

Government spending and the exchange rate*

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Abstract

This paper studies how home bias in public spending and interest rate reaction to domestic inflation jointly shape the exchange rate response to balanced and debt-financed fiscal expansions. Our analysis is conducted in a theoretical two-country "perpetual youth" DSGE model where the transmission mechanism of fiscal shocks works through relative marginal costs at Home and abroad.

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1 Introduction

The financial crisis that led the world economy into recession in 2009 stimulated a revived interest in the role of fiscal policy as a stabilization tool. Relevant discretionary fiscal interventions have been undertaken in the US and in many other industrialized countries, often coupled with expansionary monetary policies. Interestingly, however, although the effects of fiscal shocks and their international transmission have long been investigated in the literature, not much consensus was achieved.

In this paper, we study the role that public-spending composition and the monetary policy regime play in shaping the exchange-rate response to fiscal shocks. We find that the appreciation implied by modern open-economy Dynamic Stochastic General Equilibrium (DSGE) new Keynesian models¹ critically hinges on two specific features of the latter: the Taylor principle and home bias in public consumption.²

Ganelli (2005a) investigated the role played by home bias in public spending in a *Redux* model *à la* Obstfeld and Rogoff (1995). He shows that a balanced budget fiscal expansion used to purchase domestic goods only stimulates domestic demand, but this effect is completely offset by the tax burden. Consequently, domestic consumption and money demand do not react, leaving the exchange rate unaffected by the fiscal shock. DSGE open-economy new Keynesian models such as Corsetti and Pesenti (2001) and Devereux and Engel (2003) find that after a balanced-budget fiscal expansion, private consumption decreases and, through international risk sharing, the exchange rate appreciates. Exchange rate depreciation occurs if we introduce incomplete financial markets (Kollmann, 2010), productive government spending (Basu and Kollmann, 2013) or spending reversals (Corsetti et al, 2012)³.

The analysis of debt-financed fiscal policy, in general, has been somehow delayed with respect to studies investigating the role of monetary policy in the NOEM framework. This is largely due to the fact that in most models Ricardian equivalence holds and only balanced-budget policies can be studied. Only recently, the standard two-country framework based on the Representative Agent (RA) model has been extended to account for agents' heterogeneity, turnover in financial markets and some form of market imperfection or incompleteness that allow to depart from Ricardian equivalence and investigate fiscal policies more in detail (see Ganelli, 2005b, Cavallo and Ghironi, 2002, Di Giorgio and Nisticò, 2007, 2013). These advances allow a comparison between the outcomes of fiscal shocks in the static Mundell–

¹These models are also often referred to as New Open-Economy Macroeconomics (NOEM) models.

²The empirical evidence in Trionfetti (2000), Brulhart and Trionfetti (2004) and Nakamura and Steinsson (2011) shows that public spending in OECD countries is home-biased.

³The recent empirical evidence is mixed, with results that depend on the period and on the countries studied. See for example Kim and Roubini (2008), Monacelli and Perotti (2010), Beetsma et al. (2008) and Bénétrix and Lane (2013).

Fleming model and the intertemporal approach used in the modern literature (see Ganelli, 2005b) and a better understanding of the role played by different factors in affecting the exchange-rate response.

In this paper we study the effects of fiscal expansions on the exchange rate in a two-country DSGE model, extended with a “perpetual youth” structure of the demand side, along the lines of Di Giorgio and Nisticò (2007, 2013). This extension allows us to break Ricardian equivalence and analyze both balanced-budget and of debt-financed fiscal policy. Our main contribution is to highlight the joint role of endogenous monetary policy⁴ and home bias in public spending to explain the exchange rate response to fiscal shocks. Moreover, we show a new transmission mechanism of fiscal shocks that works through firms’ marginal costs. Finally, we show that this different transmission mechanism also implies that the exchange-rate appreciation occurs regardless of the financing of the fiscal expansion (tax versus debt), in contrast to Ganelli (2005b)’s result of ambiguous responses derived in a *Redux*-type model.

The paper is organized as follows. In Section 2, we describe a fully specified non-Ricardian two-country DSGE model of the business cycle. In Section 3 we investigate, by means of simulations, the effects of balanced and non-balanced-budget fiscal shocks on key macroeconomic variables. Section 4 concludes.

2 The Model

The model consists of a continuum of households and firms in the interval $[0, 1]$, divided in two countries H and F , of dimension n and $(1 - n)$, respectively. The two countries are structurally symmetric. Each household, in each country, supplies labor inputs to firms and demands a bundle of consumption goods consisting of both home and foreign goods.

The productive sector produces a continuum of perishable goods, which are differentiated across countries and with respect to one another. As in the modern NOEM and DNK tradition, there are nominal rigidities in the form of a Calvo (1983) price-setting mechanism and monetary policy is specified as the control of a short-term interest rate through a Taylor-type feedback rule.⁵

In order to be able to analyze a broader range of fiscal shocks and compare our results with existing literature, moreover, we extend the standard framework to also break Ricardian equivalence through a perpetual-youth structure of the demand side of the economy. The general model is therefore a two-country OLG economy, along the lines of Di Giorgio and Nisticò (2007, 2008).

⁴In this paper monetary policy is defined endogenous if the Taylor principle holds.

⁵See, among others, Benigno (2004) and Galí and Monacelli (2005).

2.1 The Demand Side

The demand-side of our economy is a discrete-time stochastic version of the perpetual youth model introduced by Blanchard (1985) and Yaari (1965). Each period, in each country, a constant share γ of traders in the financial markets are randomly replaced by newcomers with zero-financial wealth; from that period onward, these newcomers start trading in the financial markets and face a constant probability γ of being replaced as the next period begins.⁶

