Government Spending, Downward Nominal Wage Rigidity, and Exchange Rate Dynamics*

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Abstract

In this paper, we show that government spending impacts the real exchange rate asymmetrically, depending on whether spending is raised or cut. We first consider an extension of the small open economy model put forward by Schmitt-Grohé and Uribe (2016) in order to illustrate the mechanism. The key feature of the model is that wages are downwardly rigid and that monetary policy is generally unable to fully offset the effect of this nominal rigidity. We show that an expansion of government spending causes a real appreciation, while a reduction of government spending causes a real depreciation. But, importantly, the depreciation is generally smaller than the appreciation. In a second step, we estimate local projections using quarterly data for 38 advanced and emerging market economies, covering the period from the early 1990s to 2017. We find that positive government spending shocks appreciate the real exchange rate. Negative spending shocks have no significant effect. This result is robust across alternative identification schemes.

Keywords: downward nominal wage rigidity, government spending shocks, real exchange rate

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1 Introduction

What is the impact of government spending shocks on the real exchange rate? As we address this question, we focus on a novel aspect that has been ignored by a large recent literature that we review briefly below. We explore whether the real exchange rate responds asymmetrically to government spending innovations depending on whether they raise or lower spending. This focus seems warranted in light of a simple theoretical consideration. In an open economy model of the type put forward in Schmitt-Grohé and Uribe (2016), where nominal wages are upwardly flexible, but downwardly rigid, the real exchange rate is bound to respond asymmetrically to government spending shocks unless monetary policy is able to undo the effect of nominal rigidities altogether. This is only possible if the central bank engineers a specific adjustment of the exchange rate which may be difficult to bring about in practice, either because of domestic or external constraints.

In the first part of our analysis, we explore this conjecture formally. We extend the original model of Schmitt-Grohé and Uribe (2016) along two dimensions. First, we introduce government spending in the form of the government consuming a share of nontradable goods. In order to finance its purchases, it levies lump-sum taxes so that the government budget is balanced at all times. Second, we analyze the effect of a somewhat richer menu of monetary and exchange rate policies. We consider the limiting case of a pure float and a pure peg, as well as an intermediate regime in which monetary policy allows for limited exchange rate flexibility only. Otherwise, our setup mimics the original model.

We find our conjecture fully borne out as we solve the model. Consider first the benchmark of a monetary policy regime that uses the nominal exchange rate to stabilize employment. In doing so, it offsets completely the effect of the nominal wage rigidity. In this case, an increase of government spending appreciates the real exchange rate in the same way as a decrease induces it to depreciate. This real exchange rate reaction induces a change in the firms' marginal costs and induces an expenditure switch to maintain a full-employment equilibrium. In contrast, under a currency peg the response of the real exchange rate is asymmetric. Starting at a situation of full employment, an increase of government spending does not alter production. Instead, the real exchange rate appreciates, as the non-binding nominal rigidity allows wages and therefore prices to increase. This appreciation in turn crowds out private consumption completely. The resulting government spending multiplier on output is zero. The nature of the adjustment differs in case of a contractionary cut in government spending. In this case the wage constraint becomes binding so that real wages cannot fall sufficiently in the face of reduced demand for nontradable goods. As the nominal exchange rate is pegged, it as well cannot adjust to lower firms' costs. As a consequence, the real exchange rate does not fall sufficiently. To the extent that the real exchange rate depreciates somewhat, private consumption is crowded in, but this effect is insufficient to stabilize output at its full-employment equilibrium.

We also perform a quantitative model analysis. We show that the asymmetry of the exchange rate response to government spending shocks is indeed sizeable unless the exchange rate is completely flexible. There is strong appreciation in response to higher spending, but weak depreciation in response to reduced spending. We also find that the output multiplier differs strongly depending on whether government spending is raised or cut.

In the second part of the paper, we turn to the data. We rely on the database for fiscal shocks assembled by Born et al. (forthcoming). It contains quarterly time series data for government spending shocks for a panel of up to 38 countries including both advanced and emerging market economies. The data runs from the early 1990s to the end of 2017. Importantly, the database includes two distinct shock series, which are based on alternative strategies to compute surprise innovations of government spending. First, as in Ramey (2011), government innovations are measured as the difference between actual government spending growth and the forecast of professional forecasters. Second, as in Blanchard and Perotti (2002), government spending innovations are measured by means of a forecast error derived from a vector autoregression model.

We estimate the response of the real exchange rate and other variables to both shock series in isolation. For this purpose we rely on local projections à la Jordà (2005). This approach is particularly suitable for the purpose at hand, since it allows us to estimate responses for positive and negative as well as large and big shocks separately. Again, we find our initial conjecture fully borne out by the data. In response to higher government spending the real exchange rate appreciates, while it does not significantly depreciate in response to a government spending cut. This finding is robust across alternative specifications and, in particular, it holds for both spending shock series under consideration.

There are several recent studies which assess the effect of government spending shocks on the real exchange rate. While standard business cycle models predict government spending to appreciate the real exchange rate, this prediction is not necessarily borne out by the data. A large number of studies has obtained conflicting results (Corsetti et al., 2012a; Ilzetzki et al., 2013; Kim and Roubini, 2008; Miyamoto et al., 2018; Monacelli and Perotti, 2010; M. O. Ravn et al., 2012; Steinsson, 2008).[1] However, these studies do not allow for asymmetric responses to spending increases and spending cuts which, in light of our result, may go some way towards an explanation of the conflicting results.

[1] See S. H. Ravn and Jørgensen (2018) for a potential resolution to conflicting results for the inflation response after government spending shocks.

Our paper also relates to studies which have focused on other nonlinearities in the fiscal transmission mechanism. This includes the role of the business cycle and the zero lower bound on interest rates (Auerbach and Gorodnichenko, 2012; Christiano et al., 2011; Ramey and Zubairy, 2018) or sovereign risk (Born et al., forthcoming; Corsetti et al., 2013a). Shen and Yang (2018) focus on the role of downward nominal wage rigidity in giving rise to state dependent multipliers in a closed economy. Other studies have highlighted features of particular relevance for the fiscal transmission mechanism that are specific to open economies such as the role of the exchange rate regime (Born et al., 2013; Corsetti et al., 2013b, 2012b; Erceg and Lindé, 2012; Ilzetzki et al., 2013) or sudden stops (Liu, 2018).[2] Another relevant study is Bianchi et al. (2018) on optimal fiscal policy under a currency peg in the presence of downward wage rigidity and sovereign risk. Lastly, Crucini et al. (2014) investigate the role of sticky wages in accounting for real exchange rate dynamics, but they do not examine the asymmetric effects of government spending.

The remainder of the paper is organized as follows: Section 2 presents the baseline model. Section 3 illustrates the transmission mechanism at work through the lens of a simple tractable version of the model. Section 4 discusses the parametrization and the quantitative results of our baseline model. Section 5 establishes empirically that the model prediction holds up in the data – namely, that the appreciation of the exchange rate in response to spending increases is stronger than the depreciation in response to spending cuts in a sample of advanced and developing countries. Section 6 concludes.

2 Model

In this section, we describe a two-sector model of a small open economy, populated by a government, a representative household, and a representative firm. The small open economy can operate different exchange rate regimes. We build on Schmitt-Grohé and Uribe (2016)'s model with downward nominal wage rigidity and extend it by introducing fiscal policy. The model features a nontradable and a tradable sector. Production only takes place in the nontradable sector with labor being the only production factor. Markets are incomplete and there is trade in an internationally traded bond, denominated in foreign currency. Borrowing in the domestic economy is subject to a borrowing constraint.

[2] In the model of Liu (2018), government spending is also shown to impact the economy asymmetrically, depending on whether it is cut or raised.

2.1 Households

There is a representative household endowed with $\bar{h}$ hours of time. The household's preferences are given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{(g_t^N)^{1-\sigma_g}}{1-\sigma_g} \right] \tag{1}$$

where $\mathbb{E}_t$ is the conditional expectations operator, c_t denotes private consumption in period t, g_t^N denotes government consumption of nontradable goods, β is the discount factor, σ and σ_g are the inverse intertemporal elasticities of private and public consumption, respectively. The consumption good c_t is a CES aggregator $A(c_t^T, c_t^N)$ with elasticity of substitution $1/(\eta+1)$ between tradables (c^T) and nontradables (c^N) given by:

$$c_t = A(c_t^T, c_t^N) = \left[\omega (c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta} \right]^{-\frac{1}{\eta}}, \quad \eta > -1, \tag{2}$$

where $\omega \in (0,1)$ is a parameter governing the share of tradables in the consumption aggregate. Households can trade in one-period foreign bonds, which are denominated in units of tradables. The nominal budget constraint is given by:

$$\mathcal{E}_t \frac{b_{t+1}}{1+r_t} + P_t^T c_t^T + P_t^N c_t^N = \mathcal{E}_t b_t + P_t^T y_t^T + \phi_t + W_t h_t - \tau_t \tag{3}$$

where P_t^T and P_t^N denote the domestic currency price of tradable and nontradable goods, respectively, $\mathcal{E}_t$ is the nominal exchange rate defined as the domestic currency price of one unit of foreign currency, b_{t+1} denotes international bond holdings chosen at the beginning of time t, r_t is the world interest rate, W_t is the nominal wage, h_t denotes hours worked, ϕ_t denotes the representative firm's profits, defined below, and τ_t denotes lump-sum taxes levied by the government. The stochastic endowment of y_t^T follows an exogenous $AR(1)$-process with persistence ρ_y and shock standard deviation ε_y.

