domestic inflation, are compatible with saddle-path stability. The economic intuition for this result can be explained as follows.

Consider first a standard closed-economy framework, with either flexible or sticky prices. In such a setup, the destabilizing effect of passive monetary policies has the following rationale. If consumers expect a high level of inflation and monetary policy is passive, the real interest rate declines. As a result of the Euler equation, characterizing the consumption-saving optimal decision, households reduce savings and increase consumption. The associated increase in aggregate demand causes prices to increase, hence validating the initial inflation expectations. As a consequence, passive monetary policies generate indeterminacy of equilibrium. Monetary policies in the respect of the Taylor principle are necessary to induce a unique stable equilibrium.

Consider now what occurs in a small-open-economy framework in which the transmission mechanism of monetary policy is crucially affected by a risk premium on external debt. When monetary policy is passive, an upward perturbation in inflation causes the real interest rate to decrease and private consumption to increase, analogously to the closed-economy case. However, the increase in consumption tends to stimulate foreign debt accumulation over time, hence leading to an increase in the country-specific risk premium. This makes the interest rate on foreign debt rise. Ceteris paribus, international parity conditions precluding arbitrage opportunities require an increase in the domestic real interest rate, which reduces aggregate demand and inflation. As a result, active monetary policies are not necessary to guarantee macroeconomic stability.

Despite the fact that saddle-path stability does not require an aggressive interest rate policy, the study of transitional dynamics we perform demonstrates that exchange rate adjustment in response to exogenous disturbances depends in a critical way on whether monetary policy is active or passive. An increase in external debt brings about an increase in the country-specific risk premium and hence in the nominal interest rate facing the small open economy. As a consequence, the risk-adjusted interest rate parity condition requires an increase in the domestic nominal interest rate net of domestic currency depreciation. The domestic real interest rate must also raise because of the PPP condition. When monetary policy is active (passive), this raise in the domestic real interest rate may take place if and only if there is an increase (decrease) in the exchange depreciation rate. This explains why exchange rate dynamics are crucially affected by whether the monetary policy stance is active or passive.

We then study the implications for the optimal monetary policy design. We demonstrate that the degree of responsiveness of the nominal interest rate to inflation should be related to the stock of foreign debt. In particular, we show that it is optimal to implement a more passive monetary policy stance in response to larger levels of the outstanding foreign-currency-denominated debt. The economic intuition for this result goes as follows. High external indebtedness causes the country-specific risk premium to rise. As a result, the interest rate on foreign debt increases. According to the international parity conditions, under an active monetary policy stance the domestic nominal interest rate must also increase in order ensure a higher real interest rate precluding arbitrage opportunities. Real money balances decrease, thereby lowering welfare. That is why, in this is case, a fully accommodating monetary policy is needed.

The scheme of the paper is as follows. Section 2 discusses the paper's contribution to the literature. Section 3 presents the model and describes the monetary policy regimes. Section 4 derives the perfect-foresight macroeconomic equilibrium. Section 5 develops the steady-state analysis. Section 6 studies the stability properties of the setup and examines the issue of transitional dynamics. Section 7 studies the optimal monetary policy. Section 8 concludes.

2 Related Literature and Model Choice

In this paper we study exchange rate dynamics in a simple optimizing general equilibrium monetary model of exchange rate determination, with flexible prices and perfect competition, extended to include a risk premium on domestic assets and a monetary authority adopting an interest rate rule. The model used in this paper relates to different strands of literature.

First, it is related to the literature which explores the conditions under which interest-rate feedback policy rules may generate macroeconomic instability by causing self-fulfilling inflation expectations. Notably, Taylor's (1993) prescription that only active interest rate rules yield a unique stable equilibrium has been questioned by several works. Benhabib, Schmitt-Grohé and Uribe (2001), in particular, demonstrate that the way in which money is assumed to enter preferences and technology may completely reverse the stabilizing properties of Taylor-type rules. The present paper contributes to this literature by investigating whether Taylor's prescriptions are robust with respect to the presence of external financial frictions.

Second, the paper is related to the literature focussing on monetary policy design for small open economies and emerging market economies. Most of these contributions abstract from the presence of financial externalities, assuming that international asset markets are complete (e.g., Laxton and Pesenti, 2003; Galí and Monacelli, 2005). Nevertheless, De Paoli (2009) shows that the design of optimal monetary policy is significantly affected by the asset market structure. Devereux, Lane and Xu (2006) study the welfare ranking of alternative monetary policy rules for emerging market economies when financial frictions are operative. The present paper contributes to this literature by analyzing the issue of dynamic stability in the presence of risk premia on external debt, and by distinguishing between active and passive interest-rate feedback rules.

Finally, the paper is related to the literature on exchange rate determination. In particular, it presents a simple and natural microfounded extension of the flexible-price monetary models of the 1970s (e.g. Frenkel, 1976; Mussa, 1976), along the lines of the basic-one-good monetary model in small open economy of Turnovsky (1997), where the purchasing power parity holds continuously and money demand and supply are the key determinants of exchange rates. By allowing for imperfect substitutability between domestic and foreign assets as a consequence of the existence of a country-specific risk premium, the paper relates somehow to the early literature on the portfolio balance models of the 1980s (e.g. Frankel, 1983). By explicitly modelling the optimizing behaviour of consumers and firms in an intertemporal framework, the model relates to the so-called new-open-economy-macroeconomics started by Obstfeld and Rogoff (1995). However, in the traditional literature of exchange rate determination, most results have been derived under the assumption that the policy instrument used by the central bank is money supply.[1] Our model, on the other hand, enables us to examine the implications of financial externalities on the exchange rate in small open economies under the assumption that the monetary authority sets the nominal interest rate as an increasing function of the inflation rate, consistently with a widely documented empirical evidence. In particular, we distinguish between active and passive interest rate rules in characterizing exchange rate dynamics. In this respect, our analysis yields additional insights into the question of exchange rate dynamics.

3 The Model

Consider a small open economy operating in a world of ongoing inflation and flexible exchange rates. The economy is described by a one-good-monetary model and consists of four types of agents: consumers, firms, the government and the central bank. All agents have perfect foresight.

The domestic economy produces and consumes only one tradeable and non-storable good. Purchasing power parity (PPP) is assumed to hold at all times:

$$P = P^* E, \tag{1}$$

where P (P^*) is the domestic (foreign) price and E is the nominal exchange rate, defined as units of domestic currency per unit of foreign currency. In percentage terms the PPP is given by:

$$\pi = \pi^* + e, \tag{2}$$

where π (π^*) is the inflation rate of the good in terms of domestic (foreign) currency and e is the rate of exchange depreciation of domestic currency.