Consumers have log-utility preferences over consumption and leisure, supply labor services in a domestic competitive labor market and demand consumption goods. Consumption goods of household j are an unbiased bundle of both domestic and imported goods:⁷

$$C_t(j) = \left[n^{\frac{1}{\theta}} C_{H,t}(j)^{\frac{\theta-1}{\theta}} + (1-n)^{\frac{1}{\theta}} C_{F,t}(j)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}. \quad (1)$$

in which $\theta > 0$ is the elasticity of substitution between Home and Foreign goods. The consumption bundles $C_{H,t}^i(j)$ and $C_{F,t}^i(j)$ are Dixit-Stiglitz aggregators of the consumption goods produced in the two countries:

$$C_{H,t}^i(j) = \left[\left(\frac{1}{n} \right)^{\frac{1}{\epsilon}} \int_0^n C_t^i(h, j)^{\frac{\epsilon-1}{\epsilon}} dh \right]^{\frac{\epsilon}{\epsilon-1}} \quad C_{F,t}^i(j) = \left[\left(\frac{1}{1-n} \right)^{\frac{1}{\epsilon}} \int_n^1 C_t^i(f, j)^{\frac{\epsilon-1}{\epsilon}} df \right]^{\frac{\epsilon}{\epsilon-1}} \quad (2)$$

where $\epsilon > 1$ is the elasticity of substitution between the differentiated goods in the intervals $[0, n]$ and $(n, 1]$.⁸ We assume that the law of one price holds. The joint assumption of unbiased consumption bundles and the law of one price implies purchasing power parity:

$$P_t = \mathcal{E}_t P_t^*, \quad (3)$$

where \mathcal{E}_t is the nominal exchange rate defined as the domestic price of foreign currency. Moreover, households allocate savings among a full set of domestic state-contingent private securities and two internationally traded riskless financial assets issued in the two currencies by the governments to finance their budget deficits. Each consumer in each country is endowed with an equal amount of non-tradable shares of the domestic firms.

Consequently, each domestic household belonging to cohort j supplies labor inputs (N)

⁶For a thorough discussion of this mechanism, see Castelnovo and Nisticò (2008). An alternative interpretation of parameter γ is that it implies an expected duration of trading in financial markets ($1/\gamma$) which can be seen as the effective planning horizon. See also Leith and Wren-Lewis (2000), Leith and vonThadden (2004), Nisticò (2005) and Piergallini (2006).

⁷Symmetric relations hold for the foreign country, with appropriate asterisks.

⁸We assume such elasticity, reflecting the degree of market power, to be the same across countries.

to firms and demands consumption goods C in order to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t (1 - \gamma)^t \left[\log C_t(j) + \delta \log(1 - N_t(j)) \right]$$

subject to a sequence of budget constraints of the form

$$\begin{aligned} P_{H,t} C_t(j) + E_t \{ \mathcal{F}_{t,t+1}^H Q_{H,t}(j) \} + B_{H,t}^n(j) + \mathcal{E}_t B_{F,t}^n(j) &\leq \\ &\leq \frac{1}{1 - \gamma} \left[(1 + r_{t-1}) B_{H,t-1}^n(j) + \mathcal{E}_t (1 + r_{t-1}^*) B_{F,t-1}^n(j) + Q_{H,t-1}(j) \right] + \\ &\quad + W_t N_t(j) + P_{H,t} D_t(j) - P_{H,t} T_t(j) \end{aligned} \quad (4)$$

where $D_t(j) \equiv \frac{1}{nP_{H,t}} \int_0^n D_t(h, j) dh$ denotes j 's claims on real profits from domestic firms and $T_t(j)$ denote real lump-sum taxes levied by the domestic fiscal authority on household j . $B_{i,t}^n(j)$ denotes risk-free one-period nominal zero-coupon bonds issued by the two governments and held by generation j . $Q_{H,t}(j)$ denotes cohort j 's holdings of the portfolio of state-contingent assets, denominated in domestic currency, for which the relevant discount factor pricing one-period claims is $\mathcal{F}_{t,t+1}^H$.⁹

The solution of the optimization problem of domestic and foreign households delivers a set of cohort-specific equilibrium conditions which, once aggregated across cohorts, describe the aggregate labor supply and the dynamic path of aggregate consumption:¹⁰

$$\delta P_t C_t = W_t (1 - N_t), \quad (5)$$

$$C_t = \sigma E_t \left\{ \mathcal{F}_{t,t+1} \frac{P_{t+1}}{P_t} \right\} \Omega_t + \frac{1}{\beta} E_t \left\{ \mathcal{F}_{t,t+1} \frac{P_{t+1}}{P_t} C_{t+1} \right\} \quad (6)$$

where W_t denotes the nominal wage and Ω_t denotes the financial wealth in real terms.¹¹ The first term in (6) captures the financial wealth effect on consumption, which is increasing in the turnover rate γ :

$$\sigma \equiv \gamma \frac{1 - \beta(1 - \gamma)}{\beta(1 - \gamma)}.$$

⁹The stochastic discount factor is unique, within each country, given the assumption of complete domestic markets.

¹⁰For details on the features of the model and the derivation of individual and aggregate equilibrium conditions, see Di Giorgio and Nisticò (2008, 2013).

¹¹More in detail,

$$\Omega_{t-1}(j) \equiv \frac{1}{1 - \gamma} \left[(1 + r_{t-1}) B_{H,t-1}^n(j) + \mathcal{E}_t (1 + r_{t-1}^F) B_{F,t-1}^n(j) + Q_{H,t-1}(j) \right]$$

This additional term with respect to the RA set up is a direct implication of the random replacement of a fraction of traders in the financial market with newcomers holding zero-wealth. Indeed, the interaction between long-time traders with accumulated wealth and newcomers holding zero financial wealth drives a wedge between the equilibrium stochastic discount factor and the *average* marginal rate of intertemporal substitution in consumption. In fact, while the cohort-specific Euler equation is the same as in the RA setup, because of the insurance mechanism *à la* Blanchard, their aggregation is not straightforward (as it is in the RA setup) because the composition of traders in the financial markets tomorrow will include newcomers entering with zero-wealth to replace a share of long-time traders. These newcomers will consume on average less than long-time traders because they will not have any accumulated wealth. Aggregation will therefore account for this difference by means of a wedge between the stochastic discount factor and the average marginal rate of substitution in consumption. Such wedge is proportional to the stock of financial wealth and creates a link between average consumption growth and the dynamics of financial wealth.

Notice that what drives the financial wealth effect is not the finiteness of individual agents' planning horizon, because the effect of this feature is sterilized by the insurance mechanism *à la* Blanchard. The financial wealth effect only appears in aggregate terms, and is truly implied by the presence of agents with zero-wealth and their interaction with long-time traders. This argument is crucial for the interpretation of the nature of parameter γ , and its possible quantitative calibration. As the rate of replacement (γ) approaches zero the wealth effect fades away and the model converges to the RA set up.