We assume that the law of one price holds for tradables and that the foreign currency price of tradables is normalized to unity, so that the nominal price of tradables is equal to the nominal exchange rate, $P_t^T = \mathcal{E}_t$. The representative agent faces a credit constraint that limits his total amount of debt not to exceed an exogenous debt limit $\bar{b}$:

$$b_{t+1} \geq -\bar{b}. \tag{4}$$

Let

$$p_t^N := \frac{P_t^N}{P_t^T}$$

denote the relative price of nontradables. The household's first order conditions are given by (2)-(4) and

$$p_t^N = \frac{A_2(c_t^T, c_t^N)}{A_1(c_t^T, c_t^N)} = \frac{1-\omega}{\omega}\left(\frac{c_t^T}{c_t^N}\right)^{1+\eta} \tag{5}$$

$$\lambda_t = U'(A(c_t^T, c_t^N))A_1(c_t^T, c_t^N) = \omega\left[\omega(c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta}\right]^{\frac{\sigma-1-\eta}{\eta}}(c_t^T)^{-\eta-1} \tag{6}$$

$$\lambda_t = \beta(1+r_t)\mathbb{E}_t\lambda_{t+1} + \mu_t \tag{7}$$

$$\mu_t \geq 0 \tag{8}$$

$$0 = \mu_t(b_{t+1} + \bar{b}) \tag{9}$$

as well as a suitable transversality condition for bonds. Here, λ_t/P_t^T and μ_t are the Lagrange multipliers associated with (3) and (4), respectively.

2.2 Downward nominal wage rigidity

As in Schmitt-Grohé and Uribe (2016), nominal wage rigidity takes the form

$$W_t \geq \gamma W_{t-1}, \tag{10}$$

where $\gamma > 0$ governs the degree of downward nominal wage rigidity. Note that in practice γ also incorporates things like trend inflation that we abstract from in the current model. The higher trend inflation, the lower γ would be.
Actual hours must satisfy

$$h_t \leq \bar{h} \tag{11}$$

at all times. Similarly, the following complementary slackness condition must hold for all dates and states:

$$(\bar{h} - h_t)(W_t - \gamma W_{t-1}) = 0. \tag{12}$$

This condition implies that in periods of unemployment ($h_t < \bar{h}$) the wage rigidity constraint is binding. When the wage constraint is not binding ($W_t > \gamma W_{t-1}$), the economy must be in full employment.

2.3 Firms

Nontraded output y_t^N is produced by competitive firms operating a production technology with labor only:

$$y_t^N = h_t^\alpha. \tag{13}$$

Firms choose the amount of labor input to maximize profits, given by:

$$\phi_t \equiv P_t^N y_t^N - W_t h_t. \tag{14}$$

The optimal choice of labor h_t is then defined by the first order condition:

$$p_t^N = \frac{W_t/\mathcal{E}_t}{\alpha h_t^{\alpha-1}}. \tag{15}$$

This equation is at the core of the model mechanism. To keep full employment, a negative demand shock to nontradables requires firms' costs to fall in order to shift the supply curve and thus the demand for labor input sufficiently.

Such a decrease in costs is passed on into price of nontradables and makes them more attractive relative to tradables, i.e. p_t^N falls. As equation (15) makes clear, firms' real cost consist of the wage in terms of tradables per unit of output. Thus, a decrease in real costs can be brought about by decreases in either the nominal wage or exchange rate devaluations.

2.4 Real exchange rate

The real exchange rate is defined as the ratio of the foreign consumer price index to the domestic consumer price index expressed in a common currency:

$$RER_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t}$$

where P_t^* denotes the nominal price of consumption in the foreign country in units of foreign currency and P_t denotes the nominal price of consumption in the domestic country in units of domestic currency. As shown by Schmitt-Grohé and Uribe (2017), there is a one-to-one relationship between the relative price of nontradables p_t^N and the real exchange rate RER_t. Using the fact that the aggregator function A is increasing, homogenous of degree one, and concave, we can rewrite the equilibrium condition (5) as

$$p_t^N = P\left(\frac{c_t^T}{c_t^N}\right)$$

where the function P is increasing. Under the assumptions that the law of one price holds for tradables and that the foreign relative price of the final consumption good in terms of tradables is constant and normalized to unity, we obtain

$$RER_t = A_1(P^{-1}(p_t^N), 1).$$

Under the functional forms assumed in this section, the real exchange rate is therefore calculated as

$$RER_t = \left[\omega^{\frac{1}{(1+\eta)}} + (1-\omega)^{\frac{1}{(1+\eta)}} (p_t^N)^{\frac{\eta}{(1+\eta)}}\right]^{\frac{-(1+\eta)}{\eta}}.$$

2.5 Fiscal policy

The government only consumes nontradable goods according to a balanced budget:

$$P_t^N g_t^N = \tau_t.$$

Government spending g_t^N follows an exogenous $AR(1)$-process with persistence ρ_g and shock standard deviation ε_g.

2.6 Market clearing and definition of equilibrium

Market clearing in the nontradable sector requires

$$y_t^N = c_t^N + g_t^N \tag{16}$$

at all times. Combining this condition, the production technology for nontradables, the household's budget constraint, the government's budget constraint, and the definition of firms' profits, we obtain the market clearing condition for the tradable sector:

$$c_t^T = y_t^T + b_t - \frac{b_{t+1}}{1+r_t} \tag{17}$$

which must hold at all times. We assume that the world interest rate is constant, that is

$$r_t = r \tag{18}$$

for all t.

Let $w_t \equiv W_t/\mathcal{E}_t$ denote the real wage in terms of tradables and $\epsilon_t \equiv \frac{\mathcal{E}_t}{\mathcal{E}_{t-1}}$ the gross rate of devaluation of the domestic currency. We can then express the equilibrium conditions in real terms:

Definition 1. *An equilibrium is defined as a set of stochastic processes* $\{c_t^T, h_t, b_{t+1}, w_t, \lambda_t, \mu_t,\}_{t=0}^{\infty}$ *satisfying*

$$c_t^T = y_t^T + b_t - \frac{b_{t+1}}{1+r} \tag{17}$$

$$\lambda_t = \omega\left[\omega(c_t^T)^{-\eta} + (1-\omega)(h_t^{\alpha} - g_t^N)^{-\eta}\right]^{\frac{\sigma-1-\eta}{\eta}}(c_t^T)^{-\eta-1} \tag{6'}$$

$$\lambda_t = \beta(1+r)\mathbb{E}_t\lambda_{t+1} + \mu_t \tag{7'}$$

$$b_{t+1} \geq -\bar{b} \tag{4}$$

$$\mu_t \geq 0 \tag{8}$$

$$0 = \mu_t(b_{t+1} + \bar{b}) \tag{9}$$

$$\frac{w_t}{\alpha h_t^{\alpha-1}} = \frac{1-\omega}{\omega}\left(\frac{c_t^T}{h_t^{\alpha} - g_t^N}\right)^{1+\eta} \tag{19}$$

$$w_t \geq \gamma\frac{w_{t-1}}{\epsilon_t} \tag{20}$$

$$h_t \leq \bar{h} \tag{11}$$

$$0 = (\bar{h} - h_t)\left(w_t - \gamma\frac{w_{t-1}}{\epsilon_t}\right) \tag{21}$$

given initial conditions $\{w_{-1}, b_0\}$*, exogenous stochastic processes* $\{y_t^T, g_t^N\}_{t=0}^{\infty}$*, and an exchange rate policy* $\{\epsilon_t\}_{t=0}^{\infty}$*.*

2.7 Exchange rate policy

Let denote the full-employment real wage by

$$w_t^f \equiv \frac{A_2(c_t^T, F(\bar{h}) - g_t^N)}{A_1(c_t^T, F(\bar{h}) - g_t^N)}F'(\bar{h}).$$

As proved by Schmitt-Grohé and Uribe (2016), any exchange rate policy satisfying

$$\epsilon_t \geq \gamma\frac{w_{t-1}}{w_t^f}$$

ensures full employment at all times. From this class of full-employment policies, the one that minimizes movements in the nominal exchange rate is given by

$$\epsilon_t = \max\left\{\gamma \frac{w_{t-1}}{w_t^f}, 1\right\},$$

so that the nominal exchange rate only varies when the full-employment wage falls below the lower bound γw_{t-1}. The policy therefore yields the minimum devaluation needed to maintain full employment during a crisis. The exchange rate policy we assume (as in Liu (2018)) can capture alternative exchange rate arrangements:

$$\epsilon_t = \max\left\{\gamma \frac{w_{t-1}}{w_t^f}, 1\right\}^{\phi_\epsilon}$$

with $\phi_\epsilon \in [0, 1]$. The case $\phi_\epsilon = 0$ implements a pure peg, whereas $\phi_\epsilon = 1$ corresponds to a pure float. In general, the smaller ϕ_ϵ, the less flexible the exchange rate.

