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Capital Mobility and the Effectiveness  
of Fiscal Policy in Open Economies

by

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# Capital Mobility and the Effectiveness of Fiscal Policy in Open Economies

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## **Abstract**

This paper uses a dynamic general equilibrium two-country optimizing ‘new-open economy macroeconomics’ model to analyze the consequences of international capital mobility for the effectiveness of fiscal policy. Conventional wisdom suggests that higher capital mobility diminishes the effectiveness of fiscal policy. The model laid out in this paper provides an example that a higher degree of capital mobility can also increase the effectiveness of fiscal policy. This tends to be the case if the stance of monetary policy can be described by means of a simple monetary policy rule.

*Keywords:* Fiscal policy; Capital mobility; Financial market integration; Monetary Policy

*JEL classification:* F36, F41

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## 1. Introduction

The globalization of financial markets has become one key manifestation of the increasing world-wide economic integration. This process of integration has been fostered by the abolition of legal restrictions on cross-border capital movements and by technological advances that have lowered information and communication costs considerably. As a result, international financial markets have grown rapidly during the past decades and international capital mobility has increased significantly. Because the degree of international capital mobility plays a key role for the effects and the effectiveness of macroeconomic policies, this can have important implications for economic policy.

As regards fiscal policy, the classic contributions of Fleming (1962) and Mundell (1963) imply that, in a flexible exchange rate regime, the effectiveness of fiscal policy, as measured by its effect on aggregate output, is an inverse function of the degree of international capital mobility. In the case of two large interdependent economies, the Mundell-Fleming model implies that capital mobility gives rise to an exchange-rate induced crowding-out effect and, thereby, diminishes the effectiveness of fiscal policy in the country in which it takes place. In the case of a small open economy, the results that can be derived from the Mundell-Fleming model are even stronger. This model suggests that in a world of perfect capital mobility the exchange-rate induced crowding out effect implies that fiscal policy has no effects on output at all in a small open economy (see, e.g., Hallwood and MacDonald, 2000). Even though researchers pointed out that the implications of capital mobility for the effectiveness of fiscal policy may be unclear (Greenwood and Kimbrough, 1985), the conventional wisdom derived from the Mundell-Fleming model has been that capital mobility diminishes the effectiveness of fiscal policy in open economies.

Recently, Sutherland (1996) and Senay (2000) have shown that this core result of the Mundell-Fleming analysis in principle also holds if one uses a micro-founded dynamic

monetary general equilibrium macroeconomic model to study the output effects of fiscal policy in open economies. Using variants of the prototype two-country sticky-price 'new-open economy macroeconomics' (NOEM) model developed by Obstfeld and Rogoff (1995), they have derived the result that moving from imperfect to perfect capital mobility diminishes the effectiveness of fiscal policy. Thus, as in the traditional Mundell-Fleming model, the effectiveness of fiscal policy, as measured in terms of its short-run effect on output, tends to be an inverse function of the degree of capital mobility.

In this paper, I argue that increasing the degree of capital mobility can increase the effectiveness of fiscal policy in a standard NOEM model if the stance of monetary policy can be described by means of a simple monetary policy rule. This result shows that in analyses of the implications of capital mobility for the effectiveness of fiscal policy the interaction between fiscal and monetary policy should be taken into account. To derive this result, I use a variant of the standard NOEM model also employed by Sutherland (1996). I extend Sutherland's model to incorporate a richer specification of the monetary policy rule pursued by central banks. Sutherland uses a purely autoregressive process as a monetary policy rule. The monetary policy rule I add to Sutherland's model contains this monetary policy rule as a special case and is general enough so that I can discuss the implications of various other monetary policy rules for the effectiveness of fiscal policy. I analyze the implications of monetary policy rules that imply that central banks adopt a policy of nominal income targeting, a policy of a strong response to inflation, and a 'speed limit' policy. The latter implies that central banks seek to target inflation and output growth. These rules have attracted much attention in the recent literature on monetary policy rules. See, for example McCallum and Nelson (1999) for an analysis of nominal income targeting and Walsh (forthcoming) for an analysis of 'speed limit' policies.

I organize the remainder of the paper as follows. In Section 2, I lay out the theoretical model. In Section 3, I use impulse response functions to analyze the effectiveness of fiscal policy under alternative assumptions regarding the degree of international capital mobility. I also conduct a sensitivity analysis to study how the results of my analysis depend upon the specification of the monetary policy rule. Furthermore, I show that capital mobility tends to increase the effectiveness of fiscal policy even if I add other features like habit formation or inflation inertia in the form of a partially backward-looking price-setting mechanism to the model. In Section 4, I offer some concluding remarks.

## **2. The Model**

The model I study in this paper is a variant of the dynamic general equilibrium open economy model developed by Sutherland (1996). This model is a natural candidate for analyzing the question I address in this paper because it retains the basic structure of the prototype NOEM model developed by Obstfeld and Rogoff (1995). Though the details of its specification are still under discussion, their model has emerged as the new workhorse model in the international macro and finance literature. The main difference between the prototype model advanced by Obstfeld and Rogoff and Sutherland's model is that the latter is built on the assumption that domestic and foreign bonds are imperfect substitutes. This assumption renders it possible to analyze the implications of the degree of capital mobility for the effectiveness of macroeconomic policies. I modify Sutherland's model in two respects. First, I add to the model a richer specification of the monetary policy rule that describes the central banks' policy. Second, as suggested by the results of recent empirical studies (see, e.g., Fuhrer, 2002), I assume that households consumption choices reflect habit formation. I use the second extension to conduct one of the sensitivity analyses described in Section 3.2 below.

