

Fiscal policy in a New Keynesian Overlapping Generations Model of a Small Open Economy^{1), 2)}

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This paper introduces three features into an otherwise standard model of "New Open Economy Macroeconomics" of a small open economy, and analyzes effects of a fiscal expansion. Those three features are: (1) Presence of non-tradable goods, (2) Biases toward domestically produced goods, especially non-tradable goods, in government expenditure, and (3) an overlapping generations (OLG) structure a la Blanchard (1985), Yaari (1965), and, more closely related, Ganelli (2005). We show that biases toward non-tradable goods in fiscal spending makes large differences in the effects of a fiscal expansion on output. We also show that, in the presence of the OLG structure, an increase in public spending causes consumption to rise and the exchange rate to appreciate at the same time, under some reasonable parameter settings.

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1. Introduction

This paper studies effects of fiscal policy in a dynamic model of a small open economy. Currently, the standard framework for analyzing the effects of monetary policy in an open economy environment is "new open economy macroeconomics", introduced into the literature by Obstfeld and Rogoff (1995) and developed further by such authors as Clarida, Gali and Gertler (2001). Adolfson, Laséen, Lindé, and Villani (2008) estimate a larger scale New Keynesian model using a Bayesian technique with Swedish data to evaluate effects of monetary policy in a small open economy. On the other hand, there have been relatively few studies that utilize this framework to analyze the effects of fiscal policy *per se* (with some important exceptions such as Ganelli (2005)), though there have been many studies on the interaction between monetary and fiscal policies. We suspect one of the reasons is that the standard models in this literature do not yield results that fit our prior expectations about fiscal policy. First, the models typically generate very small effects of a fiscal expansion on output. In many instances, consumption falls rather than increases, contrary to the popular belief. Second, in many of those models, most notably in the seminal work of Obstfeld and Rogoff (1995), in response to a fiscal expansion, the nominal

exchange rate depreciates. On the other hand, it is popularly believed that a fiscal expansion causes the exchange rate to appreciate (perhaps under the influence of the textbook Mundell-Fleming model).

A few recent studies utilize more full-fledged dynamic models to study effects of fiscal policy. Pierdzioch (2004) develops a two country New Keynesian model to examine effects of a permanent increase in government expenditure. Households are assumed to be infinitely lived, and the central bank follows a money supply targeting rule. This study finds that such a fiscal expansion increases output but decreases consumption due to a negative wealth effect. Ganelli and Tervala (2010) also develops a two country New Keynesian model in which government spending falls onto both government consumption, which enters the household utility function, and public investment, which is productive. They study how a spending shift from government consumption to public investment increases both output and consumption. Our model differs from those two in that it is a small open economy model. We also ignore roles played by productive public investment. Somewhat closer to our own research question, Christiano, Trabandt and Walentin (2010) build a medium scale open economy model in which the monetary authority is assumed to follow a Taylor rule. They estimate this model using Swedish data

with a Bayesian technique. They find that a fiscal expansion has a positive effect on output but a negative effect on consumption. In summary, the literature on the effects of fiscal policy in an open economy is still in its infancy, and we have not accumulated sufficient research experiences to reach a consensus. Our objective is to move this growing literature one step forward by building a new model with some realistic features.

In this paper, we focus on the following three features of the original model of Obstfeld and Rogoff (1995, 1996):

(i) All the goods are assumed to be tradable.

(ii) The government in their model purchases not only domestically produced tradable goods but also foreign goods. Moreover, their relative shares in the government expenditure equal their output shares in the world. For example, if GDP of the foreign country is ten times larger than that of the home country, the relative spending shares of home and foreign goods in the home government's budget is 1:10.

(iii) Households are infinitely lived and their consumption depends on the present value of their disposable income. Thus, a temporary increase in income that a fiscal expansion might bring about would be mostly smoothed out. Also, the Ricardian equivalence holds, and a deficit financed fiscal expansion would have exactly the same effect as a tax financed one. We relax those assumptions and introduce the following features:

(1) We introduce non-tradable goods.

(2) We generalize the government spending structure and allow for the possibility that a disproportionately large fractions of the public expenditure might fall on to domestically produced goods, in particular, non-tradables.

(3) We follow Ganelli (2005) to incorporate overlapping generations structure à la Blanchard (1985) and Yaari (1965). Households face a constant probability of death in each period, and thus become more myopic. The Ricardian equivalence fails, and households perceive government bonds as part of their net wealth.

On the other hand, while Obstfeld and Rogoff (1995, 1996) develop two country models, ours is a small open economy model.

We follow the recent trend in the literature to introduce gradual price adjustment. We also introduce capital accumulation. Implications of this model are studied numerically, using impulse response analyses. It is shown that, in this model, an increase in public spending can cause consumption to rise and the exchange rate to appreciate at the same time, which is consistent with the popular belief about fiscal policy. Those tendencies are stronger under a Taylor-type monetary policy rule with interest rate smoothing, and stronger nominal stickiness.

The rest of the paper is organized as follows. Section 2 introduces the model. Section 3 provides impulse response analysis of a government expenditure shock under various parameter settings. Section 4 concludes.

2. The model

We consider a small open economy called "home" country, denoted by H . Prices and the interest rate set in "foreign" country is given to the home country, as well as the demand for "home" tradable goods that comes from "foreign" country.

2.1 Basics

Overlapping generations structure of the population

We follow Blanchard (1985) and Yaari (1965) to introduce an overlapping generations structure into the model while retaining analytical tractability of the model's dynamics. In each period, a new generation of households is born. Each generation consists of a continuum of households, whose number is predetermined. From the next period onward, they face a constant probability of death in each period. We denote the probability of survival per period by q , the probability of death thus is $1-q$. By the law of large numbers, the size of each cohort becomes q times smaller each period.

We follow Blanchard (1985) and Yaari (1965), as well as Ganelli (2005) to assume that a kind of annuities is available to the households. At the end of each period, households sell their total financial wealth (specified later) to annuities companies. If they survive in the next period, $1/q$ times the value of annuities purchased will be awarded to them. If they die, their financial wealth will

be confiscated by the annuities companies. This form of contract is compatible with a competitive annuities market with free entry of the annuities companies.

Unlike Ganelli (2005), we allow for the possibility that the overall population may not be constant over time, following Buiter (1988) and Weil (1989). This generalization would be necessary if one wishes to develop a model that can be directly estimated by data³⁾. We assume that, in each period, the size of the newborn generation is equal to q' times the overall population of the previous period, where q' , the birth rate, may or may not be equal to $1-q$, the death rate. If we denote the population growth rate by n , we have

$$1+n = q+q' \quad (1)$$

As we shall see later, it is the birth rate, not the death rate, that affects the equilibrium conditions, as emphasized by Buiter and Weil.

Goods types

There are three types of goods in the model: Home tradable goods (H goods), Foreign tradable goods (F goods), and Non-tradable goods (that are produced at home, N goods). Households, firms and the government buy all three types of goods. On the producer side, there are two types of firms: H firms, that produce H goods, and N firms, that are specialized in the production of N goods.

2.2 Individual Optimization

Individual household

Consider a typical household that belongs to generation a . We assume that households in each generation are completely identical, so this household's choice will be the same as the generation's average. Hence we shall drop the subscripts that denote the individual. For example, this household's consumption in period t will be simply denoted as $C_{a,t}$.

This household maximizes its expected discounted sum of utility from each period. It derives utility from consumption and money holding, while receiving disutility from work. Specifically, its lifetime utility takes the following form:

$$U_{a,t} = E_t \sum_{\tau=t}^{\infty} (q\beta)^{\tau-t} u_{a,\tau}, \quad (2)$$

where $u_{a,t} = \ln C_{a,t} + w_l \ln (1-L_{a,t})$

$$+ w_m \ln \left(\frac{M_{a,t}}{P_t} \right) \quad (3)$$

As indicated above, $C_{a,t}$ is this household's consumption, or more accurately, its "composite consumption index" that consists of utilities from various types of goods. Its details will be specified later. Also, $L_{a,t}$ is this household's labor supply and thus $1-L_{a,t}$ is its leisure, and $M_{a,t}$ is its money holding. The variable P_t is the overall price index for private agents, which will be specified later. The parameter β is the subjective discount factor and is positive, while the weight parameters w_l and w_m are both positive.