3 Analytical Example

In this section, we consider a simplified version of the model in order to illustrate the mechanism which operates at the heart of the model. We study the adjustment to a one-time surprise government spending shock at time 0 where agents know that no further shocks will happen—an MIT shock. We will first show that, starting from a full-employment equilibrium, the real exchange rate response to cuts and increases in government spending is asymmetric depending on the exchange rate regime. We then show that the response of the economy to a government spending shock is state-dependent under a peg, i.e. the response differs whether the cut in spending happens in a state of slack or of full employment. We also derive a condition under which the asymmetric exchange rate response persists, even if the economy starts out in a state of slack.

3.1 A stylized model

We assume a simple preference and production structure with $U(c_t) = \ln(c_t)$ and $A(c_t^T, c_t^N) = c_t^T c_t^N$. The production function for nontradables is $F(h_t) = h_t$, so that the marginal product of labor is given by $F'(h_t) = 1$. Furthermore, assume that the endowment of tradables, y^T, and the world interest rate, r, are constant over time. Without loss of generality, we set $y^T = 1$. We also assume that wages are perfectly downward rigid, i.e. $\gamma = 1$. In this case, any contractionary shock is sufficient to induce the downward nominal wage rigidity constraint to become binding. Finally, we set $\bar{h} = 1$ and $\beta(1+r) = 1$ and abstract from the borrowing constraint that is required in the full model to induce a stationary ergodic asset distribution. Given the preferences and the functional forms above, we obtain the following equilibrium conditions:

$$c_t^T = 1 + b_t - \frac{b_{t+1}}{1+r} \tag{22}$$

$$y_t^N = h_t^N = c_t^N + g_t^N \tag{23}$$

$$\frac{1}{c_t^T} = \frac{1}{c_{t+1}^T} \tag{24}$$

$$p_t^N = \frac{A_2(c_t^T, h_t - g_t^N)}{A_1(c_t^T, h_t - g_t^N)} = \frac{c_t^T}{h_t - g_t^N} \tag{25}$$

$$p_t^N = \frac{w_t}{F'(h_t)} = w_t \tag{26}$$

$$RER_t = \frac{1}{p_t^N} \tag{27}$$

$$w_t \geq \frac{w_{t-1}}{\epsilon_t} \tag{28}$$

$$h_t \leq 1 \tag{29}$$

$$0 = (1 - h_t)\left(w_t - \frac{w_{t-1}}{\epsilon_t}\right) \tag{30}$$

$$w_t^f = \frac{c_t^T}{1 - g_t^N} \tag{31}$$

$$\epsilon_t = \max\left\{\frac{w_{t-1}}{w_t^f}, 1\right\}^{\phi_\epsilon} \tag{32}$$

$$0 = \lim_{j \to \infty} \left(\frac{1}{1+r}\right)^j b_{t+j} \ , \tag{33}$$

where (33) is the transversality condition. We now consider the effects of a negative and a positive government spending shock depending on the exchange rate arrangement. In particular, we focus on the two polar cases, namely the pure peg and the pure float. In both instances, we assume that, prior to the shock, the economy has been at the full-employment equilibrium with no outstanding debt, $b_0 = 0$, i.e. with policy choices $b_{t+1} = 0$, $c_t^T = y^T = 1$, $c_t^N = 1 - g$, where g denotes the fixed steady state value of government consumption, and $p_t^N = w_t = \frac{1}{1-g}$ for all $t < 0$. It is convenient to combine equations (25) and (26), as

$$w_t = \frac{c_t^T}{h_t - g_t^N}. \tag{34}$$

3.2 Negative government spending shock

The economy is subject to a negative government spending shock at time 0. Assume the following process for government spending:

$$g_t^N = \begin{cases} 0 < \underline{g} < g & \text{if } t = 0 \\ g & \text{if } t > 0. \end{cases} \tag{35}$$

Proposition 1. *Under a pure float, a one-time surprise negative government spending shock brings about real exchange rate depreciation on impact that maintains a full-employment equilibrium. In contrast, under a pure peg the real exchange rate does not depreciate and employment falls below its efficient level.*

Proof. The Euler equation (24) implies that tradable consumption is constant at its new value, i.e., $c_t^T = c_{t+1}^T$ for all $t \geq 0$. The resource constraint (22) then implies $b_t - \frac{b_{t+1}}{1+r} = b_{t+1} - \frac{b_{t+2}}{1+r}$ for all $t \geq 0$. Thus, if there is any increase in debt in one period, debt will keep increasing. This is a reflection of the well-known random walk property of consumption in this type of setup. Any increase in additional tradable consumption financed by debt persists in future periods and, given a constant endowment y^T, needs to be financed by further additional debt issuance. Because this continuing debt accumulation would violate the transversality condition (33), debt needs to be constant at its initial value of 0, i.e., $b_t = 0$[3] and $c_t^T = y^T = 1$ for all $t \geq 0$. In period 0, the nontradable resource constraint (23) implies $c_0^N = y_0^N - \underline{g}$, while equation (34) implies that the real wage is given by $w_0 = \frac{y^T}{h_0 - \underline{g}}$. Thus, we need to solve for nontradable output y_0^N and hours worked h_0, which both depend on the exchange rate arrangement.

Pure peg ($\phi_\epsilon = 0$): Conjecture that the economy is in a situation of unemployment with $h_0 < 1$. In this case the wage constraint (28) must be binding: $w_0 = \frac{w_{-1}}{\epsilon_0}$. But under the peg, the gross nominal exchange rate devaluation is given by $\epsilon_0 = 1$. Consequently, the real wage is given by $w_0 \overset{(34)}{=} \frac{y^T}{h_0 - \underline{g}} = \frac{y^T}{1-g} = w_{-1}$, which implies $1 - g = h_0 - \underline{g} < 1 - \underline{g}$. This in turn requires $g > \underline{g}$, which is true by assumption (35). This proves that $h_0 < 1$ indeed is the equilibrium employment level, which is associated with the output level $y_0^N = h_0 = \frac{y^T}{w_{-1}} + \underline{g} = 1 - (g - \underline{g})$.

Pure float ($\phi_\epsilon = 1$): Again conjecture that the economy is in a situation of unemployment with $h_0 < 1$. The gross nominal exchange rate devaluation follows from (32) as

[3] A different way to see this is to notice that this equation is an unstable homogenous second-order difference equation with roots $(1 + r)$ and 1. Given b_0 and the transversality condition, the trivial solution is only one.