Domestic residents may hold three assets: domestic money, domestic government

[1] The issue of exchange rate determination under interest-rate feedback rules in the context of a two-country framework with complete international markets is examined by Benigno and Benigno (2008).

bonds and foreign assets. Domestic money and government bonds are not held by foreigners. Foreign assets are internationally-traded and are denominated in foreign currency. However, the home country has not access to a perfect world capital market, but faces an upward-sloping supply curve of foreign debt, along the lines suggested by Bardhan (1967), Obstfeld (1982), Bhandari, Haque and Turnovsky (1990), and Turnovsky (1997). From the standpoint of the borrowing economy, denoting by f the level of real foreign debt and y domestic output, the nominal interest rate on foreign debt R^* can then be expressed as follows:

$$R^* = i^* + \sigma(f) \tag{3}$$

where i^* is the interest rate prevailing in the world market and $\sigma(f)$ is the country-specific risk premium. Function $\sigma(\cdot)$ is continuous, increasing in f and strictly positive.

International capital mobility implies that a risk-adjusted interest parity of the following type holds:

$$R = R^* + e, \tag{4}$$

where R is the nominal rate of interest on bonds issued by the domestic government.

The infinitely-lived representative consumer faces the following lifetime utility function:

$$\int_0^\infty [U(c,\ell) + V(m)]e^{-\beta t}dt, \tag{5}$$

where β is the rate of time preferences and c, ℓ and m denote consumption, labor and real money balances, respectively. Functions $U(\cdot)$ and $V(\cdot)$ satisfy the following conditions: $U_c > 0$, $U_\ell < 0$, $V' > 0$, $U_{cc} < 0$, $U_{\ell\ell} < 0$, $U_{c\ell} < 0$, and $V'' < 0$.

The flow budget constraint in real terms is:

$$\dot{m} + \dot{b} + \dot{a} = w\ell + z - \tau - c + (R - \pi)b + (R^* - \pi^*)a - \pi m, \tag{6}$$

where b denotes government bonds, a foreign assets, w the wage rate, z profits, and τ

lump-sum taxes. Notice that, by definition, $a = -f$. Throughout the paper, for any generic variable of the model x, $\dot{x}$ denotes dx/dt.

The representative agent chooses the optimal plan for c, ℓ, m, b and a in order to maximize her lifetime utility (5), subject to (6) and given the initial conditions $m(0) = \frac{M_0}{P(0)}$, $b(0) = \frac{B_0}{P(0)}$ and $a(0) = \frac{A_0}{P^*}$, where M, B and A denote the nominal stocks of money, government bonds and foreign assets, respectively. Note that consumers take the rate at which the country can borrow from abroad as given in making their decisions. In other words, R^* is intended to be increasing in the aggregate level of foreign debt, which each consumer assumes she is unable to influence.

The solution to the consumer's optimization problem yields the following conditions:

$$U_c(c, \ell) - \mu = 0, \tag{7}$$

$$U_\ell(c, \ell) + w\mu = 0, \tag{8}$$

$$V'(m) - \mu\pi = -\dot{\mu} + \mu\beta, \tag{9}$$

$$\mu(R - \pi) = -\dot{\mu} + \mu\beta, \tag{10}$$

$$\mu(R^* - \pi^*) = -\dot{\mu} + \mu\beta, \tag{11}$$

together with the flow budget constraint (6), the initial conditions and the transversality conditions:

$$\lim_{t\to\infty} \mu m e^{-\beta t} = \lim_{t\to\infty} \mu b e^{-\beta t} = \lim_{t\to\infty} \mu a e^{-\beta t} = 0, \tag{12}$$

where $\mu e^{-\beta t}$ is the discounted Lagrange multiplier associated with the wealth accumulation equation (6).

Perfectly competitive firms face a standard neoclassical production function of labor:

$$y = \Lambda\phi(\ell) \tag{13}$$

where y denotes output, $\phi'(\cdot) > 0$, $\phi''(\cdot) < 0$, and Λ is a positive technology parameter. Each firm hires labor in order to maximize profits. At the optimum, labor marginal productivity is equal to the real wage rate $\Lambda\phi'(\ell) = w$.

The domestic government faces the following flow budget constraint expressed in real terms:

$$\dot{m} + \dot{b} = g - \tau + (R - \pi)b - \pi m, \tag{14}$$

where g is government spending. The government is assumed to adopt a tax policy consisting in balancing the budget at all times:

$$\tau = g + (R - \pi)b - \pi m. \tag{15}$$

The monetary authorities set the nominal interest rate as an increasing function of the inflation rate, as in Benhabib, Schmitt-Grohé and Uribe (2001):

$$R = i + \rho(\pi), \tag{16}$$

where $\rho(\cdot)$ is continuous, non-decreasing, and there exists at least one $\overline{\pi} > -\beta$ such that $i + \rho(\overline{\pi}) = \beta + \overline{\pi}$; i is a positive parameter capturing exogenous deviations from the feedback component of the rule. Following Leeper (1991), the interest rate rule (16) is 'active ('passive') if $\rho' > (<)1$. In other words, under an active (passive) monetary policy, the central bank responds to inflation by raising (lowering) the real interest rate.

The dynamic equation describing the accumulation of net foreign assets is given by the trade balance plus interest payments:

$$\dot{a} = y - c - g + (R^* - \pi^*)a. \tag{17}$$

We can rewrite (17) in terms of net foreign debt accumulation as:

$$\overset{\bullet}{f} = c + g - y + (R^* - \pi^*)f. \tag{18}$$

4 Macroeconomic Equilibrium

Combining the set of optimality conditions (7)-(11) together with the interest rate on foreign debt function (3), the international parity conditions (2) and (4), the production function (13), the monetary policy rule (16), and the foreign debt accumulation equation (18), the perfect-foresight equilibrium can be described as follows:

$$\overset{\bullet}{\mu} = \mu\beta - (i^* + \sigma(f) - \pi^*)\mu, \tag{19}$$

$$\overset{\bullet}{f} = c + g - \Lambda\phi(\ell) + (i^* + \sigma(f) - \pi^*)f, \tag{20}$$

$$c = c(\mu, \Lambda), \qquad c_\mu, c_\Lambda < 0, \tag{21}$$

$$\ell = \ell(\mu, \Lambda), \qquad \ell_\mu, \ell_\Lambda > 0, \tag{22}$$

$$m = m(\mu) + \frac{\rho'}{\rho' - 1}\eta\left(i^*, f, i, \pi^*\right), \; m_\mu < 0, \eta_{i^*}, \eta_f < 0, \eta_i, \eta_{\pi^*} > 0, \tag{23}$$

$$e = \frac{1}{\rho' - 1}\epsilon\left(i^*, f, i, \pi^*\right), \; \epsilon_{i^*}, \epsilon_f > 0, \epsilon_i, \epsilon_{\pi^*} < 0, \tag{24}$$

where (19) and (20) are the pair of equations describing the evolution of the economy over time and (21)-(24) describe the equilibrium paths for consumption, work effort, real money balances and the rate of exchange depreciation of domestic currency, respectively. See Appendix A for details.