2.2 The Supply Side

The productive sector produces a continuum of perishable goods, which are differentiated across countries (with elasticity of substitution $\theta > 0$) and with respect to one another (with elasticity of substitution $\epsilon > 1$). Each firm, in each country, has access to a linear technology $Y_t(i) = N_t(i)$, with $i = h, f$.¹² Each period both domestic and foreign firms set output prices according to Calvo's (1983) staggering mechanism with $1 - \vartheta$ ($1 - \vartheta^*$) being the probability for each firm in country H (F) to optimally adjust its price. In equilibrium, this assumption implies a set of familiar New Keynesian Phillips Curves and the following real marginal cost

¹²We model technology without considering country-specific productivity shocks because we focus on the effects of fiscal shocks on the exchange rate. Our results do not vary qualitatively in presence of productivity shocks.

for the two countries:

$$MC_t = \frac{\delta C_t}{1 - Y_t \Xi_t} \left[n + (1 - n) \mathcal{S}_t^{1-\theta} \right]^{\frac{1}{1-\theta}} \quad (7)$$

$$MC_t^* = \frac{\delta C_t^*}{1 - Y_t^* \Xi_t^*} \left[n \mathcal{S}_t^{\theta-1} + (1 - n) \right]^{\frac{1}{1-\theta}}, \quad (8)$$

in which \mathcal{S} denotes the terms of trade and Ξ and Ξ^* capture (second-order) relative price dispersion among firms of country H and F , respectively.

2.3 The Government

Our baseline assumption with respect to fiscal policy is the standard feature of NOEM DSGE models: the government of each country consumes an exogenously given amount of domestic goods only:

$$G = \left[\left(\frac{1}{n} \right)^{1/\epsilon} \int_0^n g(h)^{\frac{\epsilon-1}{\epsilon}} dh \right]^{\frac{\epsilon}{\epsilon-1}} \quad G^* = \left[\left(\frac{1}{1-n} \right)^{1/\epsilon} \int_n^1 g^*(f)^{\frac{\epsilon-1}{\epsilon}} df \right]^{\frac{\epsilon}{\epsilon-1}}.$$

As a consequence, public demand for brands h and f is equal to:

$$g(h) = \left(\frac{p(h)}{P_H} \right)^{-\epsilon} G \quad g^*(f) = \left(\frac{p^*(f)}{P_F^*} \right)^{-\epsilon} G^*.$$

The government of domestic country can finance its own consumption G_t by levying lump-sum taxes T_t to domestic households and by issuing nominal debt denominated in local currency $B_{H,t}^n$. This implies the following budget constraint for the domestic fiscal authority, in real per-capita terms (let $B \equiv B^n/P$):

$$B_{H,t} = (1 + r_{t-1}) \frac{P_{t-1}}{P_t} B_{H,t-1} + Z_t, \quad (9)$$

where Z_t denotes the domestic real primary deficit, defined as

$$Z_t \equiv \frac{P_{H,t}}{P_t} G_t - T_t. \quad (10)$$

2.4 The Linear Model.

We analyze a first-order approximation of the model's equilibrium conditions around a zero-inflation/zero-deficit steady state. Let $x_t \equiv \log X_t - \log X$ denote the log-deviation of variable

X from its steady state.¹³ Moreover, let $x^W \equiv nx^H + (1-n)x^F$ denote world aggregates and $x^R \equiv x^H - x^F$ denote H relative aggregates. We also set $s_c \equiv Y/C$.

Our model economy can be summarized by the following linear equations. An aggregate labor supply relates each country's hours worked to domestic consumption and the real wage:

$$c_t + \varphi n_t = w_t - p_t, \quad (11)$$

where φ is the inverse Frisch-elasticity of labor supply. Nominal interest rates are linked through a standard Uncovered Interest-rate Parity (UIP) condition

$$E_t \Delta e_{t+1} = r_t - r_t^*, \quad (12)$$

which, coupled with the Law of One Price and unbiased consumption bundles, implies

$$r_t - E_t \pi_{t+1} = r_t^* - E_t \pi_{t+1}^*, \quad (13)$$

in which $\pi_t \equiv \log(P_t/P_{t-1})$ and $\pi_t^* \equiv \log(P_t^*/P_{t-1}^*)$ are the CPI-based inflation rate for country H and F , respectively.

Net foreign assets α , expressed in terms of country H 's position, evolve as a function of consumption differential and the terms of trade:

$$\alpha_t = \frac{1}{\beta} \alpha_{t-1} + (\theta - 1)(1 - n)s_t - (1 - n)c_t^R. \quad (14)$$

The dynamics of net foreign assets with respect to the terms of trade are the result of two competing effects. On the one side, a depreciation of s_t deteriorates the current account because it reduces the real value of domestic production, relative to absorption (negative absorption effect: $-(1 - n)s_t$). On the other side, a deterioration of the terms of trade makes domestic goods more competitive in the international markets, and imply a switch towards home goods and a consequent improvement in net foreign asset holdings (positive switching effect: $\theta(1 - n)s_t$). As long as Home and Foreign goods are substitute in the utility of consumers ($\theta > 1$) the positive switching effect dominates and a deterioration of the terms of trade implies a current account surplus.

Let $\pi_{i,t} \equiv \log(P_{i,t}/P_{i,t-1})$ denote the PPI-based inflation rate for country i . The terms of trade, then, evolve according to:

$$s_t = s_{t-1} + \Delta e_t + \pi_{F,t} - \pi_{H,t}. \quad (15)$$

¹³Exceptions are $g_t \equiv \frac{G}{Y} \log(G_t/G)$, $\tau_t \equiv \frac{T}{Y} \log(T_t/T)$, and z_t , ω_t , and $b_{i,t}$ which, given the assumption of zero-primary deficit in steady state, we define as $z_t \equiv Z_t/C$, $\omega_t^i \equiv \Omega_t^i/C$ and $b_{i,t} \equiv B_{i,t}/C$.

Public debt, in country H , follows the linearized law of motion:

$$b_{H,t} = \frac{1}{\beta} b_{H,t-1} + z_t, \quad (16)$$

where the real primary deficit equals:

$$z_t = s_c(g_t - \tau_t) - (s_c - 1)(1 - n)s_t \quad (17)$$

The state equations for domestic, world and relative consumption read:

$$c_t = E_t c_{t+1} - (r_t - E_t \pi_{t+1} - \varrho) + \sigma \beta \omega_t \quad (18)$$

$$c_t^W = E_t c_{t+1}^W - (r_t^W - E_t \pi_{t+1}^W - \varrho) + \sigma b_t^W \quad (19)$$

$$c_t^R = E_t c_{t+1}^R + \sigma b_t^R + \frac{\sigma}{1-n} \alpha_t \quad (20)$$

in which ϱ is the steady-state real interest rate, and relative public debt evolves according to $b_t^R = \frac{1}{\beta} b_{t-1}^R + z_t^R$.