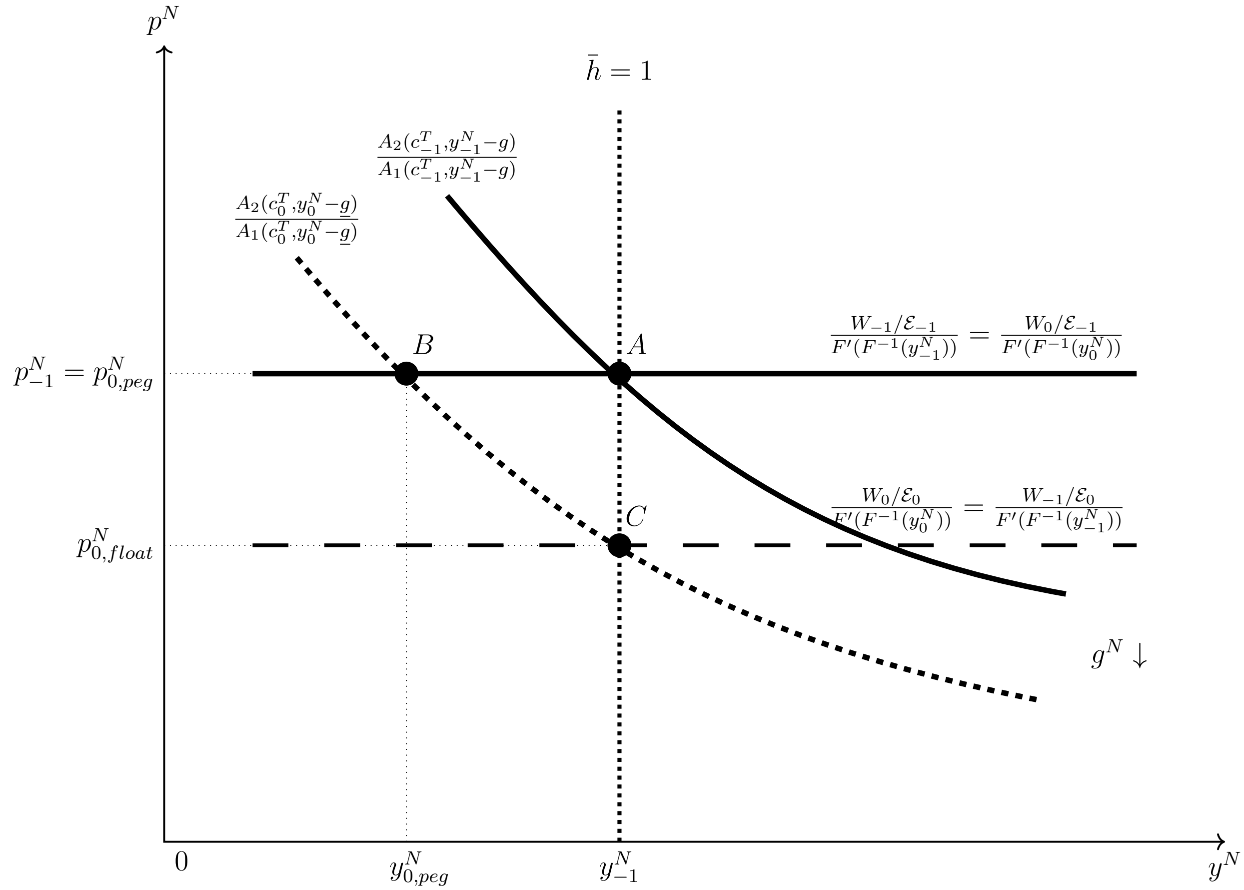
$\epsilon_0 = \max\left\{\frac{1-g}{1-\underline{g}}, 1\right\} = \frac{1-g}{1-\underline{g}}$. This implies $h_0 - \underline{g} = 1 - \underline{g}$. The assumption that $h_0 < 1$ therefore leads to a contradiction: $1 - \underline{g} = h_0 - \underline{g} < 1 - \underline{g}$. Consequently, it must be that $y_0^N = h_0 = 1$ and the economy is at its full-employment equilibrium.

From (25) then follows that $p_{0,peg}^N = \frac{1}{h_0 - \underline{g}} = \frac{1}{1-g} > \frac{1}{1-\underline{g}} = p_{0,float}^N$. Hence, a negative government spending shock causes a fall in p^N and a corresponding increase in RER, (real exchange rate depreciation) under the pure float, but not under a pure peg. $\square$

This is the mechanism outlined in the previous section: given that nominal wages cannot fall sufficiently to restore full employment, it is the real exchange rate that adjusts under a float and causes the firms' costs to fall. This in turn decreases the relative price of tradables, leading to an expenditure switch towards tradables and an increase in labor demand. In contrast, under a pure peg the latter channel is not available and there is no real exchange rate depreciation. Nontradable consumption and therefore the relative price of tradables are unaffected.

The mechanism can also be illustrated graphically. Since the tradable consumption decision is independent of the level of activity in the nontradable sector under the assumptions in this section, we can focus exclusively on this sector, for shocks will not spill over to the tradable sector. Figure 1 illustrates the transmission mechanism of a one-time negative government spending shock to the market for nontradables for the pure peg and the float scenario. The figure depicts the demand and supply schedules for nontradables in terms of output, and therefore in terms of employment, because in equilibrium $y_t^N = h_t$, given c_t^T, g_t^N and $W_t/\mathcal{E}_t$. Suppose that the initial position of the nontraded sector is at point A, where the economy is in full employment. A cut in the government consumption of tradables from g to $\underline{g}$ shifts the demand schedule leftwards. Under a pure peg (i.e., $\phi_\epsilon = 0$), firms costs do not change and the supply schedule is unaffected so that the relative price $p_{0,peg}^N$ does not move. The new equilibrium B features a lower level of output and involuntary unemployment. Under a pure float (i.e., $\phi_\epsilon = 1$), instead, the devaluatory exchange rate policy reduces firms's costs and shifts the supply schedule downwards. This reduces the relative price to $p_{0,float}^N$ until the economy reaches the new equilibrium C. In this point, the economy maintains full employment. For intermediate values of ϕ_ϵ, the exchange reaction would be insufficient to fully restore employment and the new equilibrium would lie between points B and C.

Figure 1: Nontradable sector: adjustment to a negative government spending shock.



Note: The solid and the dashed downward-sloping lines represent the demand for nontradables in the initial government spending state g and after the cut to $\underline{g}$, respectively. The solid and the dashed horizontal lines represent the supply for nontradables in the initial state and after the shock, respectively. The vertical line shows the available labor endowment.

3.3 Positive government spending shock

Consider now a positive government spending shock hitting the economy at the full-employment equilibrium. Assume that government spending takes on values in $(0, 1)$, as before, and that its process is given by:

$$g^N_t = \begin{cases} \bar{g} > g & \text{if } t = 0 \\ g & \text{if } t > 0. \end{cases} \tag{36}$$

Proposition 2. *Regardless of the exchange rate regime, a one-time surprise positive government spending shock does not cause unemployment. The real exchange rate appreciates by the amount that is sufficient to maintain a full-employment equilibrium.*

Proof. Conjecture that the shock does not cause unemployment, that is, $h_0 = 1$. Then it must be that the wage constraint is not binding so that

$$w_0 = \frac{1}{1-\bar{g}} > \frac{1}{(1-g)\epsilon_0} = \frac{w_{-1}}{\epsilon_0} \, . \tag{37}$$

Pure peg ($\phi_\epsilon = 0$): With a gross nominal exchange rate devaluation rate equal to $\epsilon_0 = 1$, equation (37) implies that $1 - g > 1 - \bar{g}$. This is true by assumption (36).

Float ($\phi_\epsilon \neq 0$): Equations (31) and (32) imply a gross nominal exchange rate devaluation rate of $\epsilon_0 = \max\left\{\frac{1-\bar{g}}{1-g}, 1\right\}^{\phi_\epsilon} = 1$. The same logic as in the peg case then requires that $h_0 = 1$.

Thus, full employment $h_0 = 1$ is the equilibrium, regardless of the exchange rate regime. From (25) then follows that the price of nontradables increases and therefore the real exchange rate appreciates by the same amount: $p^N_{0,peg} = p^N_{0,float} = \frac{1}{1-\bar{g}} > \frac{1}{1-g} = p^N_{-1}$. □

Figure 2 illustrates the case of a positive government spending shock of the same size as the negative shock considered before, starting again from the full-employment equilibrium A'. An increase in public nontradable consumption leads to a rightward shift of the demand schedule, thus bringing about excess demand for labor (point B'). This drives up the nominal wage, which is upwardly flexible, thereby shifting the supply schedule up to point C', where the full-employment equilibrium in the labor market is restored. As a result, the relative price p^N_0 is increased, contributing to a reduction in private nontradables consumption. Figures 1 and 2, together, show that the less flexible is the exchange rate arrangement, the stronger is the asymmetry in the response of the relative price, and therefore of the real exchange rate.