The above logarithmic form of the utility function is *not* purely for simplicity. It is assumed that new households are born with zero financial wealth. On the other hand, the average household of the economy, in general, would have either positive or negative financial wealth. This means that different generations might choose different values of consumption, labor supply or money holding. To be able to aggregate individual first order conditions and to derive equilibrium dynamics of macro variables, the logarithmic form is the only possibility.

In the labor market, the household acts as a price taker, and receives W_t units of nominal wage per hour. As labor is homogeneous and the market is perfectly competitive, every household receives the same wage per hour. Moreover, it is assumed that labor is freely mobile between firms and between the two sectors of production, H and N. As a consequence, the wage rate will be equalized across firms and across sectors.

In the financial market, each household has four alternative forms of holding wealth, besides money. One is the "home bond", which is traded only locally, whose amount outstanding is denoted as $B_{a,t}^H$ (in the units of the home currency) and yields the interest rate i_t^H , also in the units of the home currency, with certainty. Another is the "foreign bond", traded in the international financial market, whose amount outstanding is denoted as $B_{a,t}^F$ (in the units of the *foreign* currency) and yields the interest rate i_t^F , also in the units of the *foreign* currency, with certainty. The other two types of assets are the ownership or the shares of firms in home country, also traded only domestically. Denote the overall value of H firms by $V_{H,t}$, and the household's share of those firms as $s_{H,a,t}$, then the total amount of share holding for this sector is

$V_{H,t} \cdot s_{H,a,t}$. Holding this fractions of the shares, the household will be entitled to the same proportion of overall profit of the H sector in the next period, denoted $\Pi_{H,t+1}$. Likewise, for the N sector, denoting their overall value by $V_{N,t}$ and the household's share by $s_{N,a,t}$, the overall share holding for this sector is $V_{N,t} \cdot s_{N,a,t}$, and the household is entitled to the same fraction of the overall profit, $\Pi_{N,t+1}$.

Define this household's "(beginning-of-the-period) financial wealth" as

$$FW_{a,t} = \frac{1}{q} \cdot [(V_{H,t} + \Pi_{H,t}) \cdot s_{H,a,t-1} + (V_{N,t} + \Pi_{N,t}) \cdot s_{N,a,t-1} + (1+i_t^H)B_{a,t-1}^H + (1+i_t^F)B_{a,t-1}^F \cdot e_t + M_{a,t-1}] \quad (4-1)$$

On the right hand side, e_t is the nominal exchange rate between "home" and "foreign": note that its increase implies depreciation for the home currency. Also, define the "end-of-the-period financial wealth" as

$$EW_{a,t} = V_{H,t} \cdot s_{H,a,t} + V_{N,t} \cdot s_{N,a,t} + B_{a,t}^H + B_{a,t}^F \cdot e_t + M_{a,t} \quad (4-2)$$

Then this household's budget constraint is:

$$W_t \cdot L_{a,t} - T_t^{PC} + Transfer_{a,t} + FW_{a,t} = P_t \cdot C_{a,t} + EW_{a,t} \quad (4-3)$$

In the above, T_t^{PC} is the value of (lump sum) taxes imposed equally on each household alive in period t . $Transfer_{a,t}$ is lump sum transfer of money from the government ("helicopter money").

Household optimization conditions

Use $\lambda_{a,t}$ to denote the "current value" Lagrange multiplier associated with the constraint (4-3). The following are the first order conditions:

$$\lambda_{a,t} \cdot P_t \cdot C_{a,t} = 1, \quad (5-1)$$

$$W_t(1-L_{a,t}) = w_t \cdot P_t \cdot C_{a,t}, \quad (5-2)$$

$$\frac{i_t^H}{1+i_t^H} M_{a,t} = w_m \cdot P_t \cdot C_{a,t}, \quad (5-3)$$

$$\lambda_{a,t} = \beta(1+i_t^H)E_t \lambda_{a,t+1}, \quad (5-4)$$

$$e_t \cdot \lambda_{a,t} = \beta(1+i_t^F)E_t e_{t+1} \cdot \lambda_{a,t+1}, \quad (5-5)$$

$$\text{and } V_{J,t} \cdot \lambda_{a,t} = \beta E_t (V_{J,t+1} + \Pi_{J,t+1}) \cdot \lambda_{a,t+1}, \quad (J=H \text{ or } N) \quad (5-6)$$

With the exception of (5-1), all the conditions are linear in variables with subscript "a", which makes aggregation over "a" possible later. Using (5-2) to (5-6), the budget constraint can be written as

$$q\beta E_t \frac{\lambda_{a,t+1}}{\lambda_{a,t}} FW_{a,t+1} = FW_{a,t} + DI_t - (1+w_l+w_m)P_t \cdot C_{a,t}, \quad (6)$$

where $DI_t = W_t - T_t^{PC}$.

Note that "disposable income", DI_t , is independent of a . Solving forward using (5-1) and imposing the transversality condition, we get

$$(1+w_l+w_m)P_t \cdot C_{a,t} = (1-q\beta) \cdot [FW_{a,t} + H_{a,t}], \quad (7-1)$$

where "human wealth", $H_{a,t}$, is defined by:

$$H_{a,t} = E_t \sum_{\tau=t}^{\infty} (q\beta)^{\tau-t} \cdot \frac{\lambda_{a,\tau}}{\lambda_{a,t}} \cdot DI_{\tau}. \quad (7-2)$$

Individual Firms

Each of the production sectors, H and N, consists of a continuum of firms, whose number is normalized to be one for each sector. The goods markets are monopolistically competitive, as each firm in either sector specializes in production of a single "brand" or a differentiated variety of products. When changing prices or capital stock, they have to incur adjustment costs. Consider firm j of sector J ($J=H$ or N). Its objective is to maximize the shareholder value of the firm, or the discounted sum of profit flows (discounted at the rate at which the shareholders discount future).

$$V_{J,t}(j) = E_t \sum_{\tau=t+1}^{\infty} \beta^{\tau-t} \cdot d\lambda_{t,\tau} \cdot \Pi_{J,\tau}(j), \quad (8)$$

where $d\lambda_{t,\tau}$ is the mean of $\lambda_{a,\tau}/\lambda_{a,t}$ over all households who are alive in period t . Profit for this firm in period t , $\Pi_{J,t}(j)$, is given by

$$\Pi_{J,t}(j) = P_{J,t}(j) \cdot D_{J,t}(j) - W_t \cdot L_{J,t}(j) - P_t \cdot E_{J,t}(j) \quad (9)$$

where $P_{J,t}(j)$ is the price set by this firm, $D_{J,t}(j)$ is the demand curve this firm faces, $L_{J,t}(j)$ is the amount of labor employed by this firm, and $E_{J,t}(j)$ is the firm's non-wage expenditure:

$$E_{J,t}(j) = I_{J,t}(j) + ACK_{J,t}(j) + ACP_{J,t}(j) \quad (10)$$

where $I_{J,t}(j)$ is the firm's investment, $ACK_{J,t}(j)$ is the adjustment cost of capital, and $ACP_{J,t}(j)$ is the adjustment cost of changing prices.

The firm faces the following constraints. First, the demand for the firm must equal its supply, which is given by the usual Cobb-Douglas production function:

$$D_{J,t}(j) = Y_{J,t}(j) = A_{J,t} \cdot K_{J,t-1}^{\alpha}(j) \cdot (\Gamma_t \cdot L_{J,t}(j))^{1-\alpha} \quad (12)$$

where $K_{J,t-1}(j)$ is this firm's capital stock at the beginning of period t , and Γ_t corresponds to the deterministic trend in the aggregate level of technology, and it increases at the rate γ each period. Also, $0 < \alpha < 1$. Next, the demand curve for the good of a firm has a constant elasticity form:

$$D_{J,t}(j) = (P_{J,t}(j))^{-\theta} \cdot Z_{J,t} \quad (13)$$

where $\theta > 0$ is the price elasticity of demand, and $Z_{J,t}$ is a variable that is beyond control of this firm. Third, capital stock evolves according to:

$$I_{J,t}(j) = K_{J,t}(j) - (1 - \delta)K_{J,t-1}(j) \quad (14)$$

where $1 > \delta > 0$ is the depreciation rate. Fourth, the adjustment cost of capital takes a quadratic form:

$$ACK_{J,t}(j) = \frac{\phi_K}{2} \cdot \frac{(K_{J,t}(j) / ((1+n) \cdot (1+\gamma)) - K_{J,t-1}(j))^2}{K_{J,t-1}(j)} \quad (15)$$

where $\phi_K > 0$ ⁴⁾. Fifth, the adjustment cost of prices is also quadratic:

$$ACP_{J,t}(j) = \frac{\phi_P}{2} \cdot \frac{(P_{J,t}(j) - P_{J,t-1}(j))^2}{P_t \cdot P_{J,t-1}(j)} \cdot D_{J,t}(j) \quad (16)$$

where $\phi_P > 0$.