As in the Obstfeld-Rogoff model, the world is made up of two countries. Each country is inhabited by infinitely-lived identical households. The households form rational expectations and maximize their expected lifetime utility. In addition, each country is populated by a continuum of firms. The households in each country own the respective domestic firms. The firms sell differentiated products in a monopolistically competitive goods market. Because each firm has monopoly power on the goods market, it treats the price it charges for its product as a choice variable. When changing the price of their product, firms have to take into account that prices are sticky. As is standard in the NOEM literature, the capital stock is fixed. The only production factor used by firms is labor. Firms hire labor in a perfectly competitive labor market. There is no migration of labor across countries.

### 2.1 *Households' Preferences and Goods Market Structure*

Domestic and foreign households have identical preferences and maximize their expected lifetime utility. The expected lifetime utility of a domestic household is defined as  $U_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} u_s$ , with  $0 < \beta < 1$  being the households' subjective discount factor. The operator  $E_t$  denotes expectations conditional on the information set available to the household in period  $t$ . The period-utility function,  $u_t$ , is given by

$$u_t = (\sigma / (\sigma - 1)) (C_t / C_{t-1}^h)^{(\sigma-1)/\sigma} + \chi (M_t / P_t)^{1-\varepsilon} / (1-\varepsilon) - \kappa N_t^\mu / \mu, \quad (1)$$

where  $\mu > 1$ ,  $\sigma > 0$ ,  $\kappa > 0$ ,  $\varepsilon > 0$ ,  $\chi > 0$ , and the habit formation parameter lies in the interval  $h \in [0,1)$ . In Eq. (1),  $C_t$  denotes a real consumption index,  $N_t$  denotes the households' labor supply, and  $M_t / P_t$  denotes the end-of-period real money holdings, where

$M_t$  denotes domestic nominal money balances and  $P_t$  denotes the aggregate domestic price index defined below. Households hold only the money issued by the central bank of the country in which they reside (i.e., there is no currency substitution).

The aggregate consumption index,  $C_t$ , is defined as a Dixit-Stiglitz aggregate over a continuum of differentiated, perishable domestic and foreign consumption goods of total measure unity. These goods are sold by domestic and foreign firms in a monopolistically competitive goods market and are indexed by  $z$  on the unit interval, so that the aggregate consumption index can be expressed as

$$C_t = \left[ \int_0^1 c_t(z)^{(\theta-1)/\theta} dz \right]^{\theta/(\theta-1)}, \quad (2)$$

where  $\theta > 1$  and  $c(z)$  denotes consumption of good  $z$ .

The domestic aggregate price index,  $P_t$ , is defined as the minimum expenditure required to buy one unit of the aggregate consumption index,  $C_t$ . Assuming that the law-of-one-price holds for each differentiated good and denoting the domestic currency price of good  $z$  by  $p_t(z)$ , this price deflator can be written as

$$P_t = \left[ \int_0^1 p_t(z)^{1-\theta} dz \right]^{1/(1-\theta)} = \left[ \int_0^n p_t(z)^{1-\theta} dz + \int_n^1 \{S_t p_t^*(z)\}^{1-\theta} dz \right]^{1/(1-\theta)}, \quad (3)$$

where  $n$  ( $1-n$ ) is the number of differentiated goods made at home (abroad),  $S_t$  denotes the nominal exchange rate defined as the amount of domestic currency units required to buy

one unit of the foreign currency, and  $p_i^*(z)$  denotes the foreign currency price of a differentiated product produced abroad. Here and in the following, an asterisk denotes a foreign variable. With identical preferences at home and abroad and the law-of-one-price holding for each differentiated good, it immediately follows from Eq. (3) that purchasing power parity holds:  $P_t = S_t P_t^*$ , where  $P_t^*$  denotes the aggregate foreign price level.

## 2.2 *The Structure of Financial Markets*

In addition to real balances, households hold internationally traded domestic and foreign nominal bonds. When deriving the optimal allocation of their wealth between these three assets, households have to take into account that international bond markets are not perfectly integrated. Whereas home households have free access to the domestic capital market, they incur intermediation costs when undertaking positions in the international bond market. Similarly, foreign households can trade foreign currency denominated bonds without incurring transaction costs but they incur intermediation costs when trading in domestic currency denominated bonds. The intermediation cost for taking positions in the international bond market are a convex function of the level of funds transferred from the domestic to the foreign bond market in period  $t$  (see Sutherland, 1996). Thus, the functional form of the real intermediation costs,  $Z_t$ , incurred by domestic households when undertaking positions in the international bond market is given by

$$Z_t = 0.5\psi I_t^2, \tag{4}$$



where  $\psi > 0$  is a positive constant and  $I_t$  denotes the level of real funds transferred by domestic households from the domestic to the foreign bond market. Both  $Z_t$  and  $I_t$  are denominated in terms of the consumption aggregate,  $C_t$ .