Proposition 3. *The response of the real exchange rate to positive and negative one-time surprise positive government spending shocks of the same size is perfectly symmetric under a pure float. It is asymmetric under other exchange rate regimes.*

Proof. For a negative shock and positive shock of the same magnitude we have $\bar{g} - g = g - \underline{g}$. From equation (27) then follows that under a negative shock

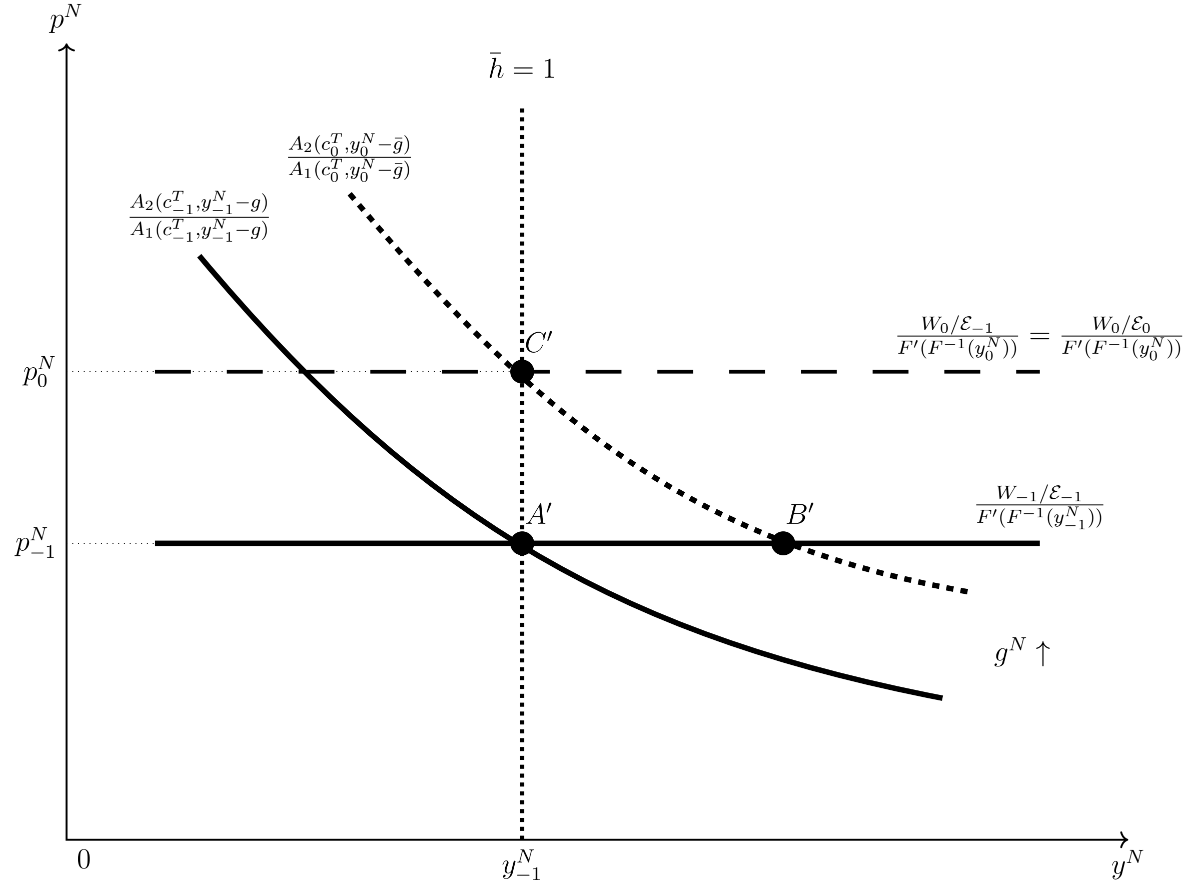
$$\Delta RER^- = \frac{1}{p^N_{0,float}} - \frac{1}{p^N_{-1}} = (1 - \underline{g}) - (1 - g) = g - \underline{g} = (\bar{g} - g) \, , \tag{38}$$

while for a positive shock

$$\Delta RER^+ = (1 - \bar{g}) - (1 - g) = -(\bar{g} - g). \tag{39}$$

□

Figure 2: Nontradable sector: adjustment to a positive government spending shock.



Note: The solid and the dashed downward-sloping lines represent the demand for nontradables in the initial government spending state g and after the increase to $\bar{g}$, respectively. The solid and the dashed horizontal lines represent the supply for nontradables in the initial state and after the shock, respectively. The vertical line shows the available labor endowment.

The previous proposition is a reflection of the fact that the pure float fully counteracts the nominal rigidity and always results in the efficient full-employment equilibrium through an adjustment in the real exchange rate. With an inflexible exchange rate regime, a positive government spending shock also keeps employment at the full-employment level due to the nominal wage constraint not binding. In contrast, a negative government spending shock causes the wage constraint to bind and, with the nominal exchange rate also being rigid, the real exchange rate cannot sufficiently adjust, leading to unemployment.

3.4 State-dependence of the response

The previous argument hinges on the assumption that, absent the government spending shock, the economy is at full employment. We will now show that the asymmetric exchange rate response under the peg also persists if the economy is in a state of slack when the government spending shock hits. For this purpose, we introduce a tradable endowment shock δ_t. The resource constraint (22) then becomes

$$c_t^T = \delta_t + b_t - \frac{b_{t+1}}{1+r} \tag{40}$$

Similar to the government spending shock, we again assume an MIT structure with a one-time surprise shock $\delta_0 < 1$ at time zero and $\delta_t = 1, t \neq 0$. We can solve the nontradable block by backward induction. The Euler equation (24) implies that tradable consumption jumps to a new level and stays there, i.e., $c_t^T = c_{t+1}^T$ for all $t \geq 0$. The resource constraint (22) again implies $b_t - \frac{b_{t+1}}{1+r} = b_{t+1} - \frac{b_{t+2}}{1+r}$ for all $t \geq 1$. Thus, if there is any increase in the face value of debt after $t = 1$, debt will keep increasing and it will violate the transversality condition (33). Thus, debt needs to be constant at its value at the beginning of period one, b_1. The Euler equation and the resource constraint then imply

$$c_0^T = \delta_0 - \frac{b_1}{1+r} = 1 + \frac{r}{1+r} b_1 = c_1^T. \tag{41}$$

From this follows that the debt choice b_1 is given by

$$b_1 = \delta_0 - 1. \tag{42}$$

Thus, the household will smooth tradable consumption by borrowing the shortfall from abroad and permanently foregoing the annuity out of this debt in terms of consumption:

$$c_0^T = 1 - \frac{r}{1+r}(1 - \delta_0). \tag{43}$$

Given the drop in tradable consumption, equation (25) shows that hours worked h_0 must also fall. The latter follows from the binding wage constraint, which pins down the relative price via equation (26) as $p_0^N = w_0 = w_{-1}$. As a consequence, the tradable endowment shock causes the economy to contract and unemployment to rise. The next proposition states the condition under which, in this situation of economic slack, the effect of positive and negative government spending shocks on the real exchange rate is still asymmetric.

Proposition 4. *Under a full peg, the response of the real exchange rate to a positive and a* *negative government spending shock of the same size is asymmetric as long as the increase in government consumption of nontradables causes private consumption of nontradables to fall relatively more than the endowment shock causes consumption of tradables to fall, i.e.*

$$1 - \frac{r}{1+r}\left(1-\delta_0\right) > \frac{1-\bar{g}}{1-g}. \tag{44}$$

Proof. First, consider the case of a government spending cut from g to $\underline{g}$. Given that the relative price of nontradables cannot fall, equation (26) implies an additional one-to-one fall of hours worked in order to keep the denominator constant. The real exchange rate then stays constant as well. Now consider an increase in government spending from g to $\bar{g}$. The response of the real exchange rate depends on the relative price movement and therefore on the relative size of the two shocks. As long as the economy remains in a situation of unemployment, the response is symmetric to that observed under a negative shock: the wage constraint remains binding and the relative price is pinned down by $p_0^N = w_0 = w_{-1}$. Any increase in government spending increases hours worked one-for-one. Equation (26) then allows computing the size of $\bar{g}$ required to leave the state of slack. Given

$$p_0^N = \frac{c_0^T}{1-\bar{g}} = \frac{1 - \frac{r}{1+r}\left(1-\delta_0\right)}{1-\bar{g}} > \frac{1}{1-g} = p_{-1}^N, \tag{45}$$

it follows that $1 - \frac{r}{1+r}\left(1-\delta_0\right) > \frac{1-\bar{g}}{1-g}$. The left-hand side here represents the gross rate of change in tradable consumption relative to the baseline level of 1. The right-hand side represents the gross rate of change in the private consumption of nontradables. Whenever the latter falls by more than the former, the relative price increases and the real exchange rate appreciates. □

Thus, while the effect of government spending on the real exchange rate may be symmetric for small shocks if the economy is in a situation of slack, the response is still asymmetric for large enough shocks.

4 Quantitative analysis

In this section, we investigate the impact of positive and negative spending shocks on the real exchange rate and on output in a quantitative version of our model that relaxes many of the simplifying assumptions of the previous section. It presents the parametrization of the model and the quantitative results of our experiments.