Firm optimization conditions

The first order conditions are the following two:

$$\begin{aligned} \frac{W_t/P_{J,t}(j)}{MPL_{J,t}(j)} &= \frac{\theta-1}{\theta} - ACP_{J,t}(j) + \frac{1}{\theta} \cdot \\ &\left[\frac{\partial ACP_{J,t}(j)}{\partial P_{J,t}(j)} + \beta E_t d\lambda_{t,t+1} \cdot \frac{\partial ACP_{J,t+1}(j)}{\partial P_{J,t}(j)} \right] \end{aligned} \quad (17)$$

$$\begin{aligned} \text{and } \beta E_t d\lambda_{t,t+1} \cdot W_{t+1} \frac{MPK_{J,t+1}(j)}{MPL_{J,t+1}(j)} \\ = P_t \left[1 + \frac{\partial ACK_{J,t}(j)}{\partial K_{J,t}(j)} \right] + \beta E_t d\lambda_{t,t+1} \cdot \\ P_{t+1} \left[\delta - 1 + \frac{\partial ACK_{J,t+1}(j)}{\partial K_{J,t}(j)} \right] \end{aligned} \quad (18)$$

where MPL and MPK denote marginal products of labor and capital, respectively.

2.3 Composite goods indices and average price indices

The composite consumption index, $C_{a,t}$, consists of utility from consuming H goods, $C_{H,a,t}$, N goods, $C_{N,a,t}$, and F goods, $C_{F,a,t}$:

$$C_{a,t} = [\omega^{1/\eta} C_{T,a,t}^{(\eta-1)/\eta} + (1-\omega)^{1/\eta} C_{N,a,t}^{(\eta-1)/\eta}]^{\eta/(\eta-1)} \quad (19a)$$

$$C_{T,a,t} = [\phi^{1/\rho} C_{H,a,t}^{(\rho-1)/\rho} + (1-\phi)^{1/\rho} C_{F,a,t}^{(\rho-1)/\rho}]^{\rho/(\rho-1)} \quad (19b)$$

$$\text{and } C_{J,a,t} = \left[\int C_{J,a,t}(j)^{(\theta-1)/\theta} dj \right]^{\theta/(\theta-1)} \quad (19c)$$

(J=H, N, or F).

The elasticities, η, ρ, θ , are all positive. The share parameters, ω, ϕ , are between 0 and 1. The letter "T" stands for tradable

goods, which consist of H and F goods. The corresponding price indices are suitably defined as follows:

$$P_t = [\omega P_{T,t}^{1-\eta} + (1-\omega) P_{N,t}^{1-\eta}]^{1/(1-\eta)} \quad (20a)$$

$$P_{T,t} = [\phi P_{H,t}^{1-\rho} + (1-\phi) P_{F,t}^{1-\rho}]^{1/(1-\rho)} \quad (20b)$$

$$\text{and } P_{J,t} = \left[\int P_{J,t}(j)^{1-\theta} dj \right]^{1/(1-\theta)} \quad (20c)$$

(J=H, N, or F).

Individual demand functions are given by:

$$C_{T,a,t} = \omega \cdot \left[\frac{P_{T,t}}{P_t} \right]^{-\eta} \cdot C_{a,t},$$

$$C_{N,a,t} = (1-\omega) \cdot \left[\frac{P_{N,t}}{P_t} \right]^{-\eta} \cdot C_{a,t} \quad (21a)$$

$$C_{H,a,t} = \phi \cdot \left[\frac{P_{H,t}}{P_{T,t}} \right]^{-\rho} \cdot C_{T,a,t},$$

$$C_{F,a,t} = (1-\phi) \cdot \left[\frac{P_{F,t}}{P_{T,t}} \right]^{-\rho} \cdot C_{T,a,t} \quad (21b)$$

$$\text{and } C_{J,a,t}(j) = \left[\frac{P_{J,t}(j)}{P_{J,t}} \right]^{-\theta} \cdot C_{J,a,t} \quad (21c)$$

(J=H, N, or F).

We assume that the firm's expenditure, $E_{J,t}(j)$, is also a composite index of goods, and its structure is completely identical with that of the household consumption that we have specified above. The corresponding price indices will be exactly the same as those in equations (20), and the corresponding demand functions are analogous to those in (21).

2.4 Aggregation over households and firms

Aggregation over Households

First, consider aggregating household budget constraint, (4), over different generations. Denote aggregate consumption, taxes, transfers, home bond holding, foreign bond holding, money holding and population as C_t , T_t , $Transfer_t$, B_t^H , B_t^F , M_t , and Pop_t , respectively. Also, denote labor supply per capita by L_t . In aggregating (4) over a , note that only a fraction q of the households who were alive in period $t-1$ are still there in period t . Also, note that shares add up to one, because it is assumed that foreigners do not hold those shares. Then,

$$\begin{aligned} W_t \cdot L_t \cdot Pop_t - T_t + Transfer_t + \Pi_{H,t} \\ + \Pi_{N,t} + (1+i_{t-1}^H) B_{t-1}^H \\ + (1+i_{t-1}^F) B_{t-1}^F \cdot e_t + M_{t-1} \\ = P_t \cdot C_t + B_t^H + B_t^F \cdot e_t + M_t \end{aligned} \quad (22-1)$$

Next, we derive what could be called the

aggregate "Euler" equation, which is the crucial element of the Blanchard-Yaari type overlapping generations model. The following can be shown:

$$\begin{aligned} & (1+n)^{-1}q\beta E_t(d\lambda_{t,t+1}) \cdot P_{t+1} \cdot C_{t+1} \\ &= \frac{1-q\beta}{1+w_t+w_m} \cdot \left\{ [(1+n)^{-1}q-1] \cdot \right. \\ & \quad \left. \left(V_{H,t} + V_{N,t} + B_t^H + B_t^F \cdot e_t + \frac{1}{1+i_t^H} M_t \right) \right\} \\ & \quad + q\beta \cdot P_t \cdot C_t, \end{aligned} \quad (22-2)$$

where $V_{J,t}$ is the aggregate value of firms that belong to sector J . Note that, when $q=1$ and $n=0$, that is, no new generation will ever be born ($q'=0$) and the population is constant, this equation reduces to the usual Euler equation.