On the supply side, Calvo price-setting implies two NKPC of the usual kind:

$$\pi_{H,t} = \beta E_t \pi_{H,t+1} + \zeta m c_t, \quad (21)$$

$$\pi_{F,t} = \beta E_t \pi_{F,t+1} + \zeta^* m c_t^*, \quad (22)$$

in which $\zeta \equiv \frac{(1-\vartheta)(1-\beta\vartheta)}{\vartheta}$, $\zeta^* \equiv \frac{(1-\vartheta^*)(1-\beta\vartheta^*)}{\vartheta^*}$, and the real marginal costs, expressed in terms of aggregate and relative variables, follow:

$$m c_t = \frac{s_c + \varphi}{s_c} c_t^W + (1-n)c_t^R + (1-n) \frac{s_c + \varphi \theta}{s_c} s_t + \varphi g_t \quad (23)$$

$$m c_t^* = \frac{s_c + \varphi}{s_c} c_t^W - n c_t^R - n \frac{s_c + \varphi \theta}{s_c} s_t + \varphi g_t^*. \quad (24)$$

2.5 Parameterization

We parameterize the model on a quarterly frequency, following previous studies and convention, and consistently with Di Giorgio and Nisticò (2013). Specifically, the steady-state net quarterly interest rate ϱ was set at 0.01, implying a long-run real annualized interest rate of 4%.¹⁴ The rate of replacement γ was set equal to 0.1, consistently with the evidence for the U.S. recently provided, in a related framework, by Castelnuovo and Nisticò (2010). In order to meet the steady-state restrictions, the intertemporal discount factor β was set at 0.99. The

¹⁴Since we focus on a symmetric steady state the values reported in the text are meant to refer to both countries as well as to the world economy.

Table 1: Stochastic properties of the fiscal shocks.

Shock	ρ_g	σ_g	$Adj.R^2$	Shock	ρ_τ	σ_τ	$Adj.R^2$
g	0.692 (11.164)	0.0066	0.4674	τ	0.768 (14.008)	0.0192	0.5802
g^*	0.638 (10.056)	0.0041	0.4159	τ^*	0.905 (25.269)	0.0105	0.8181

degree of monopolistic competition is taken from Rotemberg and Woodford (1997), $\epsilon = 7.66$, which implies an average markup of 15%. In line with estimates provided for the U.S. by Smets and Wouters (2007), we set the Calvo parameter at 0.75, implying that prices are revised on average once a year. Parameter s_c was set equal to 1.25, implying a ratio of public consumption to output of about 20%. As to the steady-state Frisch elasticity of labor supply, $1/\varphi$, there is wide controversy about the value that should be assigned to this parameter. The empirical microeconomic literature suggests values for φ ranging from .1 to .5 (see Card, 1994, for a survey), while business cycle literature mostly uses values greater than 1 (see e.g. Cooley and Prescott, 1995). We choose a baseline value of $\varphi = 0.5$, consistently with the microevidence. The elasticity of substitution between Home and Foreign goods was set equal to $\theta = 1.5$, which implies that home and foreign goods are substitute in the utility function of consumers. Finally, we parameterize the dimension of the Home country n to 0.6, roughly consistent with the ratio of the U.S. GDP to the one of the Euro-10.

To calibrate persistence and volatility of the fiscal shocks ($g_t = \rho_g g_{t-1} + u_{g,t}$ and $\tau_t = \rho_\tau \tau_{t-1} + u_{\tau,t}$), we estimate an independent AR(1) process for each shock, using quarterly HP-filtered data on government consumption and real personal taxes in the U.S. and the Euro Area for the available sample (1970:1 to 2005:4). The values obtained are reported in Table 1. Given the structural symmetry of our framework, we follow Backus, Kehoe and Kydland (1992), among the others, and use for the benchmark simulation a symmetrized version of our estimates. We therefore calibrate $\rho_g = \rho_g^* = 0.665$, $\sigma_g = \sigma_g^* = 0.0054$, $\rho_\tau = \rho_\tau^* = 0.836$ and $\sigma_\tau = \sigma_\tau^* = 0.0148$.

3 Fiscal Shocks and the Exchange Rate

In this section we study the dynamic response of the economy to fiscal shocks, and focus particularly on the role of endogenous monetary and fiscal policy in shaping the short-run and long-run response of the exchange rate.

As to economic policy, we assume in each country the presence of two policy makers: a Central Bank and a fiscal authority. The former sets the domestic nominal interest rate and the latter either public consumption or the level of domestic taxes.¹⁵

Monetary policy follows a simple instrument rule of the kind introduced by Taylor (1993), where the nominal interest rate responds to deviations of the GDP deflator $\pi_{H,t}$ and the domestic output gap from the zero targets:

$$r_t = \varrho + \phi_\pi \pi_{H,t} + \phi_x x_t + u_{m,t}, \quad (25)$$

in which $u_{m,t}$ are white noises capturing pure monetary policy shocks. In the simulation analysis below, we vary the response coefficients, to assess how their values affect the exchange-rate response to fiscal shocks. As baseline calibration for the response coefficients and the volatility of monetary policy shocks, we use the following (symmetrized) values, consistent with the estimates provided for the U.S. and the Euro Area by Smets and Wouters (2003, 2007): $\phi_\pi = \phi_\pi^* = 2$, $\phi_x = \phi_x^* = 0.1$, $\sigma_m = \sigma_m^* = 0.0016$.

As to fiscal policy, we consider several alternative specifications, focusing only on “passive” (in the sense of Leeper, 1991) or implementable (in the sense of Schmitt-Grohe and Uribe, 2006) fiscal rules. The first specification considers the case in which the government targets a balanced budget in every period:

$$z_t = 0. \quad (26)$$

In this case, an increase in public consumption is, financed through an equivalent increase in domestic taxes.

Given the non-Ricardian structure of our model, we can also analyze alternative fiscal regimes which do not imply a balanced budget in every period. In particular, one alternative regime has real taxes follow an exogenous, stationary autoregressive process:

$$\tau_t = \rho_\tau \tau_{t-1} + (1 - \rho_\tau) \xi_b b_{t-1} + u_{z,t}, \quad (27)$$

where a drift adjusting to the stock of outstanding debt insures equilibrium determinacy ($\xi_b = (\varrho/s_c)$) and fiscal solvency. In this regime, therefore, an increase in public consumption is financed through new debt.