The income received by domestic households consists of the yield on their holdings of domestic and foreign bonds, the profit income for the ownership of domestic firms (i.e., dividend income), and the labor income. Summing up these income components, the households determine their optimal consumption and decide on their preferred domestic and foreign bond holdings and their preferred holding of domestic nominal balances. In addition, they pay taxes and incur the transaction costs for undertaking positions in the international bond market. Consequently, the dynamics of Home households' domestic bond holdings can be described by the following period-budget constraint:

$$D_t = (1 + R_{t-1})D_{t-1} + M_{t-1} - M_t + w_t N_t - P_t C_t - P_t I_t - P_t Z_t + \tilde{\Pi}_t - P_t T_t, \quad (5)$$

where  $D_t$  denotes for the quantity of domestic currency denominated bonds,  $R_t$  denotes the nominal interest rate on domestic bonds between period  $t$  and  $t+1$ ,  $T_t$  denotes real lump-sum taxes (denominated in terms of the consumption aggregator,  $C_t$ ),  $w_t$  denotes the nominal wage rate earned in a perfectly competitive domestic labor market, and  $\tilde{\Pi}_t(z)$  denotes the nominal profit income the firm owned by the household earns upon selling its product  $z$  in the goods market. Assuming further that labor is the only production factor firms use to produce product  $z$  and that the production function is given by  $y_t(z) = N_t(z)$ , the nominal profit income is given by  $\tilde{\Pi}_t(z) = p_t(z)y_t(z) - w_t y_t(z)$ .

The dynamics of the domestic households' foreign bond holdings are given by:

$$F_t = (1 + R_{t-1}^*)F_{t-1} + P_t^*I_t, \quad (6)$$

where  $R_t^*$  denotes the nominal foreign interest rate paid for holding a foreign bond between period  $t$  and  $t + 1$ .

### 2.3 Individual Maximization

Maximizing expected life-time utility subject to Eqs. (5) and (6) and assuming that the usual transversality condition applies, one can derive the following first-order conditions describing the household's optimal consumption choice, money holdings, labor supply, and domestic and foreign bond holdings:

$$(1/C_{t-1}^h)^{(\sigma-1)/\sigma} C_t^{-1/\sigma} - \beta h C_t^{(h-h\sigma-\sigma)/\sigma} E_t(C_{t+1}^{(\sigma-1)/\sigma}) = \lambda_t P_t, \quad (7)$$

$$\chi(M_t/P_t)^{-\varepsilon} + \beta P_t E_t(\lambda_{t+1}) = \lambda_t P_t, \quad (8)$$

$$\kappa y(z)^{\mu-1} = \lambda_t w_t, \quad (9)$$

$$(1 + R_t) \beta E_t(\lambda_{t+1}) = \lambda_t, \quad (10)$$

$$\lambda_t S_t - \beta(1 + R_t^*) E_t(\lambda_{t+1} S_{t+1}) + \psi \lambda_t S_t I_t = \beta(1 + R_t^*) \psi E_t(\lambda_{t+1} S_{t+1} I_{t+1}), \quad (11)$$

where  $\lambda_t$  denotes the Lagrange multiplier. Similar first-order conditions can be derived for Foreign households. Eq. (11) implies that allowing for intermediation costs for undertaking positions in international financial markets ( $\psi > 0$ ) implies that the no-arbitrage condition of uncovered interest rate parity includes terms accounting for the intermediation costs incurred when transferring funds between the domestic and the foreign bond market.

#### 2.4 Price Setting

Because each firm has monopoly power on the market for the differentiated good it produces, it treats the price it charges as a choice variable. One therefore has to specify a price-setting mechanism for  $p_t(z)$ . In this paper, I follow Sutherland (1996) and Senay (2000) and assume that firms set the prices of their products according to a discrete-time version of the price adjustment mechanism developed by Calvo (1983). According to this price adjustment mechanism, each firm has to take into account when setting its profit-maximizing price that there is a positive probability  $0 < \gamma < 1$  that it cannot revise its price setting decision made in period  $s < t$  in period  $t$ . Firms, therefore, set the current price of their product so as to maximize the expected present value,  $V_t(z)$ , of current and future real profits, where period  $s$ ,  $s > t$ , profits are weighted by the probability that the current period price will still be in force in period  $s$ . Firms maximize

$$\max_{p_t(z)} V_t(z) = E_t \sum_{s=t}^{\infty} \gamma^{s-t} \zeta_{t,s} \tilde{\Pi}_s(z) / P_s, \quad (12)$$

where  $\zeta_{t,s} \equiv \prod_{j=s}^t (1 + RR_j)^{-1}$  denotes the market real discount factor and  $RR_t$  denotes the domestic real interest rate. Carrying out the maximization in equation (12), the profit-maximizing price can be expressed as

$$p_t(z) = \left( \frac{\theta}{\theta - 1} \right) \frac{E_t \sum_{s=t}^{\infty} \gamma^{s-t} \zeta_{t,s} (Q_s / P_s) (1 / P_s)^{-\theta} w_s}{E_t \sum_{s=t}^{\infty} \gamma^{s-t} \zeta_{t,s} (Q_s / P_s) (1 / P_s)^{-\theta}}, \quad (13)$$

where  $Q_t \equiv nC_t + (1-n)C_t^* + nG_t + (1-n)G_t^* + nZ_t + (1-n)Z_t^*$  denotes the aggregate world demand and  $G_t$  denotes domestic real government purchases. An analogous expression can be derived for the profit-maximizing price set by foreign firms.

## 2.5 Fiscal Policy

The domestic government collects lump-sum taxes and uses them together with seignorage revenues to finance real government purchases,  $G_t$ :

$$G_t = T_t + (M_t - M_{t-1}) / P_t, \quad (14)$$

where real government purchases are denominated in terms of the consumption aggregator,  $C_t$ .