5 Steady-State Analysis

Under the assumption of perfect foresight, the transitional dynamics of the model depends in part on the expectations of the long-run steady state. This Section derives the steady-state equilibrium and the long-run effects of changes in both domestic and foreign exogenous variables.

The steady state of the economy is obtained when the shadow value of wealth is constant and external debt accumulation ceases, that is when $\dot{\mu} = \dot{f} = 0$. From (19)-(24), the steady state consists of the following set of relationships:

$$\beta = i^* + \sigma(\overline{f}) - \pi^*, \tag{25}$$

$$\Lambda\phi(\ell(\overline{\mu}, \Lambda)) = (i^* + \sigma(\overline{f}) - \pi^*)\overline{f} + c(\overline{\mu}, \Lambda) + g, \tag{26}$$

$$\overline{c} = c(\overline{\mu}, \Lambda), \tag{27}$$

$$\overline{\ell} = \ell(\overline{\mu}, \Lambda), \tag{28}$$

$$\overline{y} = \Lambda\phi(\overline{\ell}), \tag{29}$$

$$\overline{m} = m(\overline{\mu}) + \frac{\rho'}{\rho' - 1}\eta\left(i^*, \overline{f}, i, \pi^*\right), \tag{30}$$

$$\overline{e} = \frac{1}{\rho' - 1}\epsilon(i^*, \overline{f}, i, \pi^*). \tag{31}$$

Equations (25)-(31) jointly determine the steady-state equilibrium solutions for $\overline{\mu}$, $\overline{f}$, $\overline{c}$, $\overline{\ell}$, $\overline{y}$, $\overline{m}$ and $\overline{e}$ as functions of the rate of time preference β, the technology parameter Λ, public spending g, the monetary policy rule exogenous component i, foreign inflation π^*, and the interest rate prevailing in the world market i^*.

To study exchange rate dynamics, it is convenient to write down the long-run responses to changes in exogenous variables of foreign debt and of the rate of depreciation, respectively. The responses to changes in domestic variables are given by:

$$\frac{d\overline{f}}{di} = 0, \ \frac{d\overline{f}}{d\beta} = \frac{1}{\sigma'} > 0, \ \frac{d\overline{f}}{d\Lambda} = \frac{d\overline{f}}{dg} = 0, \tag{32}$$

$$\frac{d\overline{e}}{di} = -\frac{1}{\rho' - 1} < (>)0, \ \frac{d\overline{e}}{d\beta} = \frac{1}{\rho' - 1} > (<)1 \ \text{ if } \ \rho > (<)1 \text{ and } \frac{d\overline{e}}{d\Lambda} = \frac{d\overline{e}}{dg} = 0. \tag{33}$$

On the other hand, the responses to changes in the foreign variables are given by:

$$\frac{d\overline{f}}{d\pi^*} = \frac{1}{\sigma'} > 0, \ \frac{d\overline{f}}{di^*} = -\frac{1}{\sigma'} > 0, \tag{34}$$

$$\frac{d\overline{e}}{d\pi^*} = -1, \ \frac{d\overline{e}}{di^*} = 0. \tag{35}$$

The long-run responses of all endogenous variables of the economy to changes in the exogenous variables of both domestic and foreign origin are reported in Tables 1 and 2, respectively, where $\Delta \equiv -\sigma' \left(c_\mu(\overline{\mu}, \Lambda) - \Lambda \phi' \ell_\mu(\overline{\mu}, \Lambda) \right) > 0$. Full derivations are developed in Appendix B.

6 Transitional Dynamics

Linearizing the differential equations (19)-(20) around the steady-state equilibrium $\{\overline{\mu}, \overline{f}\}$ yields:

$$\begin{pmatrix} \overset{\bullet}{f} \\ \overset{\bullet}{\mu} \end{pmatrix} = \begin{pmatrix} \beta + \sigma' \overline{f} & c_\mu(\overline{\mu}, \Lambda) - \Lambda \phi' \ell_\mu(\overline{\mu}, \Lambda) \\ -\sigma' \overline{\mu} & 0 \end{pmatrix} \begin{pmatrix} f - \overline{f} \\ \mu - \overline{\mu} \end{pmatrix}. \tag{36}$$

The above system displays one predetermined variable, f, and one jumping variable, μ. In order to have a unique perfect-foresight equilibrium in the neighborhood of the steady state (i.e. saddle-path stability), the Jacobian of the system must have eigenvalues of opposite sign. This property is satisfied by the system (36), since the determinant of the Jacobian, given by $\sigma' \overline{\mu} \left[c_\mu(\overline{\mu}, \Lambda) - \Lambda \phi' \ell_\mu(\overline{\mu}, \Lambda) \right]$, is negative. The Taylor principle, $\rho' > 1$, is not necessary to bring about equilibrium determinacy. Intuitively, this is because the time path of inflation depends not only on the central bank's behavior, but also on the time path of external debt and the international parity conditions. Whether monetary policy is active or passive is immaterial for determinacy.

Focusing now on the stable path, the solutions for f and e are given by:

$$f = \overline{f} + \left(f_0 - \overline{f}\right) e^{\lambda t}, \tag{37}$$

$$e = \overline{e} + \frac{1}{\rho' - 1} \epsilon_f \left(f - \overline{f}\right), \tag{38}$$

where $\lambda < 0$ is the stable eigenvalue and f_0 is the initial condition on foreign debt (see Appendix C for full derivations). Using the steady-state multipliers given by (32)-(35), the impact effects on the rate of depreciation of changes in domestic and foreign variables are, respectively:

$$\frac{de\,(0)^+}{di} = -\frac{1}{\rho' - 1} < (>)0 \quad \text{if} \quad \rho > (<)1, \frac{de\,(0)^+}{d\beta} = \frac{de\,(0)^+}{d\Lambda} = \frac{de\,(0)^+}{dg} = 0, \tag{39}$$

$$\frac{de\,(0)^+}{d\pi^*} = -\frac{\rho'}{\rho' - 1} < (>)0, \frac{de\,(0)^+}{di^*} = \frac{1}{\rho' - 1} > (<)0 \quad \text{if} \quad \rho > (<)1. \tag{40}$$

The impact effects on all endogenous variables of changes in domestic and foreign variables are summarized in Tables 3 and 4 (see Appendix D for details).