The third specification considers the case in which governments set their primary deficit following a counter-cyclical feedback rule of the kind:

$$z_t = -\mu_b b_{t-1} - \mu_x x_t + u_{z,t}. \quad (28)$$

¹⁵In the following, we assume that the foreign authorities behave symmetrically.

This specification was analyzed by recent empirical and theoretical literature (see Galí and Perotti, (2003) and Di Giorgio and Nisticò, (2013)), and encompasses different fiscal regimes, depending on the specific values for the response coefficients.

If the response coefficients on the output gap are zero and those on the stock of debt as low as needed to ensure determinacy, this fiscal rule corresponds to a passive fiscal regime like (27), and, therefore, an increase in public consumption is simply and entirely financed through new debt.

Non-zero response coefficients, on the other hand, imply that the fiscal regime actively reacts to the business cycle and the dynamics of the public debt, potentially affecting the transmission mechanism of any kind of shock. In this scenario, we calibrate the response coefficients with the following (symmetrized) values, consistent with the estimates provided by Galí and Perotti (2003) for the U.S. and the group of EMU10: $\mu_x = \mu_x^* = 0.7$, $\mu_b = \mu_b^* = 0.1$.

3.0.1 The Dynamic Response to Fiscal Shocks

Here we evaluate the dynamic effects of a wide range of fiscal policy shocks, and compare the implications for the exchange rate with those discussed in the related literature.

First, in Figures 1 and 2 we examine the effects of a balanced-budget expansion in public consumption.

When government spending is home biased, an increase in g tends to raise marginal costs at home relatively more than abroad (equations (23)–(24)), thereby triggering an increase in relative interest rates to offset the inflationary pressures. This results in a short-run appreciation of the nominal exchange rate, which worsens the external position. As a consequence, relative consumption falls (equation (20)). In our setting, therefore, the final short-run effect on relative consumption and net foreign assets are the same as in Ganelli (2005b) and Obstfeld–Rogoff (1995), while the effects on the exchange rate are reversed. This effects are shown by the solid lines in Figure 1.

This difference in results is due to the joint presence of home-biased public consumption and endogenous monetary policy. To isolate the effects of these two additional assumptions, the dashed line in Figure 1 displays the dynamic response of our economy when monetary policy is exogenous in real terms, meaning that the real interest rate does not respond to either inflation, nor the output gap.¹⁶

¹⁶This corresponds to calibrating $\phi_\pi = 1$ and $\phi_x = 0$, in equation (25). In order for the rational expectation equilibrium to be determinate, we cannot impose a fully exogenous monetary policy, i.e. a *nominal* interest-rate peg. Notice, however, that a *nominal* interest-rate peg is not necessary to characterize exogenous monetary policy in this framework, as both inflation and real activity respond to the *real* interest rate.

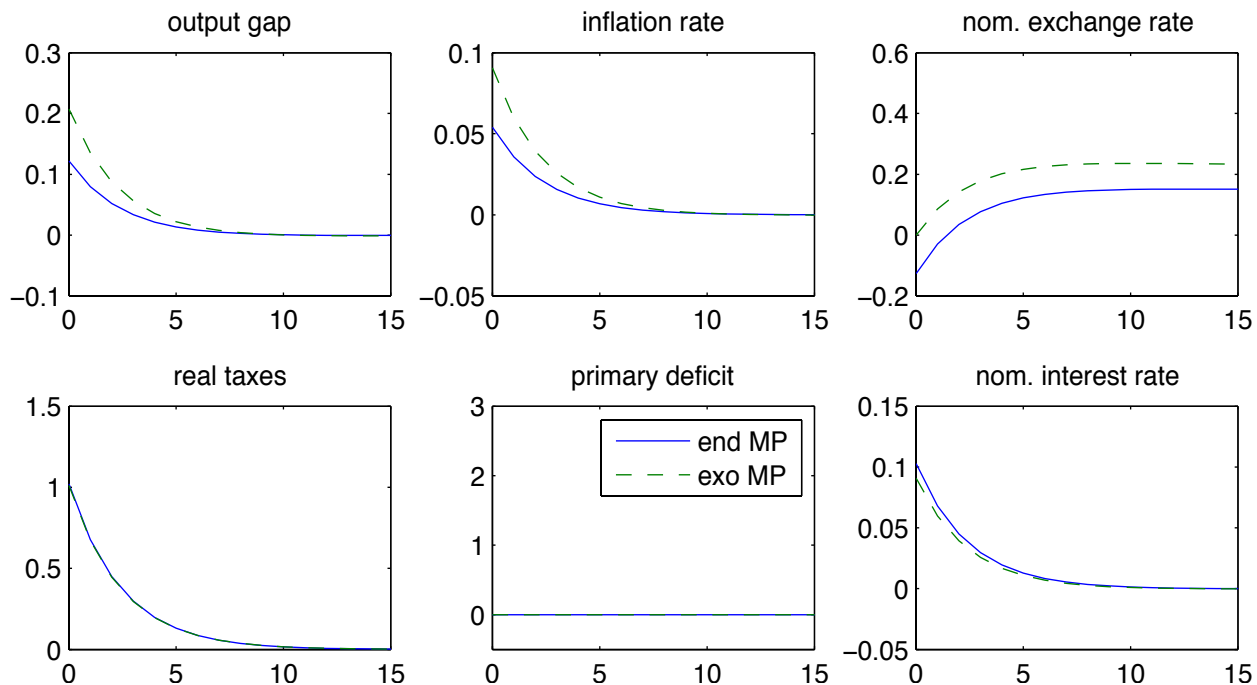


Figure 1: Response of selected variables to a 1%, balanced-budget increase in public consumption. Solid line: endogenous monetary policy. Dashed line: exogenous monetary policy.

The dashed line in Figure 1 shows that when monetary policy is exogenous and government spending is fully biased towards domestic products, the nominal exchange rate does not move at all in the short-run, in response to a balanced-budget fiscal shock. This occurs because with exogenous monetary policy, the central bank does not react to an increase in marginal cost. As a consequence of that, inflation on impact is higher than in the scenario with endogenous monetary policy. The higher inflationary pressures induced in the home country sets the domestic price level on a higher path relative to foreign one. In the long-run, accordingly, when both inflation rates are back to zero, this difference in the price levels remains and is responsible for the permanent depreciation of the nominal exchange rate. Since the expansion on public spending falls entirely on domestic goods and domestic consumers finance it entirely with taxes, domestic and foreign consumption do not react, and the exchange does not move in the short run. This is also the quasi-neutrality result discussed in Ganelli (2005a), where however, the key role of exogenous monetary policy was not identified.