The other conditions are as follows:

$$W_t(1-L_t)Pop_t = w_t \cdot P_t \cdot C_t, \quad (22-3)$$

$$\frac{i_t^H}{1+i_t^H} M_t = w_m \cdot P_t \cdot C_t, \quad (22-4)$$

$$\beta(1+i_t^H) E_t d\lambda_{t,t+1} = 1, \quad (22-5)$$

$$e_t = \beta(1+i_t^F) E_t e_{t+1} \cdot (d\lambda_{t+1}), \quad (22-6)$$

$$\text{and } V_{J,t} = \beta E_t (V_{J,t+1} + \Pi_{J,t+1}) \cdot (d\lambda_{t,t+1}) \quad (J=H \text{ or } N) \quad (22-7)$$

Aggregation over firms

On the firm side, note that all the firms in the same sector are assumed to be completely symmetric. Hence, in equilibrium, all of them make the same decisions. Denote aggregate profit, output, capital stock, labor demand, non-wage expenditure, investment, adjustment costs of capital and prices of sector J as, $\Pi_{J,t}$, $Y_{J,t}$, $K_{J,t-1}$, $L_{J,t}$, $E_{J,t}$, $I_{J,t}$, $ACK_{J,t}$, $ACP_{J,t}$, respectively ($J=H$ or N). Also denote the average price charged by sector J as $P_{J,t}$. Basically, we only need to drop the subscripts (j):

$$\Pi_{J,t} = P_{J,t} \cdot Y_{J,t} - W_t \cdot L_{J,t} - P_t \cdot E_{J,t}, \quad (23-1)$$

$$E_{J,t} = I_{J,t} + ACK_{J,t} + ACP_{J,t}, \quad (23-2)$$

$$Y_{J,t} = A_{J,t} \cdot K_{J,t-1}^\alpha \cdot (\Gamma_t \cdot L_{J,t})^{1-\alpha} \quad (23-3)$$

$$ACK_{J,t} = \frac{\phi_K}{2} \cdot \frac{(K_{J,t}/((1+n)(1+\gamma)) - K_{J,t-1})^2}{K_{J,t-1}}, \quad (23-4)$$

$$ACP_{J,t} = \frac{\phi_P}{2} \cdot \frac{(P_{J,t} - P_{J,t-1})^2}{P_t \cdot P_{J,t-1}} \cdot Y_{J,t}, \quad (23-5)$$

$$\text{and } I_{J,t} = K_{J,t} - (1-\delta)K_{J,t-1}. \quad (23-6)$$

Note that linear homogeneity of both the production and adjustment cost functions makes those aggregations possible. Likewise, the first order conditions become:

$$\begin{aligned} \frac{W_t/P_{J,t}}{MPL_{J,t}} &= \frac{\theta-1}{\theta} - ACP_{J,t} + \frac{1}{\theta} \cdot \\ & \left[\frac{\partial ACP_{J,t}}{\partial P_{J,t}} + \beta E_t d\lambda_{t,t+1} \cdot \frac{\partial ACP_{J,t+1}}{\partial P_{J,t}} \right], \end{aligned} \quad (23-7)$$

$$\begin{aligned} \text{and } \beta E_t d\lambda_{t,t+1} \cdot W_{t+1} \frac{MPK_{J,t+1}}{MPL_{J,t+1}} \\ &= P_t \left[1 + \frac{\partial ACK_{J,t}}{\partial K_{J,t}} \right] + \beta E_t d\lambda_{t,t+1} \cdot \\ & P_{t+1} \left[\delta - 1 + \frac{\partial ACK_{J,t+1}}{\partial K_{J,t}} \right] \end{aligned} \quad (23-8)$$

Aggregate private demands

Now we move on to characterize aggregate private demands. Define overall aggregate private expenditure as follows:

$$PRIV_t = C_t + E_{H,t} + E_{N,t} \quad (24-1)$$

Given the assumption that the form of the composite goods indices for households and firms are identical, we can write aggregate demand for different types of goods, denoted also by "PRIV", as:

$$\begin{aligned} PRIV_{T,t} &= \omega \cdot \left[\frac{P_{T,t}}{P_t} \right]^{-\eta} \cdot PRIV_t, \\ PRIV_{N,t} &= (1-\omega) \cdot \left[\frac{P_{N,t}}{P_t} \right]^{-\eta} \cdot PRIV_t \end{aligned} \quad (24-2)$$

$$\begin{aligned} PRIV_{H,t} &= \phi \cdot \left[\frac{P_{H,t}}{P_{T,t}} \right]^{-\rho} \cdot PRIV_{T,t}, \\ PRIV_{F,t} &= (1-\phi) \cdot \left[\frac{P_{F,t}}{P_{T,t}} \right]^{-\rho} \cdot PRIV_{T,t} \end{aligned} \quad (24-3)$$

2.5 Government

Government expenditure, G_t , is also a composite goods index. Its structure is basically the same as that for households, but we allow the share parameters to differ from those of households.

$$G_t = [(\omega^g)^{1/\eta} G_{T,t}^{(\eta-1)/\eta} + (1-\omega^g)^{1/\eta} G_{N,t}^{(\eta-1)/\eta}]^{\eta/(\eta-1)} \quad (25-1)$$

$$G_{T,t} = [(\phi^g)^{1/\rho} G_{H,t}^{(\rho-1)/\rho} + (1-\phi^g)^{1/\rho} G_{F,t}^{(\rho-1)/\rho}]^{\rho/(\rho-1)} \quad (25-2)$$

$$\text{and } G_{J,t} = \left[\int G_{J,t}(j)^{(\theta-1)/\theta} dj \right]^{\theta/(\theta-1)} \quad (J=H, N, \text{ or } F). \quad (25-3)$$

The share parameters, ω^g , ϕ^g , are between 0 and 1. The corresponding price indices are suitably defined as follows:

$$P_t^g = [\omega^g P_{T,t}^{1-\eta} + (1-\omega^g) P_{N,t}^{1-\eta}]^{1/(1-\eta)} \quad (26-1)$$

$$\text{and } P_{T,t}^g = [\phi^g P_{H,t}^{1-\rho} + (1-\phi^g) P_{F,t}^{1-\rho}]^{1/(1-\rho)} \quad (26-2)$$

Government demand functions are given by:

$$G_{T,t} = \omega^g \cdot \left[\frac{P_{T,t}^g}{P_t^g} \right]^{-\eta} \cdot G_t,$$

$$G_{N,t} = (1 - \omega^g) \cdot \left[\frac{P_{N,t}}{P_t^g} \right]^{-\eta} \cdot G_t \quad (27-1)$$

$$G_{H,t} = \omega^g \cdot \left[\frac{P_{H,t}}{P_t^g} \right]^{-\rho} \cdot G_{T,t},$$

$$G_{F,t} = (1 - \phi^g) \cdot \left[\frac{P_{F,t}}{P_t^g} \right]^{-\rho} \cdot G_{T,t} \quad (27-2)$$

$$\text{and } G_{J,t}(j) = \left[\frac{P_{J,t}(j)}{P_{J,t}} \right]^{-\theta} \cdot G_{J,t} \quad (J = H, N, \text{ or } F). \quad (28)$$

We assume that the log of government expenditure follows an AR(1) process:

$$\ln G_t - \ln G^* = \rho_G \cdot (\ln G_{t-1} - \ln G^*) + e_G, \quad (29)$$

where G^* is the steady state government expenditure which is constant, the AR(1) coefficient satisfies $-1 < \rho_G < 1$, and e_G follows an i.i.d. process.

Nominal taxes are levied according to the following process:

$$T_t = P_{G,t} \cdot G^* + \xi \cdot B_t^G \quad (30)$$

where B_t^G is the total government bonds outstanding, and ξ is a positive constant. If this coefficient is sufficiently large compared to the steady state home interest rate, it ensures sustainability of the government budget.

We assume that the government issues bond only to agents in "home" country. Then the budget constraint is:

$$P_{G,t} \cdot G_t + (1 + i_{t-1}^H) \cdot B_{t-1}^G = T_t + B_t^G. \quad (31)$$

As for monetary policy, for the moment, we assume that the central bank simply fixes the level of nominal money supply "per efficiency unit":

$$\bar{M}_t / ((1+n)^t \cdot (1+\gamma)^t) = \bar{M}, \quad (32)$$

where \bar{M} is a constant. In the later section, we will see how a deviation from such a specification might influence the results.

2.6 International environment

Foreign Country

"Foreign" country buys H goods from "home" country. It is assumed that the price elasticity of the overall foreign demand for H goods is equal to that of the home demand for H goods, ρ . It is also assumed that the price elasticity of the foreign demand for individual H firms is equal to that for the home demand, θ . Specifically,

$$X_t = \left(\frac{P_{H,t}}{e_t} \right)^{-\rho} \cdot Y_t^{FOR} \quad (33)$$

where X_t is the foreign demand for H goods, or home exports, and Y_t^{FOR} is an exogenous process that represents shifts in foreign demand. In our simulation, the latter is assumed to be fixed, for simplicity. Equation (33) implicitly assumes "Producer Currency Pricing" for H goods (or the Law of One Price). Also,

$$X_t(j) = \left[\frac{P_{H,t}(j)}{P_{H,t}} \right]^{-\theta} \cdot X_t,$$

where $X_t(j)$ is the foreign demand for firm j in the H goods producing sector.