From the analysis of both the steady-state equilibrium and the transitional dynamics, it emerges that the dynamic behavior of the nominal exchange rate critically depends upon whether the monetary-policy reaction coefficient ρ' is above or below unity. Examining (38), in fact, the exchange depreciation rate is correlated with foreign debt, along the transitional path towards the steady-state equilibrium, with a coefficient, $\epsilon_f / \left(\rho' - 1\right)$, which is greater (lower) than zero if $\rho' > (<)\, 1$. An intuitive explanation is the following. A change in external indebtedness alters the international parity conditions given by the risk-adjusted interest rate parity, thereby influencing exchange rate dynamics. In particular, an increase in foreign debt causes the country-specific risk premium to raise, leading to an increase in the nominal interest rate faced by the small open economy. This brings about an increase in the domestic nominal interest rate net of domestic currency depreciation, according to the risk-adjusted interest rate parity condition. Recalling the PPP condition, it also follows that the domestic real interest rate has to raise. The key point is that when monetary policy is active (passive), an increase in the domestic real interest rate may occur if and only if there is an increase (decrease) in the exchange depreciation rate. Exchange rate dynamics are thus qualitatively affected by whether the interest rate rule is active or passive.

Figures 1 and 2 plot the time path of the nominal exchange depreciation rate in response to changes in i, β, π^* and i^* under active and passive monetary policy, respectively.

Figure 1a shows that the rate of exchange depreciation instantaneously declines in response to an increase in i. In this case there is no transitional dynamics, since in the steady state a change in the nominal interest rate does not affect foreign indebtedness. The exchange rate jumps instantaneously to the new steady state. Intuitively, an exogenous rise in i must crowd out the endogenous component of the domestic real interest rate $(\rho(\pi) - \pi)$, in order to restore both the risk-adjusted interest rate parity and the PPP. Since monetary policy overreacts to inflation, the endogenous component of the domestic real interest rate decreases only when the rate of exchange depreciation decreases.

On the other hand, an increase in the rate of time preference β increases the level of indebtedness and hence the cost of external borrowing. In this case, the combination of the active Taylor rule with the risk-corrected interest parity and the PPP implies an increase in the depreciation rate of the domestic currency. The exchange rate, in fact, starts to increase converging gradually to its long-run equilibrium (see Figure 1b).

An increase in foreign inflation π^* causes external indebtedness to raise and the rate of exchange depreciation to fall in the long run, as it emerges from equations (34) and (35). Under an active monetary policy, a rise in foreign inflation implies a reduction on impact of the domestic currency depreciation rate, which overshoots its long-run value (see Figure 1c). After the initial downward jump, in fact, e starts to increase, approaching asymptotically a new steady-state below its original level.

Figure 1d shows that an increase in the world interest rate i^* determines an upward jump of the rate of exchange depreciation on impact, since foreign bonds become more attractive. This implies a decline in the steady-state foreign debt, as it emerges from (34). As long as the monetary authorities are engaged in an active interest rate policy, the reduction in the level of external debt over time must be associated with a decline in e, along the adjustment path towards the new steady-state equilibrium. This can occur if only if there is an instantaneous upward jump in e.

From Figures 2a-2d, one can see how the responses of the nominal exchange rate obtained under an interest rate rule satisfying the Taylor principle are reversed in the case of an accommodating monetary policy, underreacting to inflation. A passive Taylor rule requires a decline in the exchange depreciation rate each time that a domestic real interest rate increase is necessary to restore the equilibrium due, for example, to increases in β or i^* (see Figures 2b and 2d). On the other hand, an increase in i requires a reduction in the endogenous component of the domestic real rate implying, under a passive rule, a higher depreciation rate (see Figure 2a). An increase in foreign inflation requires a long-run fall in the rate of exchange depreciation, although it brings about an upward jump of e on impact (see Figure 2c). In this case, only the short-run response crucially depends on the monetary policy regime, while the effects of the PPP prevail in the long run.

7 Optimal Monetary Policy

We now derive the implications for the optimal design of interest rate policies. The optimizing problem for the central bank is to choose the monetary-policy responsiveness to inflation, i.e., ρ', in order to maximize the representative consumer's lifetime utility function (5) given the following perfect-foresight equilibrium solutions describing the perfectly competitve behaviour of the economy in the neighborhood of the steady state ($\overline{c}$, $\overline{\ell}$, $\overline{m}$,

$\overline{f}$) (see Appendix C):

$$c = \overline{c} - \frac{c_{\mu}\sigma'\overline{\mu}}{\lambda}\left(f_0 - \overline{f}\right)e^{\lambda t}, \tag{41}$$

$$\ell = \overline{\ell} - \frac{\ell_{\mu}\sigma'\overline{\mu}}{\lambda}\left(f_0 - \overline{f}\right)e^{\lambda t}, \tag{42}$$

$$m = \overline{m} + \left(\frac{\rho'\eta_f}{\rho' - 1} - \frac{m_{\mu}\sigma'\overline{\mu}}{\lambda}\right)\left(f_0 - \overline{f}\right)e^{\lambda t}. \tag{43}$$

Consistently with Friedman (1969), let us suppose that the function $V(\bullet)$ is strictly increasing in real money balances as long as $m < m^s$, but not increasing for $m > m^s$, where $m^s > \bar{m}$ represents a finite level of real money balances at which consumers are satisfied with liquidity.[2] Specifically, let us assume a sufficiently high satiation level m^s, such that $m^s > \bar{m} + \left(\eta_f - \frac{m_{\mu}\sigma'\overline{\mu}}{\lambda}\right)\left(f_0 - \overline{f}\right)e^{\lambda t}$. Optimality must imply that

$$\rho' = 0 \quad \text{if} \quad f_0 > \overline{f}, \tag{44}$$

$$1 < \rho' < \frac{1}{1 - \frac{1}{\frac{m^s - \overline{m}}{\eta_f (f_0 - \overline{f})e^{\lambda t}} + \frac{m_{\mu}\sigma'\overline{\mu}}{\eta_f \lambda}}} \quad \text{if} \quad f_0 < \overline{f}. \tag{45}$$

According to (44) and (45), the optimal degree of reactiveness of the nominal interest rate to inflation critically depends on the level foreign debt. In particular, if the outstanding foreign debt is above its steady-state target level, i.e., $f_0 > \overline{f}$, it is optimal to adopt a fully accommodating monetary policy, $\rho' = 0$. By contrast, if the outstanding foreign debt is below its steady-state target level, i.e., $f_0 < \overline{f}$, it is optimal to adopt an aggressive monetary policy, satisfying the Taylor principle $\rho' > 1$.