Figure 2 shows the role played by the composition of public consumption. The solid line shows the response to a balanced-budget increase in government spending, when the latter is fully biased towards domestically-produced goods, as in Ganelli (2005a), while the dashed line corresponds to the case discussed in Obstfeld–Rogoff (1995) and Ganelli (2005b), in which public consumption is uniformly distributed across all goods produced in the international

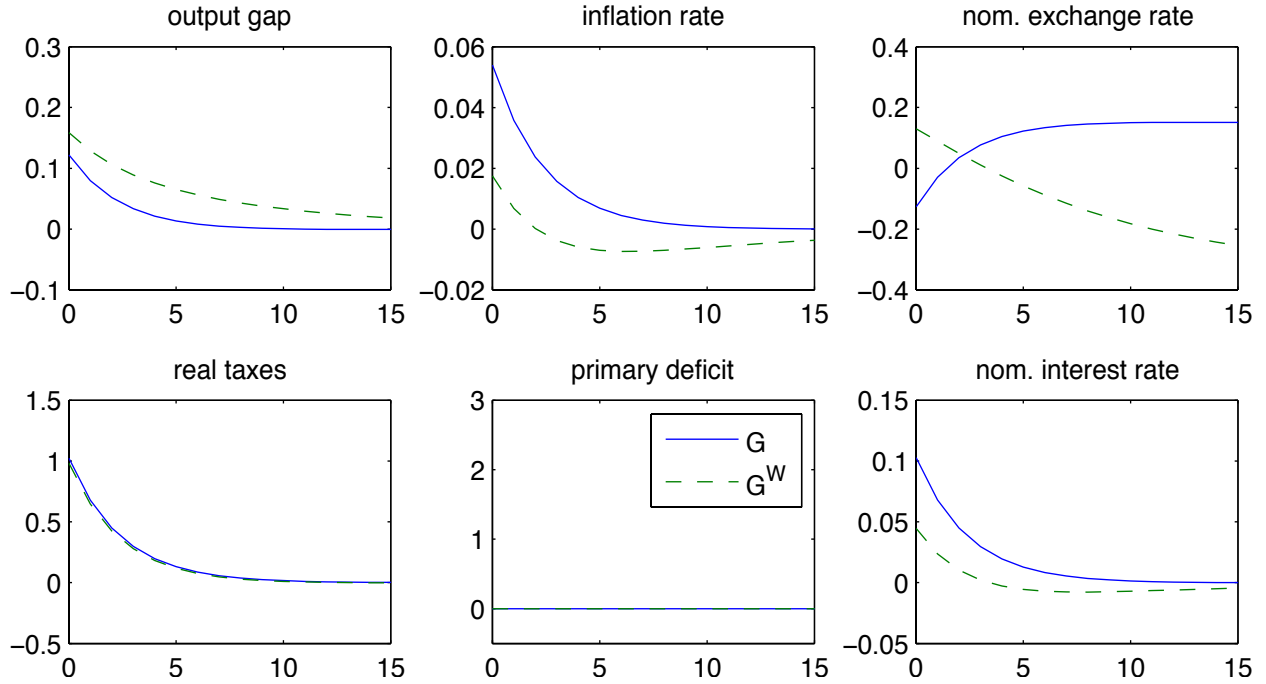


Figure 2: Response of selected variables to a 1%, balanced-budget increase in public consumption. Solid line: home-biased public consumption. Dashed line: uniformly-distributed public spending.

economy. The top-right panel of Figure 2 displays the result: if government spending is uniformly distributed across domestic and foreign goods, the exchange rate depreciates in the short run, while it appreciates in the long-run.

Interestingly, this result is qualitatively the same of the *Redux* model, but the transmission mechanism is radically different. In Obstfeld–Rogoff (1995) an increase in public consumption crowds out consumption both at home and abroad; however, since monetary policy is exogenous and the fiscal expansion is financed by an increase of domestic taxes only, domestic consumption falls more than foreign one, and the ensuing excess supply of money is higher at home than abroad. The exchange rate therefore depreciates. In our model, instead, the transmission mechanism works through marginal costs. An increase in public spending that is directed towards both home and foreign goods has positive effects on the marginal costs of both countries. However, since the fiscal expansion is financed by an increase in domestic taxes only, domestic consumption falls more than foreign one and relative consumption therefore falls. Equations (23)–(24) then imply that foreign marginal costs increase more than domestic ones, triggering a relatively stronger response by foreign monetary policy. Contrary to the case of home-biased public spending, therefore, the relative interest rate falls, thereby depreciating the exchange rate.¹⁷ This result is independent, from

¹⁷As shown by the other panels in Figure 2, relative to the case of home-biased public spending, the weaker inflationary pressures that arise in the home country translate into a lower actual inflation rate, a milder