To analyze the dynamic adjustment paths of the endogenous variables of the model in response to a fiscal policy shock, I also have to specify a stochastic process describing the

dynamics of  $G_t$ . As in Sutherland (1996) and Senay (2000), I assume that the fiscal policy shock evolves according to a simple autoregressive process:

$$\hat{G}_t = \rho_G \hat{G}_{t-1} + \varepsilon_{G,t}. \quad (15)$$

A variable with a hat denotes deviations from the pre-shock steady state. In the numerical simulations below, I follow Sutherland (1996) and Senay (2000) and assume that the innovation terms,  $\varepsilon_{G,t}$ , in the domestic and foreign fiscal policy process are perfectly negatively correlated, i.e., fiscal policy shocks are asymmetric. This is clearly a somewhat restrictive assumption. However, it has the advantage that the results I report in this paper are comparable to the results derived by Sutherland.

## 2.6 *Monetary Policy*

The policy conducted by the domestic and the foreign central bank can be described by means of a simple monetary policy rule. In the case of the domestic central bank, the monetary policy I assume in this paper has the following general format:

$$\hat{M}_t = \mu_1 \hat{M}_{t-1} + \mu_2 \Delta \hat{y}_t + \mu_3 \Delta \hat{P}_t, \quad (16)$$

where  $\Delta$  denotes the first-difference operator. A similar monetary policy rule applies in the case of the foreign central bank. This monetary policy rule has three main advantages. First, it nests the monetary policy used by Sutherland (1996). Sutherland assumes that  $\mu_1 \in [0,1]$  and  $\mu_2 = \mu_3 = 0$ . It would be more difficult to compare my results with those derived by

Sutherland if I had decided to use, for example, a variant of the interest-rate targeting rule suggested by Taylor (1993) to describe central bank policy.

Second, using this monetary policy rule guarantees that the long-run effects of a fiscal policy shock are comparable to those described by Sutherland (1996). The reason for this is that the long-run steady-state inflation and the long-run rate of output growth are both zero. As a result, in the long-run, the monetary policy rule is identical to the monetary policy rule used by Sutherland. The fact that the steady-state effects of a fiscal policy shock are comparable to those described by Sutherland allows focusing attention on the differences between the implications of Sutherland's model and of my model with respect to the effects of a fiscal policy shock at business-cycle frequencies.

Third, the monetary policy rule given in Eq. (16) has the advantage that it is general enough so that it can be used to discuss the implications of various more specific monetary policy rules. For example, if  $\mu_1 = 0$  and  $\mu_2 = \mu_3 < 0$ , this monetary policy rule implies that the central bank targets nominal income. Nominal income targeting has been recently discussed in the context of a NOEM model by McCallum and Nelson (1999). If  $\mu_3 < \mu_1 = \mu_2 = 0$ , the central bank adopts a strategy of a strict inflation response, regardless of the stance of the real economy. If  $\mu_2 < 0$  and  $\mu_3 < 0$ , the central bank reacts to both a rise in inflation and a rise in the rate of output growth. Because the central bank reacts to output growth (and not to variations in the level of output), this type of central bank policy can be compared to what Walsh (forthcoming) calls a 'speed limit' policy.

## 2.6 *Definition of Equilibrium*

In a symmetric monopolistic competition equilibrium in each country, output, consumption, the exchange rate, prices, interest rates and wage rates, domestic and foreign bond holdings

follow processes such that (i) the labor market in each country clears, (ii) the optimality conditions for consumption and asset holding are satisfied, (iii) the intertemporal budget constraint for each country is satisfied, (iv) the markets for domestic and foreign bonds are in equilibrium, and, (v) firms price setting, the dynamics of government spending, and central bank policy satisfy Eqs. (13), (15), and (16), and their foreign counterparts, respectively.

### **3. Capital Mobility and the Effectiveness of Fiscal Policy**

To analyze the implications of varying the degree of international capital mobility for the effectiveness of fiscal policy, I follow Obstfeld and Rogoff (1995) and Sutherland (1996) and log-linearize the model laid out in Section 2 around a symmetric flexible-price steady state in which the domestic and foreign asset positions are zero. To solve the model, I use the algorithm developed by Klein (2000). The calibration of the model is fairly standard and follows Sutherland (1996).

— Insert Table 1 about here.—

#### *3.1 Impulse Response Analysis*

The impulse response functions depicted in Panel A of Figure 1 visualize the impact of a permanent unit asymmetric fiscal policy shock on key domestic variables. To compute the impulse responses plotted in this figure, I assume that  $\mu_2 = \mu_3 = h = 0$ . In other words, there is no habit formation and the monetary policy rule is as given in Sutherland (1996). In this case, my model collapses to Sutherland's model. Thus, the impulse responses plotted in Panel A of Figure 1 are identical to the impulse responses to a permanent asymmetric fiscal policy shock implied by Sutherland's model. These impulse responses serve as a benchmark against which I can assess how my modifications of the model change the macro-dynamic effects triggered

by a fiscal policy shock. In Panel B of Figure 1, I show how a permanent asymmetric fiscal policy shock propagates through the economy if the calibration of the model is such that  $h = 0$  and  $\mu_2 = \mu_3 < 0$ . Thus, in this scenario, the domestic and foreign central banks pursue a strategy of nominal income targeting.