On the other hand, "foreign" country sells F goods to "home" country. Its price is determined in the following way:

$$P_{F,t}(j) = e_t \cdot P_t^{FOR}$$

where $P_{F,t}(j)$ is the price of the j -th F goods denominated in the home currency unit, while P_t^{FOR} is the same price denominated in the foreign currency unit, which follows an exogenous process. In our simulations, the latter will be assumed to be constant, for simplicity. Equation (23) represents the assumption of "Producer Currency Pricing" for F goods (or the Law of One Price). Note that P_t^{FOR} is assumed to be common to all j 's. Thus,

$$P_{F,t} = e_t \cdot P_t^{FOR} \quad (34)$$

International financial market

Interest rates on domestic and foreign bonds, i_t^H and i_t^F , faced by the home households are linked through equations (22-5) and (22-6). Note that those two equations combined would imply the conventional uncovered interest rate parity (UIP) under certainty. On the other hand, the interest rate on foreign bonds consists of two components: the constant world interest rate, i^W , and the risk premium, κ_t . The latter depends on the overall position of the country in the international market:

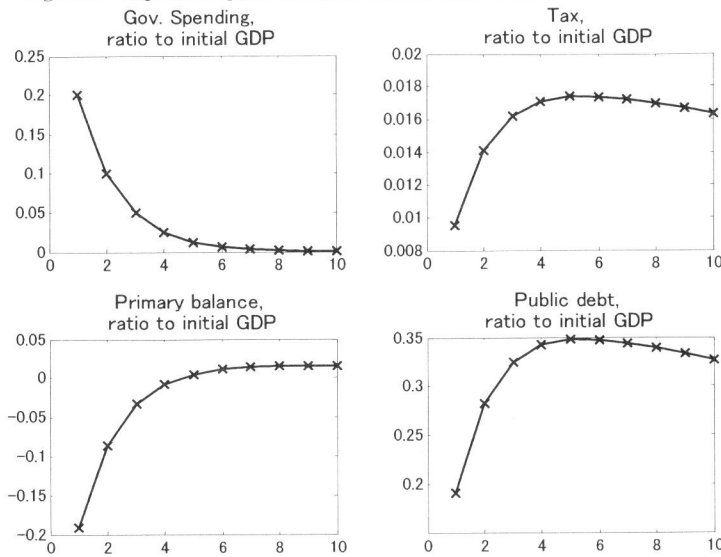
$$\begin{aligned} i_t^F &= i^W + \kappa_t \\ &= i^W + \varphi \cdot [\exp(-(B_t^F \cdot e_t) / NY_t) - 1]. \end{aligned} \quad (35)$$

In the above, B_t^F is the aggregate holdings of foreign bonds, and NY_t is the aggregate nominal output:

$$NY_t = P_{H,t} Y_{H,t} + P_{N,t} Y_{N,t}. \quad (36)$$

The parameter φ is positive. This is a modified version of the idea of "debt elastic interest rate" in Uribe and Schmitt-Grohé

Figure 1. Impulse Response Analysis: Underlying Process of Fiscal Variables



(2003)⁵⁾. As they emphasize, we need this (or an alternative assumption) to achieve stability of the whole system. Without it, the model would not satisfy the Blanchard and Kahn (1980) condition.

2.7 Market clearing

The goods market clearing conditions are:

$$Y_{H,t} = PRIV_{H,t} + G_{H,t} + X_t, \quad (37-1)$$

$$\text{and } Y_{N,t} = PRIV_{N,t} + G_{H,t}, \quad (37-2)$$

We take advantage of the Walras' law and drop the condition for F goods sector.

The labor market clearing condition is

$$L_t \cdot Pop_t = L_{H,t} + L_{N,t}. \quad (38)$$

In addition, the money market has to clear. Also, let us note that, as we assume that the government issues bonds only domestically, and the net lending among home private agents is equal to zero, we get the following:

$$B_t^H = B_t^G. \quad (39)$$

In summary, our equilibrium conditions are (20), (22), (23), (24), (26), (27), (29)–(39), plus definitions of the marginal products.

3. Impulse response analysis

In this section, we perform a set of simulations and analyze impulse responses of various variables to an increase in fiscal expenditure, G_t . We set the parameters as follows. First of all, we assume that there is no population growth or technological progress. Zero population growth implies that the

“birth rate” equals the “death rate”. Some of the parameters, namely A_H , A_N , δ , G^* , Y^{FOR} , P^{FOR} , w_h , w_m and β are chosen so that the steady state always satisfies the following numerical properties: $GDP=1$, $C=0.6$, $I=0.2$, $G=0.2$, $L=1/3$, $i^H=i^W=0.03$, and $P_H=P_N=P_F=1$ (which imply $P=1$, $e=1$, and $B^F=0$). Note that the share of each component of GDP is reasonable at this steady state. As indicated by the value of the interest rate (3%), one “period” in this exercise is considered to be one year. The other parameters are set as shown in

Table 1. The elasticities of substitution within each type of goods and between different types of goods are 5, 2, and 2 for θ , ρ , and η , respectively. The parameter on the cost of price adjustment, ϕ_P , is set to be equal to 200⁶⁾, while the adjustment cost parameter for capital accumulation, ϕ_K , is equal to 100. The private expenditure share parameters ω and ϕ are set to be 2/3 and 0.5, respectively, so that the share in the expenditure of the private sector is 1/3 for each of the three types of goods N, H, and F. The responsiveness of risk premium to foreign debt, φ , is set to be very small so that it would not affect the results in any serious way. We assume that the AR(1) parameter for government spending, ρ_G , is equal to 0.5, which means that public spending is not very persistent. On the other hand, ξ , the rate of debt repayment, is only 0.05. Thus, once the government increases its spending, most of it is financed by issuing debt, and taxes respond only very gradually. Figure 1 summarizes responses of fiscal policy variables to a unit shock to government spending under this setting. Note that, at the impact, taxes increase much less than government spending does, leading to a substantial budget deficit. Taxes increase gradually over time, but the response is so slow that, in the first five years, government debt keeps accumulating. Eventually, government spending comes down, while taxes remain high, to bring down the debt.

We study responses of various endoge-

Figure 2a. Effects of Biases in Government Expenditure
(Households have infinite horizon.)

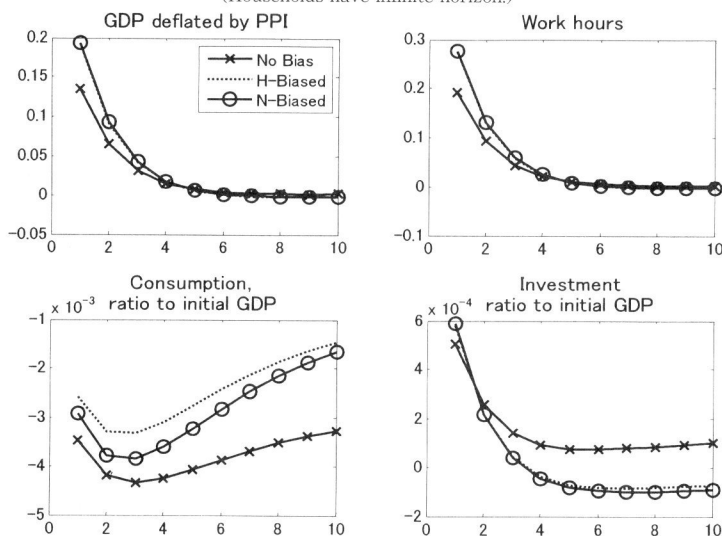
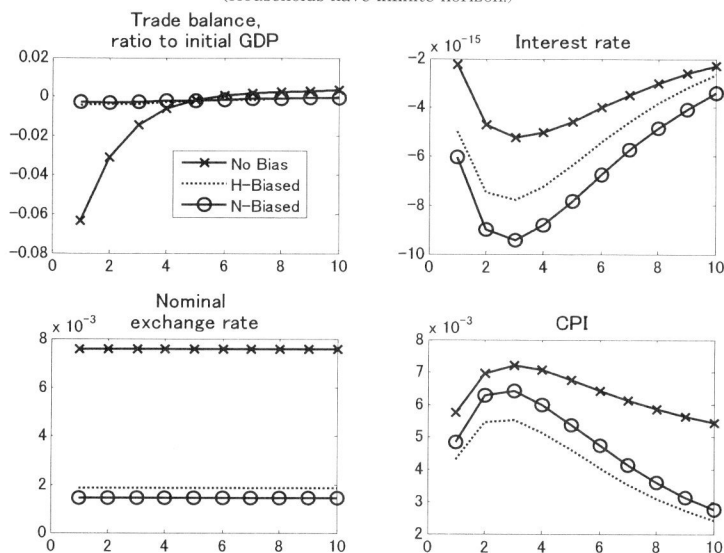