The economic interpretation for these findings goes as follows. Consider first the case in which $f_0 > \overline{f}$. According to equation (38), if the monetary authority uses a feedback policy rule satisfying the Taylor principle, $\rho' > 1$, the exchange depreciation rate must be higher than its steady-state level. According to the PPP condition, the inflation rate must also be higher than its steady-state level. Hence the Taylor rule prescribes an increase

[2] For a discussion about the existence of a satiation point for real balances, see, e.g., McCallum (1990) and Woodford (1990).

in the nominal interest rate, which lowers real money balances and so welfare. Monetary policy should thus be fully passive in order to avoid a crowding out effect on real balances. Note that this is result is robust to changes in the degree of elasticity of the upward-sloping schedule of foreign debt, measured by the parameter σ'.[3]

Next, consider the case in which $f_0 < \overline{f}$. According to equation (38), under an active monetary policy stance, the exchange depreciation rate, the inflation rate and the domestic nominal interest rate are now lower than their steady-state levels. As a result, real money balances and so welfare increase. Note that in this case, an increase in the elasticity of the schedule of foreign debt requires a less active monetary policy stance. This is because the higher σ', i.e., the more elastic the schedule of foreign debt, the higher η_f, i.e., the higher the negative sensitivity of real balances to the difference $\overline{f} - f_0$ through the international parity conditions, the lower the optimal value of ρ', i.e., the less aggressive interest rate policies must be.

8 Concluding Remarks

External indebtedness poses constraints on the borrowing opportunities of emerging market and developing economies, as empirically evidenced. We have analyzed the dynamic effects of interest rate rules in the spirit of Taylor (1993, 1999) in an optimizing model of exchange rate determination that incorporates a risk premium on foreign debt.

An imperfect global capital market has strong implications for the design of monetary policy rules in emerging market economies that do not choose to adopt a 'hard' peg exchange rate regime. In particular, it is demonstrated that when external borrowing is subject to credit risk, the usual requirement that the monetary authorities should fight inflation aggressively by raising the nominal interest rate more than proportionally with respect to increases in inflation is not necessary to ensure equilibrium stability and

[3] An increase in the elasticity of the schedule of foreign debt can be interpreted as an increase in the degree of risk aversion in the rest of the world, which generates a "flight to quality" in investment, thereby reducing the willingness to invest in the domestic economy.

uniqueness. Under a passive monetary policy, a rise in inflation causes an increase in private consumption, which tends to stimulate foreign borrowing. If the schedule of external debt is upward sloping, the accumulation of foreign debt will lead to an increase in the risk premium, which in turn will tend to reduce aggregate demand and inflation. Thus, in the presence of external financial frictions, a non-aggressive monetary policy does not necessarily lead to self-fulfilling inflation expectations.

On the other hand, our analytical findings show that the dynamics of exchange rates, when the central bank implements interest rate policies, are critically affected by whether monetary policy overreacts or underreacts to inflation. A worsening in external indebtedness generates an increase in the country-specific risk premium, thereby causing an increase in the nominal interest rate faced by the small open economy. Because of the risk-adjusted interest rate parity condition, there must be an increase in the domestic nominal interest rate net of domestic currency depreciation. Because of the PPP condition, there must also be an increase in the domestic real interest rate. The central point is that under an active (passive) monetary policy stance, an increase in the domestic real interest rate does occur if and only the exchange depreciation rate increases (decreases). Exchange rate dynamics are therefore influenced by whether the interest-rate feedback policy rule is active or passive. In this respect, the present paper adds interesting insights to the classical theoretical debate on exchange rate determination.

The issue of optimal monetary policy is also investigated. Should central banks in emerging market economies take into account external indebtedness in the design of optimal monetary rules? Should interest-rate feedback rules active or passive? Our analysis proves that the monetary-policy feedback parameter in response to an increase in the inflation rate should crucially depend upon the outstanding level of foreign debt. In particular, we find that it is optimal to adopt a more passive interest rate policy the higher stock of debt denominated in foreign currency. These results cast doubts on the conventional view that the only sound optimal monetary policy is the one based on an interest rate rule reacting aggressively to inflation pressures.

Of course, the analysis presented in this paper is based on a number of simplifying assumptions necessary to yield a framework by which to study the influence of external financial frictions on monetary policy design in a quite straightforward way. Nevertheless, at least two possible extensions are worth to be mentioned.

First, the assumption of flexible prices is primarily made for expositional simplicity. Under sticky prices, the implied sluggish adjustment of both nominal and real variables in response to monetary disturbances does not affect the character of our analysis in any essential way. Second, an upward-sloping schedule of foreign debt could be derived from explicit microfoundations. Incorporating this feature within a dynamic general equilibrium model is a very challenging issue. A formal analysis is beyond the scope of the present paper. Investigation of these issues is left to future research.

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Appendix A

Consumption and labor supply can be expressed as function of μ and Λ as follows. Totally differentiate (7) and (8), given $\Lambda\phi'(\ell) = w$, and write the results in matrix notation:

$$\begin{pmatrix} U_{cc} & U_{c\ell} \\ U_{\ell c} & U_{\ell\ell} + \Lambda\phi''\mu \end{pmatrix} \begin{pmatrix} dc \\ d\ell \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ -\Lambda\phi' & -\phi'\mu \end{pmatrix} \begin{pmatrix} d\mu \\ d\Lambda \end{pmatrix}. \tag{A1}$$

Let $\Psi \equiv U_{cc}\left(U_{\ell\ell} + \Lambda\phi''\mu\right) - U_{c\ell}^2 > 0$. We obtain the following results:

$$c_\mu = \frac{dc}{d\mu} = \frac{\begin{vmatrix} 1 & U_{c\ell} \\ -\Lambda\phi' & U_{\ell\ell} + \Lambda\phi''\mu \end{vmatrix}}{\Psi} = \frac{U_{\ell\ell} + \Lambda\phi''\mu + U_{c\ell}\Lambda\phi'}{\Psi} < 0, \tag{A2}$$

$$c_\Lambda = \frac{dc}{d\Lambda} = \frac{\begin{vmatrix} 0 & U_{c\ell} \\ -\phi'\mu & U_{\ell\ell} + \Lambda\phi''\mu \end{vmatrix}}{\Psi} = \frac{U_{c\ell}\phi'\mu}{\Psi} < 0, \tag{A3}$$

$$\ell_\mu = \frac{d\ell}{d\mu} = \frac{\begin{vmatrix} U_{cc} & 1 \\ U_{\ell c} & -\Lambda\phi' \end{vmatrix}}{\Psi} = -\frac{U_{cc}\Lambda\phi' + U_{\ell c}}{\Psi} > 0, \tag{A4}$$

$$\ell_\Lambda = \frac{d\ell}{d\Lambda} = \frac{\begin{vmatrix} U_{cc} & 0 \\ U_{\ell c} & -\phi'\mu \end{vmatrix}}{\Psi} = -\frac{U_{cc}\phi'\mu}{\Psi} > 0. \tag{A5}$$