— Insert Figure 1 about here.—

I consider first the impulse response functions depicted in Panel A. In the model described in this paper, an expansionary fiscal policy shock represents a negative wealth effect for households. This negative wealth effect induces households to decrease consumption and to increase their work effort. Because fiscal policy shocks are asymmetric, the macroeconomic adjustment process taking place in the foreign economy is a mirror-image of that taking place in the domestic economy. As a consequence, the relative demand for domestic currency declines. The resulting nominal depreciation results in an increase of the terms of trade (the home currency price of goods produced abroad relative to the home currency price of goods produced in the domestic economy). This movement in the terms of trade triggers an expenditure switching effect implying that the demand for domestic (foreign) products increases. In this situation, domestic firms increase output. This is profitable because prices are above marginal costs.

How does international capital mobility affect the dynamics of the model? To answer this question, it is useful to write down the log-linear form of the condition of uncovered interest rate parity:

$$(1 - \beta)(\hat{i}_t - \hat{i}_t^*) = E_t(\hat{S}_{t+1} - \hat{S}_t) + \tilde{\psi}E_t(\hat{I}_{t+1} - \hat{I}_t) \quad (16)$$



where  $\hat{i}_t$  denotes the domestic nominal interest rate and  $\tilde{\psi} \equiv \psi \bar{C}_0$  ( $\bar{C}_0$  denotes the level of consumption in the pre-shock steady state). Eq. (16) shows that with international bond markets being imperfectly integrated ( $\tilde{\psi} > 0$ ), the dynamics of the foreign bond holdings of households (i.e., capital flows) are reflected in the condition of uncovered interest rate parity. This direct effect of the change in the foreign bond holdings on the international nominal yield differential is absent in a world of high capital mobility ( $\tilde{\psi} = 0$ ).

In the case of a fiscal policy shock, the domestic economy runs a current account deficit, so that its foreign asset position decreases. However, because the economy rapidly converges to its post-shock steady state, the expected growth rate of capital inflows is negative. This effect is large enough so that the expected rate of appreciation of the domestic currency is larger with segmented international bond markets, implying that the nominal exchange rate overshoots its post-shock steady-state level in the short run. Taking account of the implications of this effect for the dynamics of the terms of trade, it follows that the output effect of the fiscal policy shock is larger in the case of low capital mobility as compared to the case of high capital mobility.

Panel B shows that things are different if monetary policy adopts a strategy of nominal income targeting. In this case, the fiscal policy shock induces a short-run increase in home nominal output growth. The home central bank tries to counter this increase in nominal output growth. As a result, the supply of domestic money decreases. In the regime of low capital mobility, the rate of growth of nominal output in the immediate aftermath of the fiscal policy shock is larger than in a regime of high capital mobility. Consequently, the decrease in the home money supply is relatively stronger if capital mobility is low. As prices adjust, the growth of nominal income decreases and, as a result, the home money supply starts increasing. The resulting shift in the relative supply of home and foreign money supply implies that the nominal exchange rate starts depreciating.

When money supply starts increasing, the nominal interest rate is higher in the regime of high capital mobility as compared to the regime of low capital mobility. In consequence, the rate of depreciation of the nominal exchange rate tends to be higher if capital mobility is high. In fact, the rate at which the nominal exchange rate depreciates is large enough so that the exchange rate overshoots its long-run post-shock steady-state level. This, in turn, implies that the rate of output growth during this transition phase is higher if capital mobility is high. As a result, the output impulse response function applying in the regime of high capital mobility assumes a hump-shaped form, implying that the maximum output effect of the fiscal policy shock increases in the degree of international capital mobility. Thus, fiscal and monetary policy interactions can have significant effects on the relative effectiveness of fiscal policy in a regime of low and a regime of high international capital mobility.

### 3.2 *Sensitivity Analysis*

In this section, I offer some further examples that confirm the result derived in Section 2. To this end, I analyze the implications of changes in the monetary policy rule and in the calibration of the model for the effectiveness of fiscal policy in a regime of high and a regime of low capital mobility.

I begin my analysis by studying how changes in the specification of the monetary policy rule pursued by the central banks affect my main result. Figure 2 summarizes the results of this analysis. The impulse response functions depicted in the figure suggest that the result that the effectiveness of fiscal policy can increase in an environment in which international bond markets become more integrated also obtains if the central banks pursue a ‘speed’ limit policy or if an autoregressive component is added to the monetary policy rule. In the former case, the central banks try to counter increases in the growth rate of real output and in the inflation rate. In the latter case, the lagged money supply is included in the monetary policy rule.

Interestingly, the Mundell-Fleming result that fiscal policy is more effective if capital mobility is low is restored if the home and foreign central banks pursue a policy of strong inflation response, regardless of the stance of the business cycle. The reason for this is that the price-setting mechanism I use in this paper does not add substantial inflation inertia to the dynamics of the model, so that the monetary policy rule in this case comes close to the monetary policy rule used by Sutherland (1996). Though the assumption that the central banks totally neglect the development of real output and are only concerned about inflation dynamics is somewhat unrealistic, this result shows that the specification of the monetary policy is important for the relative effectiveness of fiscal policy in a regime of high and a regime of low international capital mobility.