Figure 2b. Effects of Biases in Government Expenditure, Continued
(Households have infinite horizon.)



nous variables to a fiscal shock of the above characteristics. The simulation analysis is conducted in four steps. In the first analysis, we assume that the survival rate, q , is equal to one, that is, people have infinite horizon. Under this situation, we produce responses of various variables under different assumptions about patterns of sectoral allocation of government spending. The purpose is to see how biases in public expenditure might change the effects of a fiscal expansion. In the second analysis, we hold fixed the spending pattern, and see how deviations from infinite

horizon could alter the results. In the third analysis, we generalize the monetary policy rule and see how its specification affects the effects of fiscal policy. At the end of the section, we conduct some sensitivity analyses.

3.1 Effects of biases in government spending

Here, we assume that households are infinitely lived, that is, the Ricardian equivalence theorem holds. We focus on how differences in government spending patterns might affect responses to a fiscal expansion. The results are shown in Figures 2a and 2b. In each panel of the figures, three different impulse responses that correspond to different parameter setups are shown. The solid line with x's corresponds to the case of "no bias", which means that the government spends roughly two thirds of its expenditure on tradable goods, out of which a half is allocated to home tradables. This pattern is the same as that of households. The dashed line corresponds to the case of "H-biased" spending, in which ω^g is 0.99 and ϕ^g is set at 0.99. The line with circles corresponds to the case of "N-biased" expenditure, in which ϕ^g is set back

to 0.5 but ω^g is now 0.01. Hence most of fiscal purchases will be on non-tradables.

Note that the "H-biased" and the "N-biased" cases are mostly similar. On the other hand, those two cases differ noticeably from the "no bias" case. Hence, it seems less important on which type of domestically produced goods the government expenditure falls, but it is certainly of immense importance if the spending pattern has a "home bias" of some form. First, consider the response of output. In the "no bias case", output does increase, but the impact response is less

Figure 3a. Effects of Finite Horizon

(The spending pattern is N-biased.)

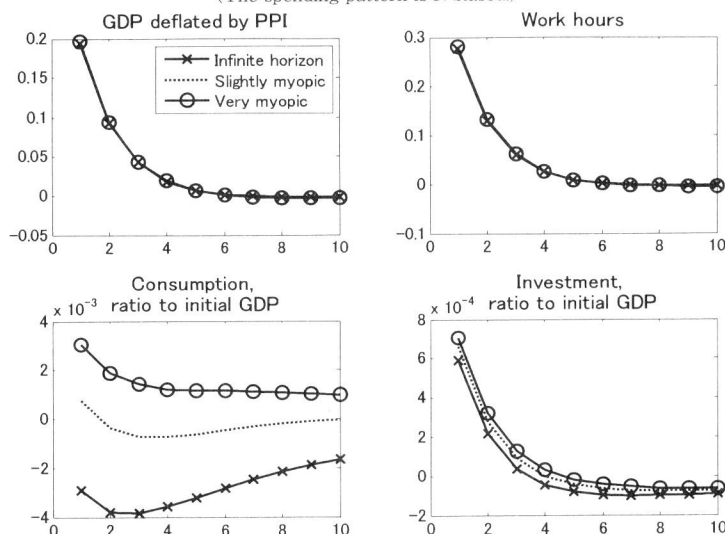
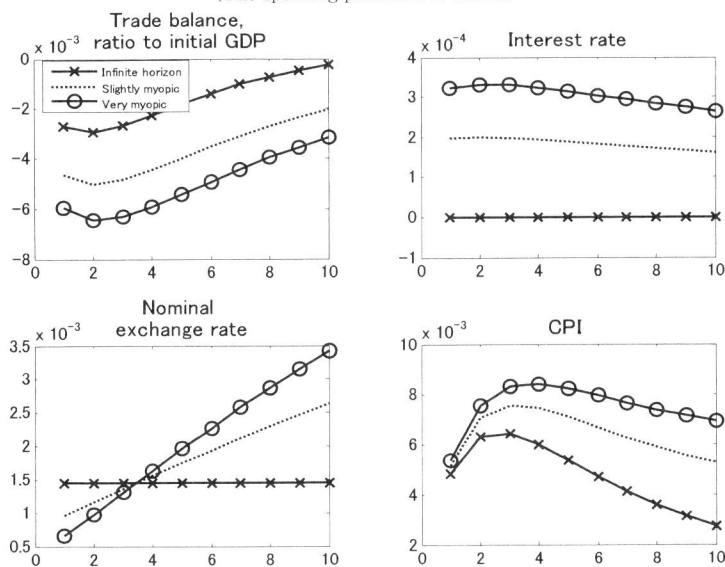


Figure 3b. Effects of Finite Horizon, Continued

(The spending pattern is N-biased.)



than 0.2, meaning that the fiscal multiplier is smaller than one⁷. In the case of home bias, output increases by almost 0.2 at the impact, which implies that the multiplier is almost exactly one. The difference comes from the fact that, when government spending is more biased toward home goods than the spending pattern of households, an increase in the former has an additional expenditure switching effect. Firms at home can increase their production at the expense of foreign producers.

Next, we study responses of consump-

tion, investment and trade balance. When government spending is not biased, its increase makes households poorer temporarily due to expected future tax increases. They offset a part of this by working harder, and thus output increases. They also respond by both reducing consumption and borrowing from abroad. The latter means that the home country's trade balance deteriorates. The figures show that, under the current set of parameter values, this latter effect is important: the fall in consumption is relatively minor in size, while trade balance worsens considerably. Also, note that fiscal expansion "crowds in", rather than crowds out, investment. As people are poorer in the disposable income sense, they try to mitigate this pain by piling up more capital inputs, which will allow them to earn more income in future. In contrast, when public expenditure is biased toward domestic goods, home households do not have to feel so poorer after a fiscal expansion, because, although their taxes are higher, those tax revenues are spent mostly on the goods that they produce. There are two opposing effects on labor supply (and thus output): on the one hand, the income effect is weaker, which induces people to increase work hours less aggressively, but, on the other hand, they are happy to work harder because they face a rising demand. Figure 2a shows that the latter effect is strong enough to induce households to work for longer hours than in the "no bias" case. As a consequence, consumption does not have to fall by a lot, because the loss in disposable income is smaller. Households have less reason to borrow from abroad to smooth consumption over time: in fact, trade

Table 1. Parameter Values for the Simulation

Parameter	Value
α	0.3
θ	5
γ	0
N	0
ϕ_P	200 (benchmark)
ϕ_K	100
ξ	0.05
η	2
ρ	2
ω	2/3
ϕ	0.5
φ	0.00001
i^w	0.1
ρ_G	0.5 (benchmark)
Q	1 (infinite horizon) 0.95 (slightly myopic) 0.9 (very myopic)
β	0.971 (infinite horizon) 0.992 (slightly myopic) 1.03 (very myopic)
ω^g	2/3 or 0.99 (if "H-biased") or 0.01 (if "N-biased")
ϕ^g	0.5 or 0.99 (if "H-biased")
χ	0 (fixed money rule) 5 (half way) 10 (near Taylor rule)

balance stays virtually unaffected in this case, as overall domestic demand switches away from foreign goods in favor of domestically produced goods.