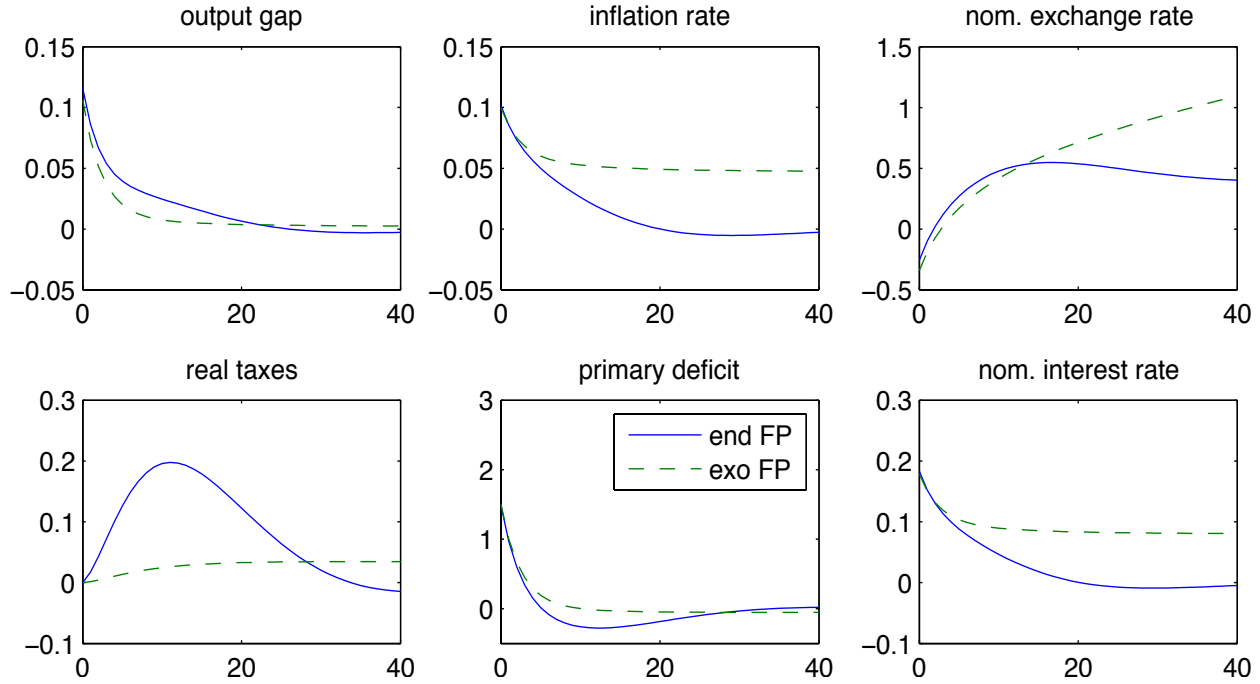


Figure 3: Response of selected variables to a 1%, debt-financed increase in public consumption. Solid line: endogenous fiscal policy. Dashed line: exogenous fiscal policy.

a qualitative perspective, on the assumption on whether monetary policy is endogenous or not, because when public consumption is uniformly distributed among domestic and foreign goods, a government spending shock acts as a global shock. As a consequence, marginal costs and the nominal interest rates in both countries move symmetrically.

The long-run effects on the nominal exchange rate also depend on the degree of home bias in government consumption. If public spending is completely home-biased, the on-impact increase in relative marginal costs sets domestic prices on a higher path, which in the long-run translates into a permanently depreciated exchange rate. On the contrary, if public spending is uniformly distributed across domestic and foreign goods, the relative marginal costs actually fall, as discussed above. The domestic price level therefore jumps on a lower path, which in the long-run translates into a permanently appreciated exchange rate.

All the effects discussed so far are clearly independent of the overlapping-generation structure of our DNK model, since the balanced-budget specification of the fiscal expansions considered does not have any effect on the accumulation of public debt and therefore does not trigger wealth effects any different from the representative-agent case. Our overlapping-generation structure, however, allows us to use our framework to simulate also other kinds of fiscal shocks, and study in particular the response of the exchange rate.

increase in the domestic interest rate and, thereby, a higher output gap.

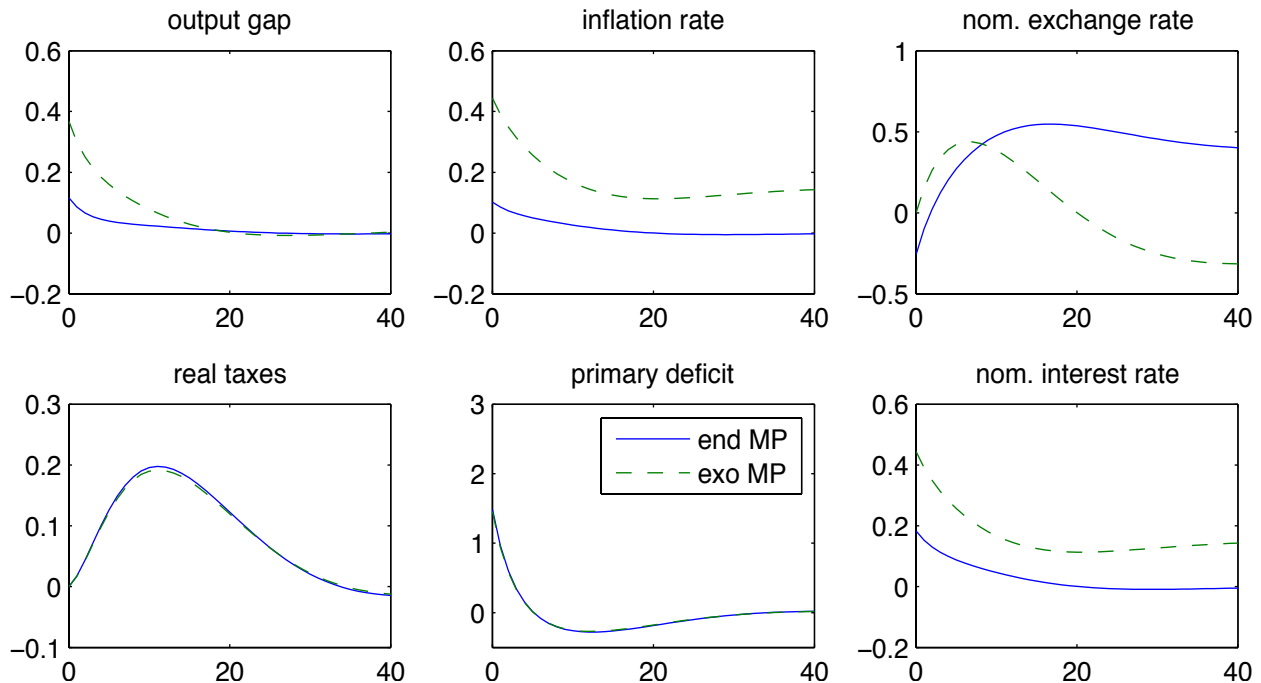


Figure 4: Response of selected variables to a 1% increase in public spending. Solid line: endogenous monetary policy. Dashed line: exogenous monetary policy.

Using a perpetual-youth version of the *Redux* model, Ganelli (2005b) argues that the effects on the exchange rate of an increase in public spending depend on how the expansion is financed: a balanced-budget (tax-financed) expansion would imply an on-impact depreciation through a reduction in relative consumption and an increase in domestic prices, while the effects of a debt-financed expansion would be ambiguous because a tax-cut tends to appreciate the exchange rate on impact. This result follows directly from the assumption that public expenditure is uniformly distributed over domestic and foreign goods, so that an increase in public expenditure acts as a global demand shock.

In our framework with complete home bias, a debt-financed expansion in public consumption unambiguously induces an appreciation of the nominal exchange rate on impact and a depreciation in the transition, as shown by Figure 3.