— Insert Figure 2 about here.—

Figure 3 gives some additional results for alternative calibrations of the model. To generate the impulse response functions for output depicted in this figure, I assume that monetary policy can be described in terms of a ‘speed limit’ policy. I consider four alternative calibrations of the model. (1) I analyze how habit formation influences the macroeconomic effects of a fiscal policy shock. Habit formation may be important because it strengthens the consumption smoothing incentives of households. Because consumption smoothing becomes an especially important issue if capital mobility is high, it is interesting to analyze how habit formation affects the main result of this paper. To this end, I set the habit persistence parameter  $h$  equal to 0.8, which lies in the range of recent empirical estimates. If  $h > 0$ , households have preferences over both the level and the rate of change of consumption. (2) I analyze the implications of a variation in the curvature of households’ period utility function with respect to consumption. To this end, I assume logarithmic preferences and change the parameter  $\sigma$  from  $\sigma = 0.75$  in the benchmark model to  $\sigma = 1.0$ . (3) I analyze the impact of a

change in the parameter  $\theta$  on the simulation results. In the benchmark model, this parameter assumes the numerical value 6. To assess the robustness of the main result of my analysis, I set this parameter equal to 11. This implies that the mark up,  $\theta / (\theta - 1)$ , charged by monopolistic firms in the goods market is cut from 20 percent to 10 percent. (4) I assume that firms depart from the Calvo-style price-setting mechanism given in Eq. (13). The Calvo-style price-setting mechanism implies that marginal costs and expected next period inflation are important for the current rate of change of prices. Fuhrer und Moore (1995) have argued that some type of backward-looking element should be introduced into inflation dynamics in order to replicate the empirically observed persistence in inflation. In order to capture this idea, I slightly modify the price-setting mechanism implied by Eq. (13). I assume

$$\Delta \hat{p}(z)_t = \beta\gamma \left( (1 - \varphi) E_t \Delta \hat{p}(z)_{t+1} + \varphi \Delta \hat{p}(z)_{t-1} \right) + (1 - \beta\gamma) \Delta w_t, \quad (13')$$

where  $\Delta$  is the first-difference operator and  $\varphi \in [0,1]$  captures the extent to which firms take past inflation into account when determining the current rate of change in the prices of their goods. If  $\varphi = 0$ , Eq. (13') reduces to the inflation dynamics implied by the Calvo-style price-setting mechanism given in Eq. (13). I assume that  $\varphi = 0.2$ , which is in the range of empirical estimates (see Galí et al., 2001).

— Insert Figure 3 about here.—

The point to take home is that the results summarized in Figure 3 indicate that the main result of this paper is robust with respect to changes in the consumption function, the price-setting mechanism, and the calibration of the model. In all four variations of the model I analyze in Figure 3, a higher degree of international capital mobility amplifies the output effects of fiscal policy at business-cycle frequencies.

## 4. Conclusions

In this paper, I provided an example showing that in a fairly standard, reasonably calibrated NOEM model, higher capital mobility need not diminish the effectiveness of fiscal policy as measured in terms of its output effects. This tends to be the case if monetary policy can be described by means of a simple monetary policy rule. The result of my analysis underscores that it is important to take into account the interaction between fiscal and monetary policy when analyzing the impact of the ongoing integration of international financial markets for the way fiscal policy shocks propagate through the economy.

I intentionally kept the model I used to reconsider the implications of international capital mobility for the effectiveness of fiscal policy very simple. The simplicity of the model assured that its basic structure coincides with the structure of the model used in a previous study by Sutherland (1996). Of course, its simplicity also implies that the model could be extended in several dimensions.

For example, it would be interesting to assess in future work how capital mobility affects the effectiveness of a debt-financed fiscal policy in the type of model I analyzed in this paper. It would also be interesting to study whether the results I derived in this paper change if government purchases are valued in consumption. While the results that drop out of such analyses may differ from the results I reported in this paper, my results in any case suggest that it should not be taken for granted that higher capital mobility diminishes the effectiveness of fiscal policy in open economies.