4.1 Parametrization

The model is solved numerically using the time iteration method presented in Bianchi et al. (2016), which has been modified to address downward nominal wage rigidity. The algorithm solves the decentralized equilibrium by backward recursive substitution of the model's optimality conditions. To discretize the past real wage, w_{-1}, we use 300 points, which are equally spaced in a log scale. We set the lowest grid value of w_{-1} at 2.75 and the highest at 5.5. To discretize the current debt state, b_t, we use 100 points and use a finer grid for low values to improve accuracy near the lower bound. The debt limit $\bar{b}$ is set at -0.8. We fix the upper bound at 0.2 and the lower bound at -0.8. In this numerical exercise, we parametrize the model at quarterly frequency. The annual risk-free world interest rate is exogenous and equal to 2 percent. The subjective discount factor β is set at 0.99. The wage rigidity parameter γ is equal to 0.995, in line with estimates in Schmitt-Grohé and Uribe (2016).[4] This means that nominal wages can fall at most by 2 percent per year. The Markov process of the tradable endowment y^T includes three realizations. The transition probability matrix is determined using the Tauchen and Hussey (1991) algorithm. The parameters ρ_y and σ_y for the stochastic process of y^T have been estimated by Bianchi (2011) using data for Argentina. His estimates are $\rho_y = 0.54$ and $\sigma_y = 0.059$. The Markov process of government spending includes nine realizations, the average being 0.18. Again, we determine the values of these realizations and their transition probability matrix using the Tauchen algorithm. The algorithm uses the parameter values $\rho_g = 0.99$ and $\sigma_g = 0.01$. As for the intratemporal elasticity of substitution between tradables and nontradables, $1/(1 + \eta)$, we set it equal to 0.44, following again Schmitt-Grohé and Uribe (2016). This value is in the range of estimates reported by Bianchi (2011). We choose to focus on the special case of equality between intra- and intertemporal elasticity of substitution, i.e. $1/(1 + \eta) = 1/\sigma$. Therefore, the inverse of the intertemporal elasticity of substitution for private consumption σ is set equal to 2.27. This case is of significant interest, both analytically and computationally, because it simplifies the characterization of the equilibrium, besides being empirically plausible (see Schmitt-Grohé and Uribe (2016)). In this case, the dynamics of debt and tradable consumption are independent of the level of activity in the nontradable sector and therefore of the exchange rate regime.[5] To simplify numerical computations, the labor share in the nontradable sector α is set equal to 1. The weight on tradables in the CES aggregator ω is set at 0.26, as in Schmitt-Grohé and Uribe (2016). The coefficient ϕ_ϵ takes on different

[4]See Jo (2018) for recent estimates of nominal wage rigidity in the US and Elsby and Solon (2018) for international evidence.

[5]Equation (6) becomes $\lambda_t = \omega(c_t^T)^{-\sigma}$, which is independent of c_t^N. The equilibrium processes for $\{y_t^T, b_{t+1}, c_t^T, \lambda_t, \mu_t\}$ can then be obtained as the solution to a subsystem of equilibrium conditions composed of (16),(6'),(7'), (4), (8), and (9).

values. We analyze the two polar cases, namely $\phi_\epsilon = 0$, which implements a pure peg, and $\phi_\epsilon = 1$, which corresponds to a pure float, as well as the intermediate scenario $\phi_\epsilon = 0.5$.

4.2 Impulse responses

We compute generalized impulse responses on the basis of stochastic simulations comparing the dynamics after a random shock to government spending and the dynamics in the absence of the shock. More specifically, we set the initial value of government spending equal to 0.18 and the size of the shock equal to 1 percentage point on impact. This corresponds to the smallest shock allowed by the grid. We then average over 10,000 replications.

Figure 3 displays impulse responses to government spending shocks that represent, in turn, a spending increase (dashed line) and a spending cut (solid line). In the figure, we report the dynamics of government spending, g^N, nontradable output, y^N, and the real exchange rate, RER, for three exchange rate regimes. The left column shows the case of fully flexible exchange rates, the right column shows results for a hard peg. The middle column shows the result for an intermediate regime where exchange rate flexibility is limited ($\phi_\epsilon = 0.5$). In all instances, vertical lines represent percentage deviations from the average unshocked path and horizontal lines represent quarters. Notice that, as before, a decline of RER represents a real appreciation.

A number of observations are noteworthy. First, the dynamics of government spending (top row) are independent of the exchange rate regime because we consider an exogenous variation of government spending throughout. Second, the adjustment to positive spending shocks is independent of the exchange rate regime, too. This is because monetary policy matters only to the extent that nominal rigidities matter. In our model, there is only a downward rigidity. Yet, in response to higher spending wages rise and they are not constrained to do so in any of the regimes under consideration. Third, turning to the non-tradable output response (second row), we observe that it is fully stabilized under flexible exchange rate, irrespectively of the sign of the shock. However, it declines in response to negative spending shocks if exchange rate flexibility is limited. This is the case where the downward nominal wage rigidity binds. It does not bind in case government spending is increased. As a result, full employment is maintained in response to positive spending shocks. Hence, we find a multiplier of zero in response to spending increases as there is full crowding out. In contrast, in response to spending cuts the multiplier is larger than zero, unless exchange rates are fully flexible. The reason again is that downward nominal wage rigidity prevents firms' costs to fall sufficiently. Under a peg, the exchange rate cannot compensate for this type of nominal rigidity.

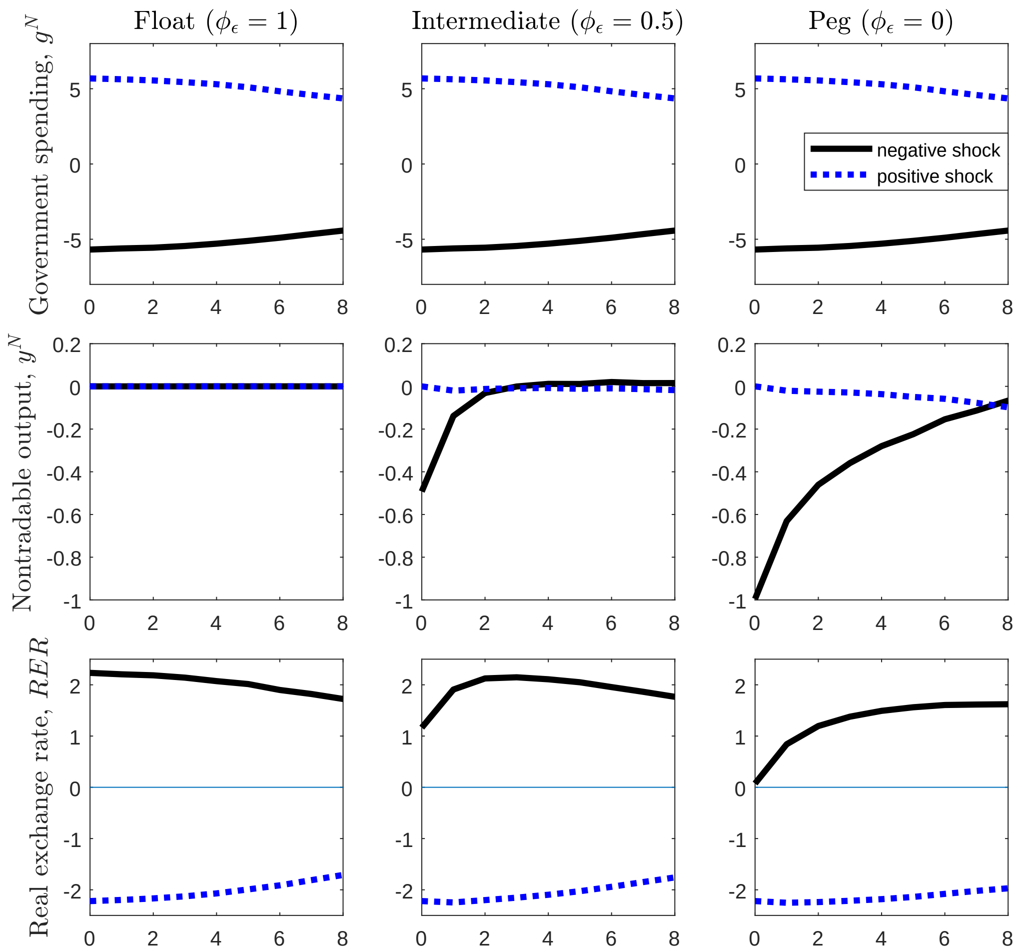


Figure 3: Generalized impulse responses to positive and negative government spending shocks of 1% of non-tradable output. Dashed line: positive shock; solid line: negative shock.

Finally, we turn to the exchange rate response (last row). Here again we observe a high degree of asymmetry in response to the shock, provided that exchange rates are not fully flexible. Government spending appreciates the real exchange rate in all scenarios. Spending cuts, in turn, induce a depreciation. In particular, the depreciation is not immediate under a peg, rather, it only builds up over time.

5 Evidence

In this section, we reassess the effect of government spending on the real exchange rate. A number of recent studies have explored the issue and reported different, partly conflicting results regarding the sign of the response (Corsetti et al., 2012a; Ilzetzki et al., 2013; Kim and Roubini, 2008; Monacelli and Perotti, 2010; M. O. Ravn et al., 2012). In what follows we take a fresh look: informed by the model-based analysis above, we ask whether spending increases and cuts impact the real exchange rate symmetrically or not.