Consider now the derivation of the exchange rate determination function (24). By combining equations (2)-(4) with the Taylor rule (16), we obtain:

$$i^* + \sigma(f) + e = i + \rho(\pi^* + e). \tag{A6}$$

Totally differentiating the above expression gives:

$$de\,(\rho' - 1) = di^* + \sigma' df - di + \rho' d\pi^*. \tag{A7}$$

Letting $\frac{de}{di^*}(\rho' - 1) = \epsilon_{i^*} = 1$, $\frac{de}{df}(\rho' - 1) = \epsilon_f = \sigma'$, $\frac{de}{di}(\rho' - 1) = \epsilon_i = -1$ and $\frac{de}{d_{\pi^*}}(\rho' - 1) = \epsilon_{\pi^*} = -\rho'$, equation (24) immediately follows.

Finally, the equation describing the time path of real money balances can be obtained by combining (9) with the Taylor rule (16):

$$V'(m) = \mu\,(i + \rho(\pi^* + e))\,. \tag{A8}$$

Totally differentiating yields:

$$V'' dm = R d\mu + \mu\,(di + \rho' d\pi^* + \rho' de)\,, \tag{A9}$$

which, given (A7), can be re-written as:

$$dm = \frac{R}{V''} d\mu + \frac{1}{\rho' - 1} \frac{\rho'\sigma' df - di - \rho' d\pi^* + \rho' di^*}{V''} \mu. \tag{A10}$$

Letting $\frac{dm}{d\mu} = m_\mu = \frac{R}{V''}$, $\frac{dm}{d_{i^*}} \frac{\rho'-1}{\rho'} = \eta_{i^*} = \frac{\mu}{V''}$, $\frac{dm}{df} \frac{\rho'-1}{\rho'} = \eta_f = \frac{\sigma'\mu}{V''}$, $\frac{dm}{di} \frac{\rho'-1}{\rho'} = \eta_i = -\frac{\mu}{\rho' V''}$ and $\frac{dm}{d_{\pi^*}} \frac{\rho'-1}{\rho'} = \eta_{\pi^*} = -\frac{\mu}{V''}$, equation (23) immediately follows.

Appendix B

Totally differentiate (25) and (26) and express the results in matrix notation:

$$\begin{pmatrix} 0 & \sigma' \\ c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda) & \beta \end{pmatrix} \begin{pmatrix} d\overline{\mu} \\ d\overline{f} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 1 & -1 \\ -\overline{f} & \kappa & -1 & 0 & 0 \end{pmatrix} \begin{pmatrix} d\beta \\ d\Lambda \\ dg \\ d\pi^* \\ di^* \end{pmatrix},$$

where $\kappa \equiv \phi(\ell(\overline{\mu},\Lambda)) + \Lambda\phi'\ell_\Lambda(\overline{\mu},\Lambda) - c_\Lambda(\overline{\mu},\Lambda) > 0$.

Letting $\Delta \equiv -\sigma'\left(c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda)\right) > 0$ we obtain the following set of derivatives:

$$\frac{d\overline{\mu}}{d\beta} = \frac{\begin{vmatrix} 1 & \sigma' \\ -\overline{f} & \beta \end{vmatrix}}{\Delta} = \frac{\beta + \sigma'\overline{f}}{\Delta} > 0, \tag{B1}$$

$$\frac{d\overline{\mu}}{d\Lambda} = \frac{\begin{vmatrix} 0 & \sigma' \\ \kappa & -\beta \end{vmatrix}}{\Delta} = -\frac{\kappa\sigma'}{\Delta} < 0, \tag{B2}$$

$$\frac{d\overline{\mu}}{dg} = \frac{\begin{vmatrix} 0 & \sigma' \\ -1 & \beta \end{vmatrix}}{\Delta} = \frac{\sigma'}{\Delta} > 0, \tag{B3}$$

$$\frac{d\overline{\mu}}{d\pi^*} = \frac{\begin{vmatrix} 1 & \sigma' \\ 0 & \beta \end{vmatrix}}{\Delta} = \frac{\beta}{\Delta} > 0, \tag{B4}$$

$$\frac{d\overline{\mu}}{di^*} = \frac{\begin{vmatrix} -1 & \sigma' \\ 0 & \beta \end{vmatrix}}{\Delta} = -\frac{\beta}{\Delta} < 0, \tag{B5}$$

$$\frac{d\overline{f}}{d\beta} = \frac{\begin{vmatrix} 0 & 1 \\ [c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda)] & -\overline{f} \end{vmatrix}}{\Delta} = -\frac{c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda)}{\Delta} = \frac{1}{\sigma'} > 0, \tag{B6}$$

$$\frac{d\overline{f}}{d\Lambda} = \frac{\begin{vmatrix} 0 & 0 \\ c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda) & \kappa \end{vmatrix}}{\Delta} = 0, \tag{B7}$$

$$\frac{d\overline{f}}{dg} = \frac{\begin{vmatrix} 0 & 0 \\ c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda) & -1 \end{vmatrix}}{\Delta} = 0, \tag{B8}$$

$$\frac{d\overline{f}}{d\pi^*} = \frac{\begin{vmatrix} 0 & 1 \\ c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda) & 0 \end{vmatrix}}{\Delta} = -\frac{c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda)}{\Delta} = \frac{1}{\sigma'} > 0, \tag{B9}$$

$$\frac{d\overline{f}}{di^*} = \frac{\begin{vmatrix} 0 & -1 \\ c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda) & 0 \end{vmatrix}}{\Delta} = \frac{c_\mu(\overline{\mu},\Lambda) - \Lambda\phi'\ell_\mu(\overline{\mu},\Lambda)}{\Delta} = -\frac{1}{\sigma'} < 0. \tag{B10}$$

Given the above results and using (21)-(24), one obtains the long-run effects on consumption, labor inputs, income, real money balances and exchange rates. This shows results reported in Tables 1 and 2.