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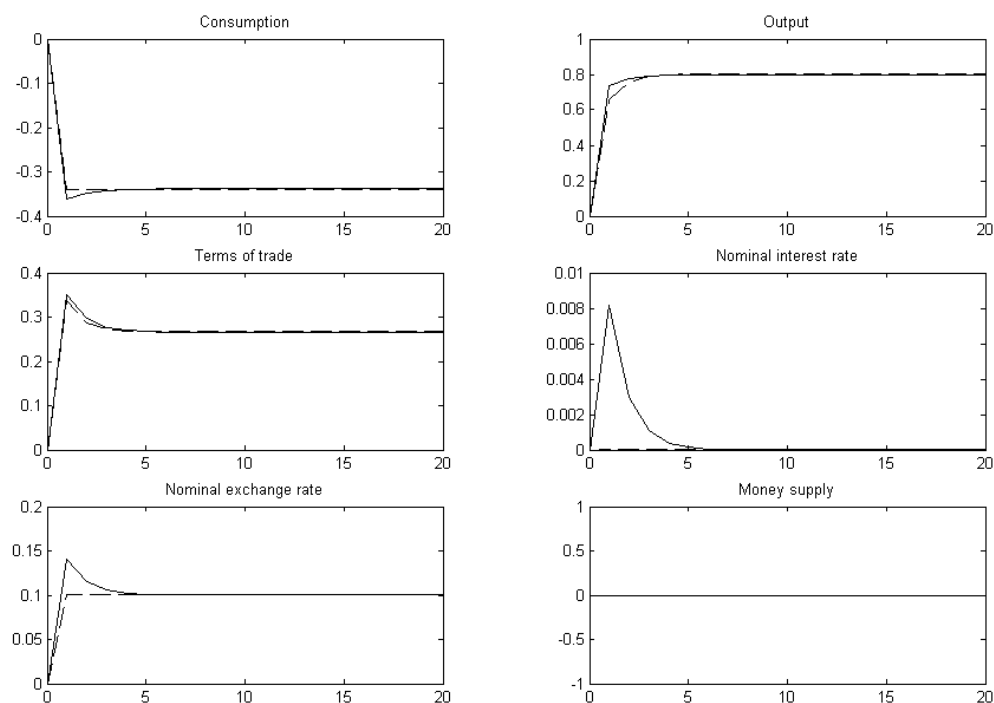
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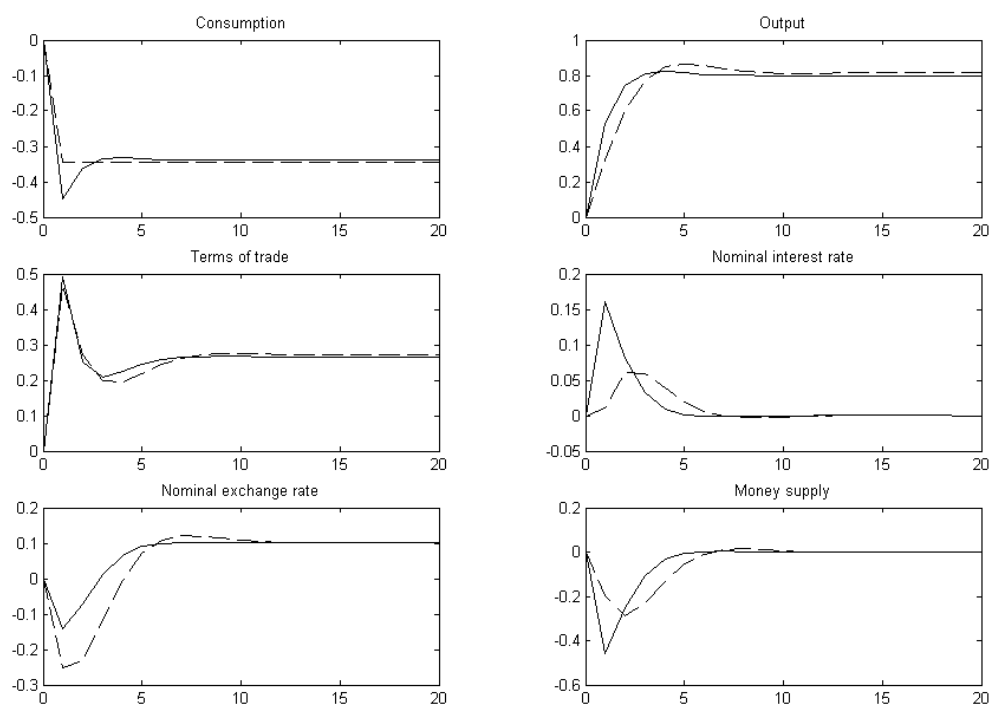
## Figures and Tables

Figure 1 – Capital mobility and the dynamic effects of a fiscal policy shock

PANEL A: Supply of central bank money is constant



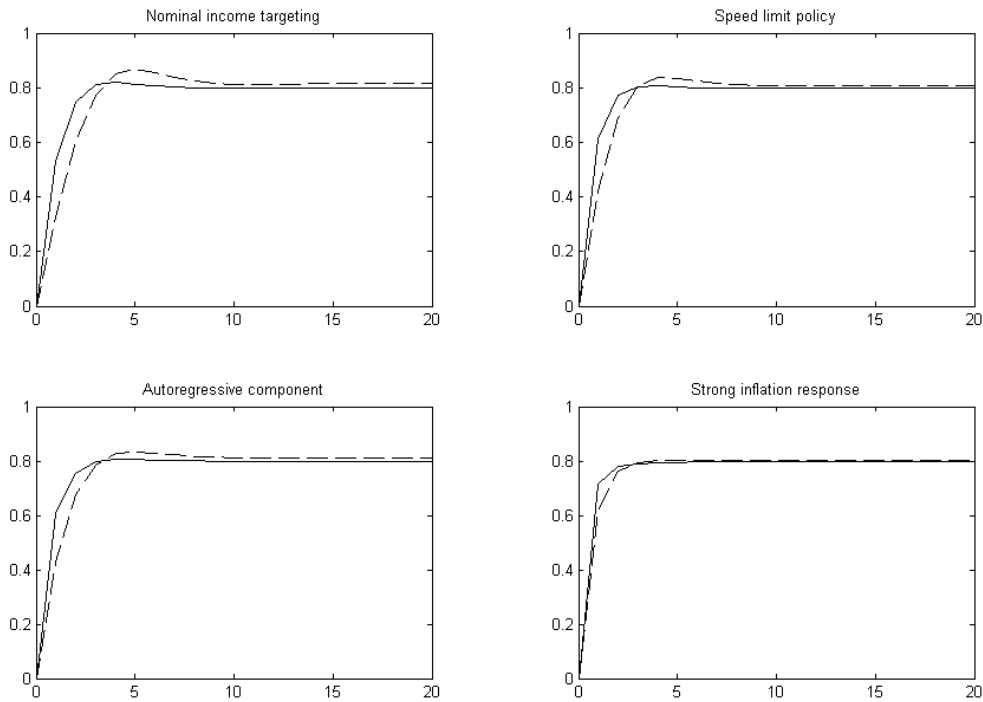
PANEL B: Nominal income targeting



*Note:* Dashed lines apply in the regime of high capital mobility ( $\tilde{\psi} = 0$ ) and solid lines apply in the regime of low capital mobility ( $\tilde{\psi} = 5$ ). In the case of nominal income targeting, I set  $\mu_2 = \mu_3 = -1.0$ . Consumption, output, the nominal exchange rate, money supply, and the terms of trade are measured as percentage deviations from the steady state. Interest rates are computed as percentage point deviations from the pre-shock steady state.