Our analysis builds on Born et al. (forthcoming), both in terms of data and in terms of identification. Our sample covers quarterly observations from the early 1990s up until 2017Q4 for 38 emerging and advanced economies. We consider two identification schemes going back to Blanchard and Perotti (2002) and Ramey (2011), respectively (see also Ramey and Zubairy (2018) for a recent discussion). In both instances, the idea is to establish first the surprise component of government spending, in the first case on the basis of an estimated vector autoregression (VAR) model, in the second case on the basis of a professional forecast. In a second step, we establish the effect of the fiscal surprise on the real exchange rate by means of local projections à la Jordà (2005). For this purpose we assume that government spending surprises are predetermined relative to other developments in the macroeconomy. This assumption is explicit in Blanchard and Perotti (2002) and implicit in Ramey (2011).[6] Corroborating evidence for this assumption is also presented in Born et al. (forthcoming).

5.1 Empirical specification

In what follows we briefly outline our empirical specification. We start with the second step which establishes the effect of government spending on the exchange rate. For this purpose we rely on fiscal shocks, $\varepsilon^g_{i,t}$, computed in the first step. Here, indices i and t refer to country i and period t, respectively.

Local projections are particularly suited to account for potentially asymmetric effects of positive and negative shocks. Our specification follows Kilian and Vigfusson (2011). We sort fiscal shocks depending on whether they are positive or negative and define $\varepsilon^{g+}_{i,t} = \varepsilon^g_{i,t}$ if $\varepsilon^g_{i,t} \geq 0$ and 0 otherwise, and similarly for negative shocks, $\varepsilon^{g-}_{i,t}$. Letting $x_{i,t+h}$ denote the variable of interest in period $t+h$, we estimate how it responds to fiscal shocks in period t on the basis of the following specification:

$$x_{i,t+h} = \alpha_{i,h} + \eta_{t,h} + \psi^+_h \varepsilon^+_{i,t} + \psi^-_h \varepsilon^-_{i,t} + \gamma Z_{i,t} + u_{i,t+h} \ . \tag{46}$$

Here, the coefficients ψ^+_h and ψ^-_h provide a direct estimate of the impulse response at horizon h to a positive and negative shock, respectively. $Z_{i,t}$ is a vector of control variables, which includes lags of government spending (growth), output (growth), and the real exchange rate.[7] The error term $u_{i,t+h}$ is assumed to have a zero mean and strictly positive variance. $\alpha_{i,h}$

[6] In her paper, she considers two approaches. One based on military news, the other based on forecast errors. Our discussion refers to the latter.

[7] To deal with (irregular) changes in base levels, following Stock and Watson (2018) we use the cumulative change between t and $t+h$ as $x_{i,t+h}$.

and $\eta_{t,h}$ denote country and time fixed effects. Standard errors are robust with respect to heteroskedasticity as well as serial and cross-sectional correlation (Driscoll and Kraay, 1998).

5.2 Identification

Our identification strategy is explained in Born et al. (forthcoming) in some detail. Here we summarize the essential aspects. Importantly, we pursue two alternative strategies to construct fiscal innovations. One strategy has been introduced by Ramey (2011). The idea is simply to purge actual government spending growth of what professional forecasters project spending growth to be. Formally, we have

$$\varepsilon_{i,t}^{g} = \Delta g_{i,t} - \mathbb{E}_{t-1}\Delta g_{i,t},$$

where $\Delta g_{i,t}$ is the realization of government consumption growth and $\mathbb{E}_{t-1}\Delta g_{i,t}$ is the previous period's forecast.

The second strategy employs a panel VAR model to compute spending surprises. Let $X_{i,t}$ denote a vector of endogenous variables, which includes government spending, output, and the change of the real effective exchange rate. We estimate the following model:

$$X_{i,t} = \alpha_i + \eta_t + A(L)X_{i,t-1} + \nu_{i,t},$$

where $A(L)$ is a lag polynomial and $\nu_{i,t}$ is a vector of reduced form disturbances with covariance matrix $E(\nu_{i,t}\nu_{i,t}') = \mathbf{\Omega}$. In our analysis below we allow for four lags since the model is estimated on quarterly data. Assuming i) a lower Cholesky factorization $\mathbf{L}$ of $\mathbf{\Omega}$, and ii) that government consumption growth is ordered on top in the vector $X_{i,t}$, the structural shock $\varepsilon_{i,t}^{g}$ equals the (scaled) first element of the reduced form disturbance vector $\nu_{i,t}$, i.e. $\varepsilon_{i,t}^{g} = \mathbf{L}^{-1}\nu_{i,t}$.[8]

Our identifying assumption, dating back to Blanchard and Perotti (2002), is that the forecast error of government spending growth is not caused by contemporaneous innovations, so that it represents a genuine fiscal *shock*. Importantly, this identification assumption is also implicit in the first strategy due to Ramey (2011). The only difference between the two strategies is the way in which the forecast error is computed, once on the basis of professional forecasts, once on the basis of a VAR. In each instance, the assumption is that the forecast error is not in part caused by an endogenous response of government spending to

[8]The estimated shocks $\hat{\varepsilon}_{i,t}^{g}$ in this specification are generated regressors in the second stage. However, as shown in Pagan (1984), the standard errors on the generated regressors are asymptotically valid under the null hypothesis that the coefficient is zero; see also Coibion and Gorodnichenko (2015), footnote 18, on this point.

other structural innovations. The rationale for this assumption is that government spending can be adjusted only subject to decision lags. Also, there is no automatic response, since government spending does not include transfers or other cyclical items.

5.3 Data

Table 1 summarizes the coverage of our sample. Altogether there are 38 countries, but professional forecasts for government spending for which we rely on *Oxford Economics* are available only for a subset of those. The data required for our VAR-based forecast error is available for all 38 countries. Born et al. (forthcoming) provide a detailed description of the data set. Our exchange rate measures is the index compiled by the BIS. An increase indicates a depreciation of the economy's currency against a broad basket of currencies.

5.4 Results

In what follows, we report results for both identification strategies. Figure 4 shows results for the forecast error based on professional forecasts. The top panel displays the impulse responses to a positive government spending shock, the bottom panel considers a negative response. Throughout, solid lines represent the point estimate, while shaded areas indicate 90 percent confidence intervals.

The response of government spending, shown on the left, is fairly persistent in both cases. We also show the response of output in the middle column. There is a significant, but moderate response on impact. The drop of output in response to a spending cut appears somewhat stronger and, in particular, more persistent. Last, we turn to the response of the real exchange rate, shown in the rightmost column.

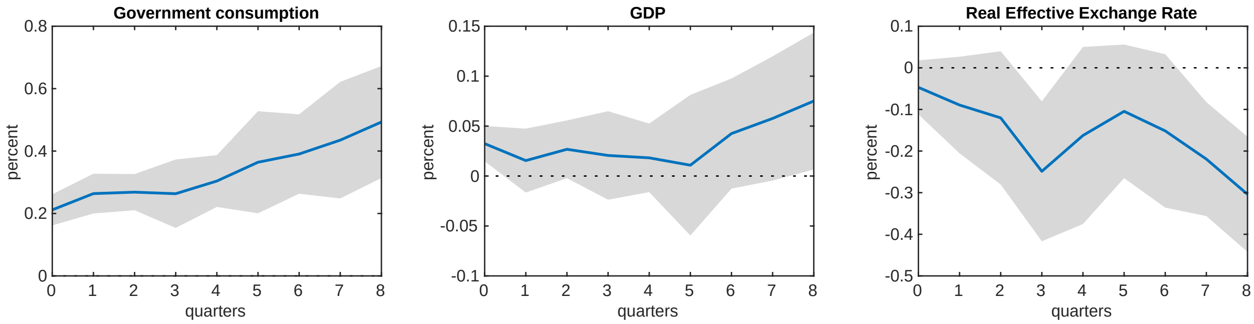
Here the asymmetry is most pronounced. In response to higher government spending, the real exchange appreciates. It does not depreciate significantly, however, in response to a reduction of government spending.

In Figure 5 we show results based on the VAR forecast error. Note that in this case our sample is quite a bit larger. However, by and large, we find very similar results. In particular, we find the response of the exchange rate to be asymmetric — in line with the predictions of the model. Overall, our evidence supports the notion of substantial downward wage rigidities that are not (completely) neutralized by monetary policy.