In response to a fiscal expansion, the interest rate stays virtually unchanged in all cases, which is due to a very high interest semi-elasticity of the demand for money given in (5-3)⁸⁾. This weak response of the interest rate means there is little pressure for the exchange rate to appreciate: note that, in textbook open economy models, it is an increase in the interest rate that leads the exchange rate to appreciate after a fiscal expansion. In fact, the exchange rate depreciates, as domestic prices increase. Those responses are contrary to the popular view. Note, however, that, under the biased spending pattern, the magnitude of the depreciation becomes very small. Thus, introducing a realistic bias in government expenditure goes a half way toward resolving this apparent "puzzle".

3.2 Effects of finite horizon

Next, we hold fixed the spending pattern

of the government, and study how different degrees of household myopia might affect the results. In Figures 3a and 3b, we always assume that public expenditure is "N-biased". Different lines correspond to different underlying assumptions about household's planning time horizon. The line with x's again corresponds to the "infinite horizon" case in which q is equal to 1 (hence it is the same as the line with o's in Figure 2). The dashed line corresponds to the "slightly myopic" case in which $q=0.95$. The line with circles corresponds to the "very myopic" case in which q is as low as 0.9. As is stated in Table 1, these values of q require different values of β to fix the steady state interest rate at 3%.

Comparing those three lines in each panel, responses of output, work hours and investment are virtually the same. The most noticeable differences are found for the responses of consumption. Unlike in the "infinite horizon" case, consumption increases, rather than decreases, at least in the short run. The reason is that myopic households do not fully take into account increases in future tax burdens. Thus they do not feel that their lifetime disposable income has declined so much in the present value sense. In fact, given that the demand for the goods they produce increases, they are encouraged to consume more. This temporary increase in consumption induces the interest rate to increase, through the Euler equation relationship. This in turn means that, through the interest rate parity, the home currency has to be depreciating over time. This tilts the impact response of the exchange rate toward zero: it is apparent from the figure that this effect is not strong enough to turn this impact response negative. This is partly because domestic prices increase more strongly when households have finite horizons, due to consumption increases, and this places a stronger pressure on the domestic currency to depreciate. We can however at least say that introducing household myopia shifts the response of the exchange rate to the "right" direction, namely in the direction more consistent with the popular belief. We also note that trade deficit increases slightly under the household myopia, as consumption increases.

Figure 4. Role of Monetary Policy Rule
(The spending pattern is N-biased and $q=0.9$.)

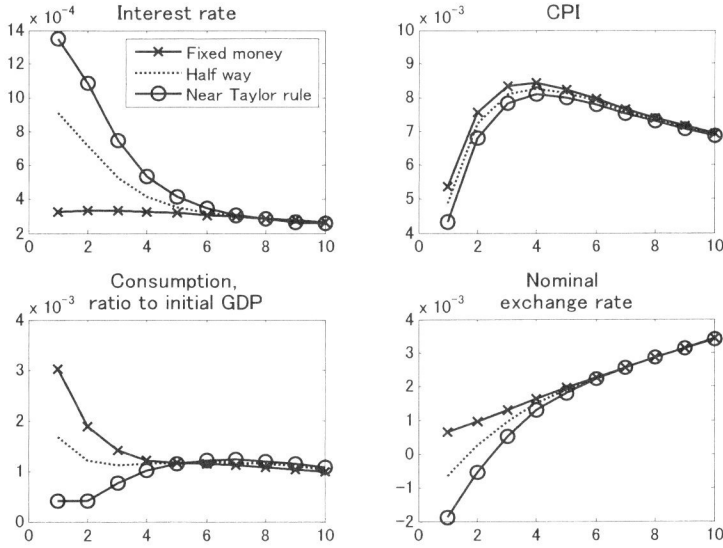
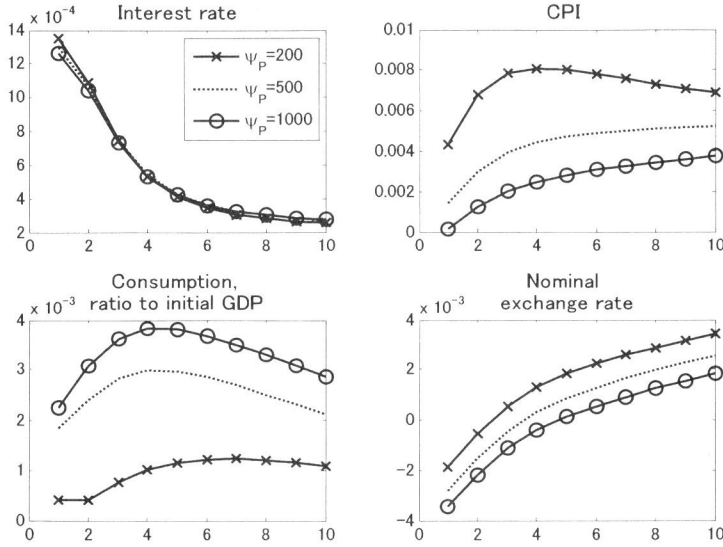


Figure 5. Role of Nominal Stickiness

(The spending pattern is N-biased, $q=0.9$, and monetary policy is near Taylor rule.)



3.3 Monetary policy rule and the effects of fiscal policy

We have so far assumed that the monetary authority simply fixes money supply. Now we generalize this and assume that there is an element of a Taylor-type interest rate targeting in the monetary policy rule. Concretely, we replace (32) with the following:

$$M_t = \bar{M} + \chi \cdot \{ (i_t - i_{ss}) - [a_i \cdot (i_{t-1} - i_{ss}) + (1 - a_i) \cdot (a_\pi \cdot (\pi_t - \pi_{ss}) + a_y \cdot (y_t - y_{ss}))] \} \quad (32')$$

In the above, the subscript "SS" denotes the steady state. Also, π_t is the CPI inflation rate and y_t is the logarithm of GDP. Note that, when we set the weighting parameter χ to be equal to zero, we are back to (32), i.e., the fixed money rule. As we increase χ , we get closer to the Taylor rule, and, in the limiting case of $\chi \rightarrow \infty$, we obtain a pure Taylor rule with interest rate smoothing. In the following exercise, we set $a_i=0.95$ (degree of interest rate smoothing), $a_\pi=1.5$, and $a_y=0.5$.

We consider those values to be standard. In Figure 4, we change the value of χ from zero to 5, and further to 10, assuming that the government is "N-biased", and that $q=0.9$. To save space, we present responses of only the interest rate, CPI, consumption and the exchange rate. Note that, as we move closer to the pure Taylor rule, the response of the interest rate becomes larger. This induces the exchange rate to appreciate. At the same time, however, those policy rules reduce substantially the effect on consumption, as the higher interest rate causes intertemporal substitution on the household side. Thus, the form of monetary policy rule

has large impacts on the effects of fiscal policy.

3.4 Robustness

In Figure 5, we repeat the same exercise as in Figure 4, fixing χ at 10, while changing the value of ϕ_P , the degree of nominal stickiness. Note that, as prices become more rigid, we observe stronger effects of a fiscal expansion: consumption increases more and the exchange rate appreciates more at the same time, as is expected.

In Figure 6, we perform another exercise

Figure 6. Role of Persistence of Government Spending

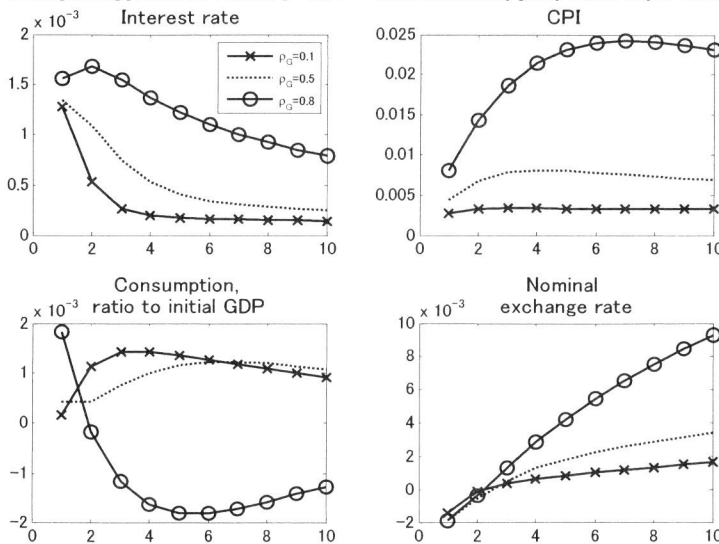
(The spending pattern is N-biased, $q=0.9$, $\psi=200$, and monetary policy is near Taylor rule.)