This result is independent of the specification of fiscal policy, whether it is completely exogenous and real taxes follow (27) – dashed line in the figure – or it cares about the business cycle and the stock of debt, by adjusting the primary deficit according to (28) – solid line.¹⁸

Notice that, again, endogenous monetary policy plays an important role in shaping the response of the exchange rate to fiscal shocks. This is shown by Figure 4, where fiscal policy follows the feedback rule of equation (28). When monetary policy is exogenous, indeed,

¹⁸In the case of exogenous fiscal policy, moreover, the long-run response of the exchange rate is a stronger depreciation, as it also reflects the accumulation of net foreign liabilities implied by the lack of fiscal discipline.

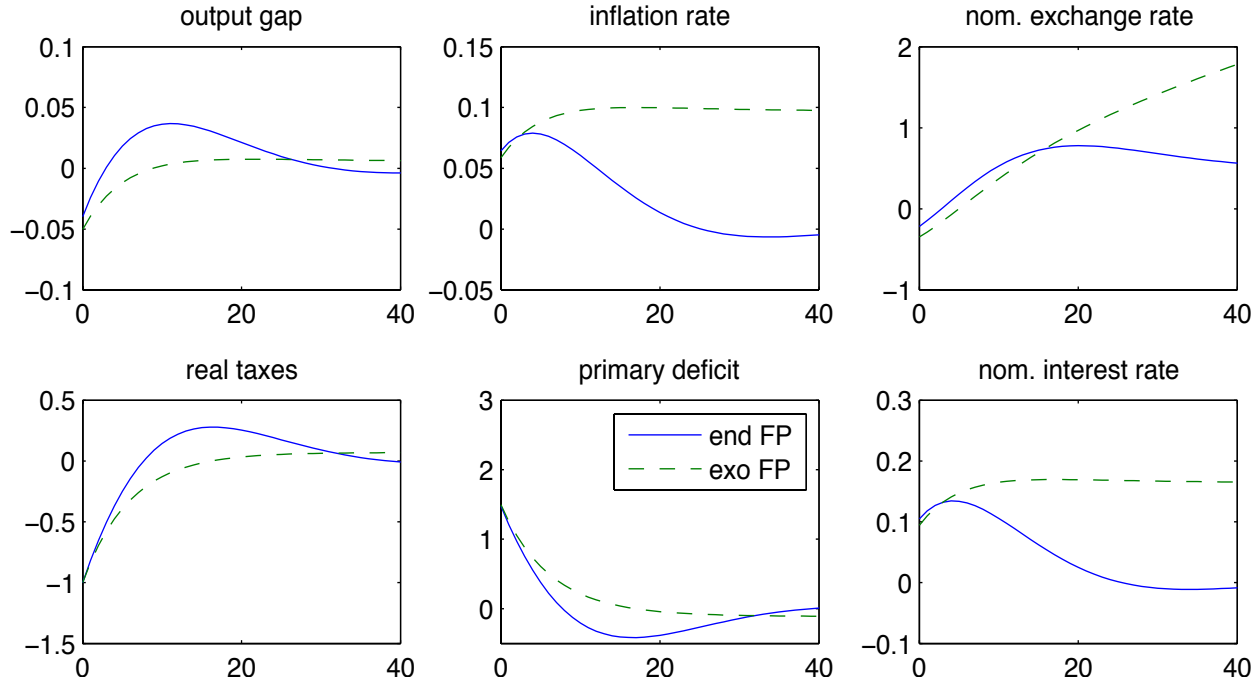


Figure 5: Response of selected variables to a 1% tax cut. Solid line: endogenous fiscal policy. Dashed line: exogenous fiscal policy.

the quasi-neutrality result holds and there is no short-run response of the exchange rate to a tax cut. Under endogenous monetary policy, however, the exchange rate appreciates unambiguously.¹⁹

A debt-financed increase in government spending is equivalent to the combination of a balanced-budget fiscal expansion (Figures 1 and 2) and a tax cut. The latter is analyzed in Figure 5 under different fiscal regimes. The dashed line shows the dynamic response when fiscal policy is completely exogenous, and real taxes follow (27), while the solid line shows the case in which fiscal policy adjusts the primary deficit according to the feedback rule of equation (28). In both scenarios, a tax cut induces a fiscal deficit and the issuance of new debt to finance it. On impact, the world and relative stocks of outstanding debt increase, as well as world and relative consumption, through wealth effects. The increase in relative consumption then induces upward pressures on relative marginal costs, which require an increase in relative nominal interest rates and the ensuing appreciation in the nominal exchange rate.

It is now straightforward why a debt-financed expansion in public spending unambiguously appreciates the exchange rate: both a balanced-budget expansion in public consump-

¹⁹Notice that in this case, the specification of monetary policy also affects the long-run response of the exchange rate: under endogenous monetary policy the long-run exchange rate depreciates, as before, while it appreciates when monetary policy is exogenous.

tion and a tax cut induce an appreciation. Under the commonly used assumption of home biased government consumption and endogenous monetary policy, therefore, it is possible to perfectly reconcile the NOEM implications with the traditional Mundell-Fleming result: a fiscal expansion leads to an appreciation of the exchange rate on impact regardless of how this expansion is financed.

4 Concluding Remarks

This paper contributes to the theoretical literature about the effects of fiscal shocks to the exchange rate by showing that it is critically related to the monetary policy regime and public spending composition. The analysis is carried out in a two-country DSGE model with perpetual youth, where Ricardian equivalence does not hold. The latter element allows us to evaluate different financing schemes for fiscal expansions.

First, when government consumption is unbiased, a balanced-budget fiscal expansion induces an exchange rate depreciation. This result was predicted in the *Redux* model, where depreciation occurs through a reduction in money demand due to a negative wealth effect. In our paper, the mechanism at work in our paper is completely different and operates through an asymmetric response of firms' marginal costs at Home and abroad and, in turn, lower response by domestic monetary policy.

Second, when government consumption is home-biased and the Taylor principle holds, the exchange rate appreciates. In this case a domestic fiscal shock implies higher relative marginal costs, which trigger an increase in relative interest rates to offset the inflationary pressures, leading to a short-run appreciation of the nominal exchange rate. By assuming realistic features such as Taylor rules and home bias in public consumption, our model exhibits the same qualitative results of both the static Mundell-Fleming framework and other NOEM-DSGE model, such as Corsetti and Pesenti (2001) and Devereux and Engel (2003).

Finally, we show that these results hold regardless of how the fiscal expansion is financed: also a debt-financed fiscal expansion leads to an exchange rate appreciation if the Taylor principle holds and public spending is home-biased.

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