Appendix C

Focusing on the stable path, the solutions for μ, f, c, ℓ, y, m and e are of the following form:

$$\mu = \overline{\mu} - \frac{\sigma'\overline{\mu}}{\lambda}\left(f_0 - \overline{f}\right)e^{\lambda t}, \tag{C1}$$

$$f = \overline{f} + \left(f_0 - \overline{f}\right)e^{\lambda t}, \tag{C2}$$

$$c = \overline{c} + c_\mu(\mu - \overline{\mu}), \tag{C3}$$

$$\ell = \overline{\ell} + \ell_\mu(\mu - \overline{\mu}), \tag{C4}$$

$$y = \overline{y} + \phi' \ell_\mu(\mu - \overline{\mu}), \tag{C5}$$

$$m = \overline{m} + m_\mu(\mu - \overline{\mu}) + \frac{\rho'}{\rho' - 1}\eta_f \left(f - \overline{f}\right), \tag{C6}$$

$$e = \overline{e} + \frac{1}{\rho' - 1}\epsilon_f \left(f - \overline{f}\right), \tag{C7}$$

where $\lambda < 0$ is the stable eigenvalue and f_0 is the initial condition on foreign debt.

Appendix D

At time $t = 0$, differentiating (C1)-(C7) with respect to some arbitrary variable, say x, yields:

$$\frac{d\mu\,(0)^+}{dx} = \frac{d\overline{\mu}}{dx} + \frac{\sigma'\overline{\mu}}{\lambda}\frac{d\overline{f}}{dx}, \tag{D1}$$

$$\frac{df\,(0)^+}{dx} = 0, \tag{D2}$$

$$\frac{dc\,(0)^+}{dx} = \frac{d\overline{c}}{dx} + c_\mu\left(\frac{d\mu\,(0)}{dx} - \frac{d\overline{\mu}}{dx}\right), \tag{D3}$$

$$\frac{d\ell\,(0)^+}{dx} = \frac{d\overline{\ell}}{dx} + \ell_\mu\left(\frac{d\mu\,(0)}{dx} - \frac{d\overline{\mu}}{dx}\right), \tag{D4}$$

$$\frac{dy\,(0)^+}{dx} = \frac{d\overline{y}}{dx} + \phi'\ell_\mu\left(\frac{d\mu\,(0)}{dx} - \frac{d\overline{\mu}}{dx}\right), \tag{D5}$$

$$\frac{dm\,(0)^+}{dx} = \frac{d\overline{m}}{dx} + m_\mu\left(\frac{d\mu\,(0)}{dx} - \frac{d\overline{\mu}}{dx}\right) - \frac{\rho'}{\rho' - 1}\eta_f\frac{d\overline{f}}{dx}, \tag{D6}$$

$$\frac{de\,(0)^+}{dx} = \frac{d\overline{e}}{dx} - \frac{\sigma'}{\rho' - 1}\frac{d\overline{f}}{dx}. \tag{D7}$$

From the above relationships for $x = i, \beta, \Lambda, g, i, \pi^*$, using the results reported in Tables 1 and 2, one can easily obtain the impact effects of Tables 3 and 4.

Table 1: Steady-State Effects of Changes in Domestic Variables and Parameters

	i	β	Λ	g
$\overline{\mu}$	0	$\frac{\beta+\sigma'\overline{f}}{\Delta} > 0$	$-\frac{\left[\phi(\bar{\ell})+\Lambda\phi'\ell_\Lambda - c_\Lambda\right]\sigma'}{\Delta} < 0$	$\frac{\sigma'}{\Delta} > 0$
$\overline{f}$	0	$\frac{1}{\sigma'} > 0$	0	0
$\bar{c}$	0	$c_\mu \frac{\beta+\sigma'\overline{f}}{\Delta} < 0$	$c_\Lambda - \frac{\left[\phi(\bar{\ell})+\Lambda\phi'\ell_\Lambda - c_\Lambda\right]\sigma' c_\mu}{\Delta} > 0$	$\frac{\sigma' c_\mu}{\Delta} < 0$
$\bar{\ell}$	0	$\ell_\mu \frac{\beta+\sigma'\overline{f}}{\Delta} > 0$	$\ell_\Lambda - \frac{\left[\phi(\bar{\ell})+\Lambda\phi'\ell_\Lambda - c_\Lambda\right]\sigma' \ell_\mu}{\Delta} \lesseqgtr 0$	$\frac{\sigma' \ell_\mu}{\Delta} > 0$
$\overline{y}$	0	$\phi'\ell_\mu \frac{\beta+\sigma'\overline{f}}{\Delta} > 0$	$\phi'\ell_\Lambda - \frac{\left[\phi(\bar{\ell})+\Lambda\phi'\ell_\Lambda - c_\Lambda\right]\sigma'\phi' \ell_\mu}{\Delta} \lesseqgtr 0$	$\frac{\sigma'\phi' \ell_\mu}{\Delta} > 0$
$\overline{m}$	$-\frac{\mu}{V''}\frac{1}{\rho'-1} \gtrless 0$	$\frac{R}{V''}\frac{\beta+\sigma'\overline{f}}{\Delta} + \frac{\mu}{V''(\rho'-1)}\rho' \lessgtr 0$	$-\frac{\left[\phi(\bar{\ell})+\Lambda\phi'\ell_\Lambda - c_\Lambda\right]\sigma'}{\Delta}\frac{R}{V''} > 0$	$\frac{\sigma'}{\Delta}\frac{R}{V''} < 0$
$\bar{e}$	$-\frac{1}{\rho'-1} \lessgtr 0$	$\frac{1}{\rho'-1} \gtrless 0$	0	0

Table 2: Steady-State Effects of Changes in Foreign Variables

	π^*	i^*
$\overline{\mu}$	$\frac{\beta}{\Delta} > 0$	$-\frac{\beta}{\Delta} < 0$
$\overline{f}$	$\frac{1}{\sigma'} > 0$	$-\frac{1}{\sigma'} < 0$
$\bar{c}$	$-c_\mu \frac{\beta}{\Delta} < 0$	$c_\mu \frac{\beta}{\Delta} > 0$
$\bar{\ell}$	$-\ell_\mu \frac{\beta}{\Delta} > 0$	$\ell_\mu \frac{\beta}{\Delta} < 0$
$\overline{y}$	$-\phi'\ell_\mu \frac{\beta}{\Delta} > 0$	$\phi'\ell_\mu \frac{\beta}{\Delta} < 0$
$\overline{m}$	$\frac{R}{V''}\frac{\beta}{\Delta} < 0$	$-\frac{R}{V''}\frac{\beta}{\Delta} > 0$
$\bar{e}$	-1	0