Table 2. Impact Effects of a Fiscal Expansion on the Exchange Rate and Consumption under Different Parameter Values

ϕ_P	q	c	exchange rate	consumption
200	3.1	0	+	+
200	3.1	5	-	+
200	3.1	10	-	+
200	5	0	+	+
200	5	5	-	+
200	5	10	-	+
500	3.1	0	-	+
500	3.1	5	-	+
500	3.1	10	-	+
500	5	0	-	+
500	5	5	-	+
500	5	10	-	+
1000	3.1	0	-	+
1000	3.1	5	-	+
1000	3.1	10	-	+
1000	5	0	-	+
1000	5	5	-	+
1000	5	10	-	+

Note 1: Entries “-” and “+” mean a decrease and an increase, respectively, in the corresponding variable. A decrease in the exchange rate means an appreciation.

Note 2: The government spending pattern is assumed to be N-biased. We also assume $q=0.9$ and $\rho_G=0.5$.

that is similar to Figure 5, but now we change the persistence parameter for the fiscal shock (ρ_G) (we thank Kengo Nutahara for encouraging us to conduct this analysis). In the figure, we assume that the spending pattern is N-biased, $q=0.9$, while fixing ϕ_P at its benchmark value of 200, and assuming a near Taylor-rule monetary policy ($\chi=10$). The main findings above do not change in this case. However, one thing that is noteworthy is that when $\rho_G=0.8$, we observe that

consumption rises sharply at the beginning but the response quickly turns negative subsequently. This is a result of two forces working in opposite directions, namely the expansionary demand effect and the tax burden effect. In the presence of a highly persistent government shock, initially the former is much stronger causing consumption to jump up, but gradually the latter overwhelms because government debt quickly increases, and so do taxes, which in turn reduce income and thus consumption of households.

In Table 2, we conduct a further robustness check on the impact effects of a fiscal expansion on consumption and the exchange rate. We assume that the spending pattern is N-biased, $q=0.9$, and $\rho_G=0.5$. We confirm that whether the exchange rate appreciates at the impact or not depends crucially on the values of the two parameters, namely the degree of price stickiness (ϕ_P) and the form of monetary policy rule (χ), while the value of the elasticity of substitution within each type of goods (θ) seems to affect the size but not the sign of response of the exchange rate. With a low value of ϕ_P (e.g. 200) and a low value of χ (e.g. zero), the appreciation of the exchange rate disappears. This is because, in such a case, domestic prices are not so rigid and thus the response of consumption is weak. This, together with the weak response of the monetary authority to changes in the real money demand causes a weak

response of the domestic interest rate. As a result, the exchange rate depreciates. When $\phi_P=1000$, i.e. prices are rigid enough, we observe an appreciation of the exchange rate even in the case in which the monetary authority fixes money supply. Turning to the results for consumption, it can be seen that the increase in consumption is robust across all parameter values.

4. Conclusion

We have shown that introducing both "home biases" in government spending and finite time horizons for households can potentially make the effects of fiscal policy more consistent with our prior beliefs about them, under certain parameter settings. Most notably, consumption responds positively, while the exchange rate appreciates. On the other hand, quantitatively speaking, these effects are rather limited: the value of the fiscal multiplier is around one, and the responses of consumption, the domestic interest rate and the exchange rate are small. One possible explanation for this is a relatively weak response of labor supply. This suggests that, for fiscal policy to play a greater role, finite horizon and nominal rigidities are not enough, and one might need to introduce real rigidities and/or other forms of myopia. In future research, we intend to continue our investigation of fiscal policy along these lines. We also intend to conduct a structural estimation of a dynamic model of a kind similar to the one presented in this paper using Japanese data.

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Notes

1) We thank our discussant Kengo Nutahara at the IER weekly seminar at Hitotsubashi University, for his insightful comments. We also thank participants at the International Conference of the ISR (Barcelona, September 2007), and seminars at Nihon University, Kobe University and Hitotsubashi University for their discussions. The first author thanks the Seimei Foundation for financial support.

2) Key Words: Fiscal Policy, New Open Economy Macroeconomics, Overlapping Generations Model, Non-tradable goods, JEL Codes: E12, E62, F41.

3) In our numerical simulation, however, we maintain the assumption of zero population growth, as we will see later.

4) This assumption is necessary to smooth out capital accumulation in an open economy setting, because borrowing from foreign countries is possible and thus investment might become volatile without any capital adjustment cost, resulting in unrealistically large swings in capital stock.

5) The only difference is that we normalize by NY_t .

6) See Keen and Wang (2007) for a comparison between the parameters on price rigidities in price

setting a la Calvo and a la Rotemberg.

7) Note that the share of government spending in GDP in the steady state is 0.2 and that, in this exercise, government spending increases by 1%.

8) It can be shown that under the utility function given in (3) and the parameter values set above, the interest semi-elasticity of money demand is $1/[i_{ss}(1+i_{ss})] = 32$, implying a very elastic money demand with respect to the interest rate.

References

- Adolfson, Malin, Stefan Laséen, Jesper Lindé, and Mattias Villani (2008) "Evaluating an Estimated New Keynesian Small Open Economy Model," *Journal of Economic Dynamics and Control*, Vol. 32, No. 8, pp. 2690–2721.
- Blanchard, O. J. (1985) "Debt, Deficits and Finite Horizons," *Journal of Political Economy* Vol. 93, No. 2, pp. 223–247.
- Blanchard, Olivier Jean and Kahn, Charles M. (1980) "The Solution of Linear Difference Models under Rational Expectations," *Econometrica*, Vol. 48, No. 5, pp. 1305–1311.
- Buiter, W. (1988) "Death, Birth, Productivity Growth and Debt Neutrality," *Economic Journal*, Vol. 98, No. 391, pp. 279–293.
- Christiano, Lawrence J., Mathias Trabandt and Karl Walentin (2010) "Introducing Financial Frictions and Unemployment into a Small Open Economy Model," Riksbank Research Paper No. 214.
- Clarida, Richard, Jordi Gali and Mark Gertler (2001) "Optimal Monetary Policy in Open versus Closed Economies: An Integrated Approach," *American Economic Review*, Vol. 91, No. 2, pp. 248–252.
- Ganelli, Giovanni (2005) "The New Open Economy Macroeconomics of Government Debt," *Journal of International Economics*, Vol. 65, No. 1, pp. 167–184.
- Ganelli, Giovanni and Juha Tervala (2010) "Public Infrastructures, Public Consumption, and Welfare in a New-open-economy-macro Model," *Journal of Macroeconomics*, Vol. 32, No. 3, pp. 827–837.
- Keen, Benjamin and Yongsheng Wang (2007) "What is a Realistic Value for Price Adjustment Costs in New Keynesian Models?" *Applied Economics Letters*, Vol. 14, No. 11, pp. 789–793.
- Obstfeld, Maurice and Kenneth Rogoff (1995) "Exchange Rate Dynamics Redux," *Journal of Political Economy*, Vol. 103, No. 3, pp. 624–660.
- Obstfeld, Maurice and Kenneth Rogoff (1996) *Foundations of International Macroeconomics*, Cambridge, MA: MIT Press.
- Pierdzioch, Christian (2004) "Capital Mobility and the Effectiveness of Fiscal Policy in Open Economies," *Journal of Macroeconomics*, Vol. 26, No. 3, pp. 465–479.
- Uribe, Martin, and Stephanie Schmitt-Grohé (2003) "Closing Small Open Economy Models," *Journal of International Economics*, Vol. 61, No. 1, pp. 163–185.
- Weil, Philippe (1989) "Overlapping Families of Infinitely-lived Agents," *Journal of Public Economics*, Elsevier, Vol. 38, No. 2, pp. 183–198.
- Yaari, M. (1965) "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer," *Review of Economic Studies*, Vol. 32, No. 2, pp. 137–160.