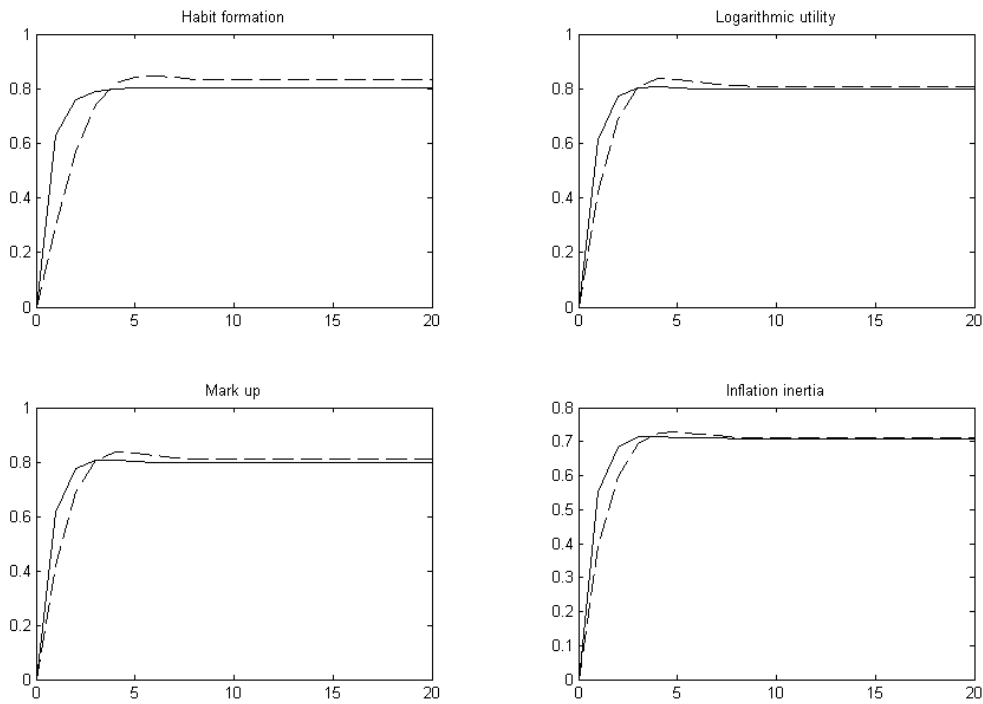


Figure 2 – Alternative monetary policy rules and the output effect of a fiscal policy shock



*Note:* Dashed lines apply in the regime of high capital mobility ( $\tilde{\psi} = 0$ ) and solid lines apply in the regime of low capital mobility ( $\tilde{\psi} = 5$ ). Output is measured as percentage deviations from the pre-shock steady state. In the case of nominal income targeting, I set  $\mu_1 = 0$  and  $\mu_2 = \mu_3 = -1.0$ . In the case of the 'speed limit' policy, I set  $\mu_1 = 0$  and  $\mu_2 = -0.5$  and  $\mu_3 = -1.0$ . When adding the autoregressive component to the nominal income targeting rule, I set  $\mu_1 = 0.25$ . In the case of the strong inflation response policy, I set  $\mu_1 = \mu_2 = 0$  and  $\mu_3 = -1.0$ .

Figure 3 – Variation of key model parameters and the output effect of a fiscal policy shock under a ‘speed limit’ policy



*Note:* Dashed lines apply in the regime of high capital mobility ( $\tilde{\psi} = 0$ ) and solid lines apply in the regime of low capital mobility ( $\tilde{\psi} = 5$ ). To analyze the implications of habit formation, I set  $h = 0.8$ . To analyze the implications of logarithmic utility, I set  $\sigma = 1.0$ . To analyze the influence of the mark up parameter, I assume that the mark up is 10 percent ( $\theta = 10$ ). To analyze the implications of inflation inertia, I set  $\varphi = 0.2$  in Eq. (13'). The parameters of the monetary policy rule are  $\mu_1 = 0$ ,  $\mu_2 = -0.5$ , and  $\mu_3 = -1.0$ .

Table 1 — The calibrated parameters

<i>Parameter</i>	<i>Value</i>	<i>Description</i>
$\beta$	0.95	Subjective discount factor
$\sigma$	0.75	Intertemporal elasticity of substitution
$\theta$	6.0	Intratemporal elasticity of substitution
$\varepsilon$	9.0	Inverse of the elasticity of utility from real balances
$\mu$	1.4	Labor supply elasticity
$\tilde{\psi}$	5 (0)	Costs for undertaking positions in international financial market in the case of low (high) capital mobility
$n$	0.5	Country size

*Note:* For parameter values, see Sutherland (1996).