Table 3: Impact Effects of Changes in Domestic Variables and Parameters

	i	β	Λ	g
$\mu(0)^+$	0	$\frac{d\overline{\mu}}{d\beta} - \frac{\overline{\mu}}{\lambda_1} > 0$	$\frac{d\overline{\mu}}{d\Lambda} < 0$	$\frac{d\overline{\mu}}{dg} > 0$
$c(0)^+$	0	$\frac{d\overline{c}}{d\beta} - c_\mu \frac{\overline{\mu}}{\lambda_1} < 0$	$\frac{d\overline{c}}{d\Lambda} \gtreqless 0$	$\frac{d\overline{c}}{dg} < 0$
$\ell(0)^+$	0	$\frac{d\overline{\ell}}{d\beta} - \frac{\overline{\mu}}{\lambda_1}\ell_\mu > 0$	$\frac{d\overline{\ell}}{d\Lambda} \lesseqgtr 0$	$\frac{d\overline{\ell}}{dg} > 0$
$y(0)^+$	0	$\frac{d\overline{y}}{d\beta} - \frac{\overline{\mu}}{\lambda_1}\phi'\ell_\mu > 0$	$\frac{d\overline{y}}{d\Lambda} \lesseqgtr 0$	$\frac{d\overline{y}}{dg} > 0$
$m(0)^+$	$-\frac{\mu}{V''}\frac{1}{\rho'-1} \gtrless 0$	$\frac{R}{V''}\frac{\beta+\sigma'\overline{f}}{\Delta} - \frac{R}{V''}\frac{\overline{\mu}}{\lambda_1} < 0$	$-\frac{\left[\phi(\overline{\ell})+\phi'\ell_\Lambda - c_\Lambda\right]\sigma'}{\Delta}\frac{R}{V''} > 0$	$\frac{\sigma'}{\Delta}\frac{R}{V''} < 0$
$e(0)^+$	$-\frac{1}{\rho'-1} \lessgtr 0$	0	0	0

Table 4: Impact Effects of Changes in Foreign Variables

	π^*	i^*
$\mu(0)^+$	$\frac{d\overline{\mu}}{d\pi^*} - \frac{\overline{\mu}}{\lambda_1} > 0$	$\frac{d\overline{\mu}}{di^*} + \frac{\overline{\mu}}{\lambda_1} < 0$
$c(0)^+$	$\frac{d\overline{c}}{d\pi^*} - c_\mu \frac{\overline{\mu}}{\lambda_1} < 0$	$\frac{d\overline{c}}{di^*} + c_\mu \frac{\overline{\mu}}{\lambda_1} > 0$
$\ell(0)^+$	$\frac{d\overline{\ell}}{d\pi^*} - \ell_\mu \frac{\overline{\mu}}{\lambda_1} > 0$	$\frac{d\overline{\ell}}{di^*} + \ell_\mu \frac{\overline{\mu}}{\lambda_1} < 0$
$y(0)^+$	$\frac{d\overline{y}}{d\pi^*} - \phi'\ell_\mu \frac{\overline{\mu}}{\lambda_1} > 0$	$\frac{d\overline{y}}{di^*} + \phi'\ell_\mu \frac{\overline{\mu}}{\lambda_1} < 0$
$m(0)^+$	$\frac{1}{V''}\left(\frac{\beta R}{\Delta} - \frac{R\overline{\mu}}{\lambda_1} - \frac{\rho'\overline{\mu}}{\rho'-1}\right) \gtrless 0$	$\frac{1}{V''}\left(-\frac{\beta R}{\Delta} + \frac{R\overline{\mu}}{\lambda_1} + \frac{\rho'\overline{\mu}}{\rho'-1}\right) \lessgtr 0$
$e(0)^+$	$-\frac{1}{\rho'-1}\rho' \lessgtr 0$	$\frac{1}{\rho'-1} \gtrless 0$

Figure 1: Exchange Rate Dynamics under Active Monetary Policy, $\rho' > 1$

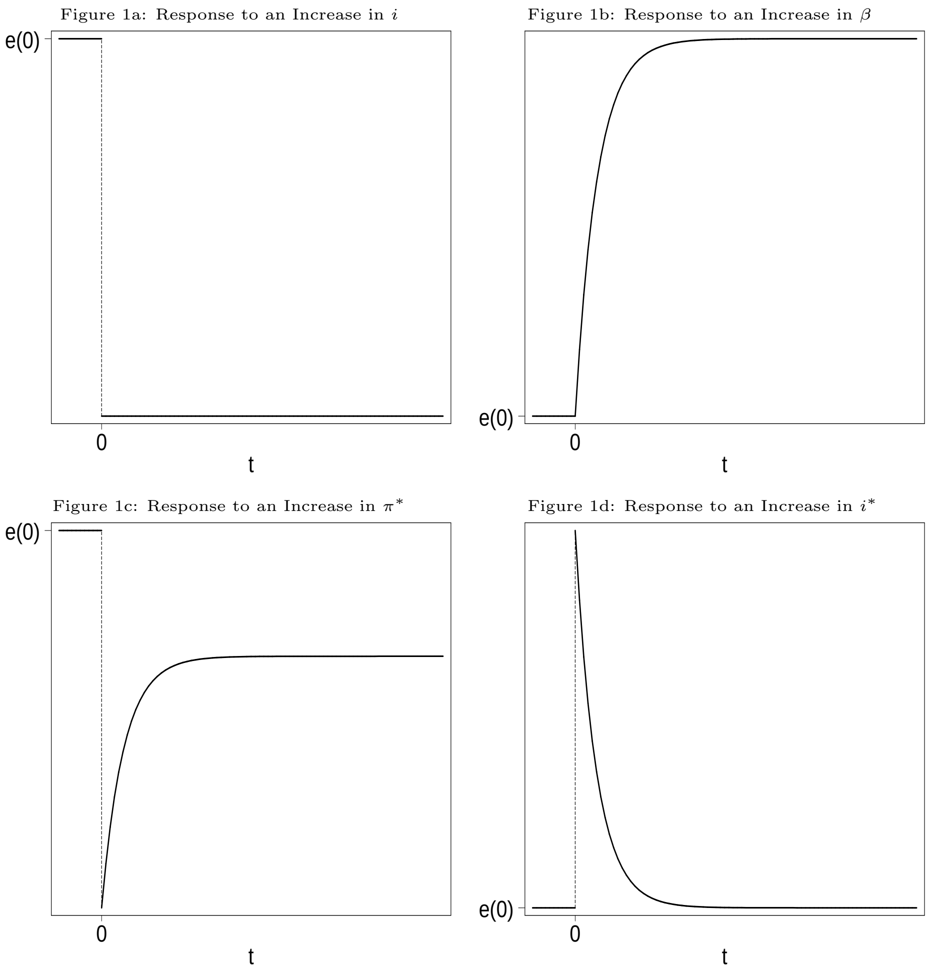

Figure 2: Exchange Rate Dynamics under Passive Monetary Policy, $\rho' < 1$