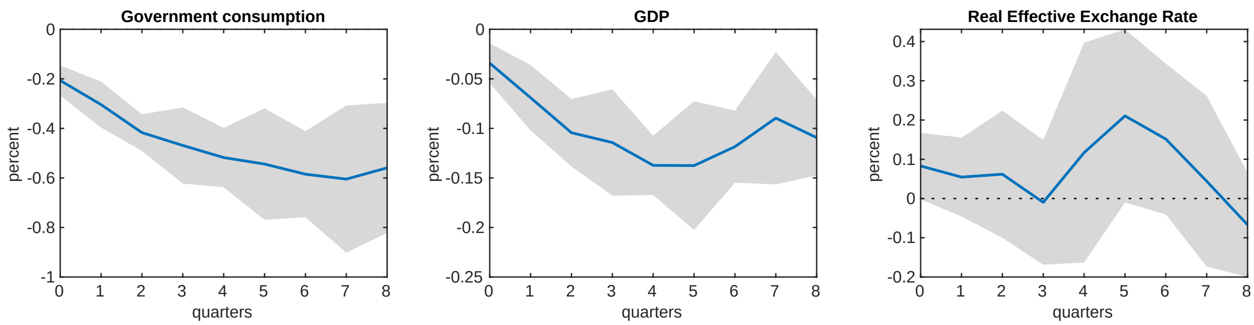
Table 1: Sample range for alternative forecasting models

	Oxford Economics		VAR	
Country	Range	T	Range	T
Argentina	1999Q3-17Q4	59	1993Q3-17Q4	74
Australia	2003Q1-10Q3	28	2002Q4-10Q3	16
Austria	1997Q1-17Q4	80	1993Q3-17Q4	93
Belgium	-	-	1991Q3-17Q4	101
Brazil	-	-	1996Q1-17Q4	83
Bulgaria	-	-	2000Q1-17Q4	67
Chile	1999Q3-17Q4	72	1999Q1-17Q4	71
Colombia	-	-	2000Q1-17Q4	67
Croatia	-	-	2003Q4-17Q4	52
Czech Republic	2004Q1-17Q4	56	2003Q4-17Q4	52
Denmark	1997Q1-17Q4	73	1991Q1-17Q4	90
Ecuador	-	-	1994Q4-17Q4	72
El Salvador	-	-	2002Q1-17Q3	58
Finland	1999Q2-17Q4	73	1992Q1-17Q4	99
France	1999Q1-17Q4	74	1998Q4-17Q4	72
Germany	2004Q1-17Q4	56	2003Q4-17Q4	52
Greece	2001Q4-17Q4	60	1995Q1-17Q4	79
Hungary	1999Q3-17Q4	72	1998Q4-17Q4	72
Ireland	2004Q1-17Q4	56	1995Q1-17Q4	87
Italy	1997Q1-17Q4	80	1991Q1-17Q4	103
Latvia	-	-	2005Q4-17Q4	44
Lithuania	-	-	2005Q1-17Q4	47
Malaysia	1999Q3-17Q4	72	2000Q1-17Q4	67
Mexico	-	-	1993Q3-17Q4	93
Netherlands	1999Q1-17Q4	74	1998Q4-17Q4	72
Peru	-	-	1996Q4-17Q4	75
Poland	-	-	2002Q1-17Q4	59
Portugal	1998Q4-17Q4	75	1995Q1-17Q4	87
Slovakia	2005Q2-17Q4	51	2003Q4-17Q4	52
Slovenia	-	-	2002Q4-17Q4	56
South Africa	-	-	1994Q3-17Q4	89
Spain	1997Q1-17Q4	80	1995Q1-17Q4	87
Sweden	1998Q3-17Q4	69	1993Q1-17Q4	78
Thailand	1999Q3-17Q4	72	1997Q1-17Q4	79
Turkey	2000Q1-17Q4	70	1998Q1-17Q4	75
United Kingdom	1997Q1-17Q4	80	1995Q1-17Q4	87
United States	2007Q4-17Q4	41	2007Q3-17Q3	36
Uruguay	-	-	2001Q1-17Q4	58
Total		1523		2701

Notes: Range refers to the first and last observation available. Note that the VAR-approach requires 5 observations to construct 4 lags of growth rates. T refers to the number of observations used for the particular country after accounting for missing values and lag construction in the unconditional model.



(a) Spending increase



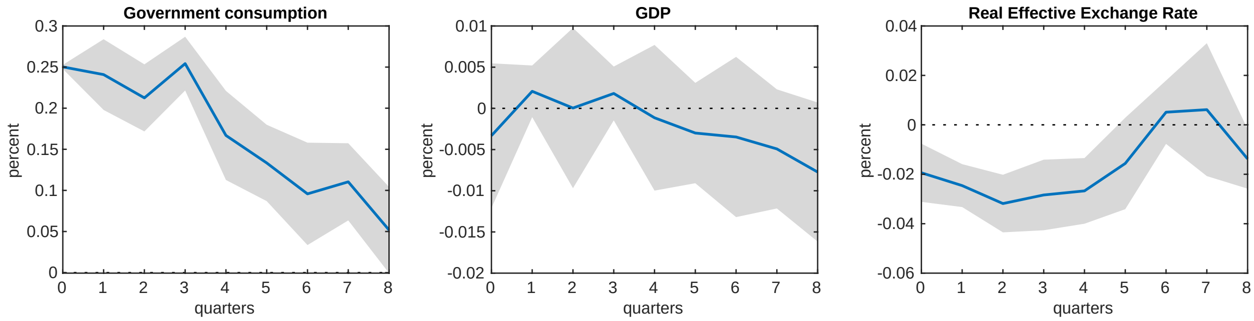
(b) Spending cut

Figure 4: Adjustment to government spending shock: identification based on forecast error of professional forecasters. Shaded areas represent 90 percent confidence intervals. Top panel: spending increase by 1 standard deviation, bottom panel: spending decrease by 1 standard deviation.

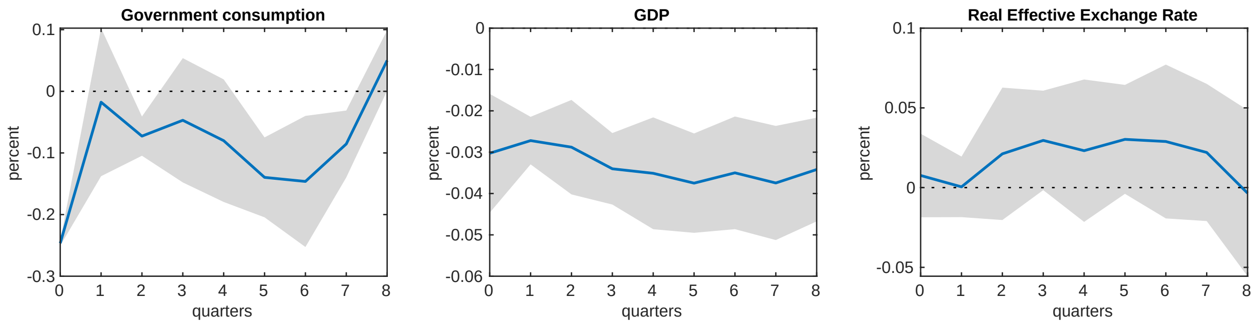
6 Conclusion

In this paper, we show that government spending impacts the real exchange rate asymmetrically, depending on whether spending is raised or cut. In particular, we rely on a simple model that departs from Schmitt-Grohé and Uribe (2016) by introducing government spending and a somewhat richer menu of exchange rate policies. The key feature of the model is that wages are (only) downwardly rigid. We consider the limiting cases of pure float and pure peg, but we also consider an intermediate regime in which monetary policy allows for limited exchange rate flexibility. If the spending shock is large enough to make the wage constraint binding, the presence of a currency peg contributes to a potentially strong asymmetry. On the other hand, economies characterized by a higher degree of exchange rate flexibility can mitigate or totally undo the real effects stemming from the downward wage rigidity, which results in a weaker asymmetry or no asymmetry altogether under a pure float.

In a second step, we take up the issue empirically and estimate local projections using quarterly data for 38 advanced and emerging market economies, covering the period from the early 1990s to 2017. We find that the real exchange appreciates in response to higher



(a) Spending increase



(b) Spending cut

Figure 5: Adjustment to government spending shock: identification based on VAR forecast error. Shaded areas represent 90 percent confidence intervals.Top panel: spending increase by 1 standard deviation, bottom panel: spending decrease by 1 standard deviation.

government spending, whereas it does not depreciate in response to a reduction of government spending. Likewise we find that the response of output is asymmetric as well. In line with the predictions of the model, there is a significant output decline due to cuts of government spending, but no significant output response due to positive government spending shocks. These results are robust across alternative identification schemes.

They are also relevant for policy, as they uncover a new dimension along which fiscal and monetary/exchange rate policies interact in a non-trivial way. By now it has been widely understood that the effects of fiscal policy tend to be larger if monetary policy is constrained (e.g. Farhi and Werning, 2016). Against this background our results call for a further distinction: if monetary policy is constrained, the strength of the effects of fiscal policy depends on whether spending is raised or cut. Hence in countries where monetary policy is constrained, for instance because of membership in a currency union, policy makers need to be aware that the effect of, say, an increase of government spending cannot easily be made undone by simply reversing it. Rather, the consequences of a one-time policy measure can have lasting effects, notably on the real exchange rate.

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