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Abstract

This paper incorporates international firm mobility into a new open economy macroeconomics model to analyze how allowing for international relocation of firms affects the impacts of government spending shocks on consumptions and the exchange rate. The paper shows that a home country government spending shock results in a proportionate decrease in the relative home consumption level and depreciation of the home currency. In addition, it is found that the depreciation increases (decreases) the relative real profits of firms located in the home country (abroad), and consequently firms relocate to the home country. The paper also shows that an increase in the degree of firm mobility weakens the effects of the government spending shocks on relative consumptions and the exchange rate.

JEL classification codes: E62; F2; F31; F41

Key words: Firms' location; Fiscal policy; Exchange rate; Consumption

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1. Introduction

In the new open economy macroeconomics (hereafter, NOEM) literature, international spillovers of fiscal policy have been studied extensively; see, e.g., Obstfeld and Rogoff (1995, 1996), Betts and Devereux (2000), Caselli (2001), Corsetti and Pesenti (2001), Cavallo and Ghironi (2002), Chu (2005) and Ganelli (2003, 2005a, 2005b).[1] This literature has focused on how the macroeconomic activity of each country and the exchange rate are influenced by unanticipated fiscal shocks under monopolistic distortions and sticky nominal prices (or wages).

However, since the publication of the Obstfeld and Rogoff (1995, 1996) papers, most NOEM models have assumed that firms are immobile across countries. Although it is feasible to explore the effects of a government spending shock in this framework under the assumption of a fixed international distribution of firms, recent empirical evidence suggests that exchange rates affect the locations of firms and their foreign direct investments (see, e.g., Cushman, 1985 and 1988, Froot and Stein, 1991, Campa, 1993, Klein and Rosengren, 1994, Goldberg and Kolstad, 1995, Blonigen, 1997, Goldberg and Klein, 1998, Bénassy-quéré et al, 2001, Chakrabarti and Scholnick, 2002, and Farrell et al., 2004).[2] For example, Campbell and Lapham (2004) find that real exchange rate movements have a significant effect on the relocation of establishments in U.S. retail trade industries located near the U.S.-Canada border. Therefore, it is obvious that the relationship between international relocation of firms and nominal exchange rates is an

[1] Other related references include Senay (1998), Lombardo and Sutherland (2004), Pierdzioch (2004), Choi (2005) and Ganelli and Tervala (2010). For surveys of the NOEM literature examining fiscal policy issues, see Lane and Ganelli (2003) and Coutinho (2005).

[2] For a survey of the literature examining determinants of foreign direct investment, see Blonigen (2005).

important aspect of observed exchange rate behavior in the recent rapid growth of international firm mobility.

However, in this literature, there has been little study of how allowing for international relocation of firms affects the macroeconomic impacts of policy shocks. One exception, however, is Johdo (2015), who presents a new NOEM model with international relocation of firms. In this literature, Johdo (2015) contrasts a two-country NOEM model without international relocation with a NOEM model with international relocation, and succeeds in showing explicitly the effects of one country's monetary expansion on the consumption of the two countries and the exchange rate, leading to firm relocation to the other country. However, the literature does not consider the impacts of a government spending shock on international relocation and other macroeconomic variables, including consumption and the exchange rate.

In this paper, we propose a NOEM model that incorporates the international movement of imperfectly competitive firms and government consumption spendings. In this model, as in Johdo (2015), the driving force behind firm mobility is the firms' real profit differential between the two trading countries. In particular, a novel feature of our model is that the international spatial distribution of firms responds to exchange rate movements caused by government spending shocks. This implies that our model generates a new international transmission effect that operates through the international relocation of firms, which has been overlooked by the NOEM literature examining fiscal policy issues.

We conclude that a government spending shock in the home country results in a proportionate decrease in the relative home consumption level and depreciation of the home currency. In addition, it is found that the depreciation increases (decreases) the relative real profits of firms located in the home country (abroad), and consequently firms relocate to the home country. Finally, we show that an increase in the degree of firm mobility weakens the effect of government spending shocks on relative consumptions and the exchange rate.

The remainder of this paper is structured as follows. In Section 2, we outline the features of the dynamic optimizing model. In Section 3, we present the symmetric equilibrium with flexible nominal wages. In Section 4, we present a log-linearized version of this model and explain how exchange rate changes affect the international relocation of firms. In Section 5, we examine how an unanticipated government spending shock affects the international distribution of firms, the exchange rate, and cross-country differences in consumption. In Section 6, we examine the welfare effects of government spending shocks. The final section summarizes the findings and concludes the paper.

2. Model structure

We assume a two-country world economy, with a home and a foreign country. The models for the foreign and home countries are the same, and an asterisk is used to denote foreign variables. There is monopolistic competition in the markets for goods and labor, whereas the markets for money and international bonds are perfectly competitive. Monopolistically competitive firms exist continuously in the world in the [0, 1] range. Each firm uses only domestic labor as an input and produces a single differentiated product. Each product is freely traded and firms earn positive pure profits. Firms are mobile internationally, but their owners are not. Producers in the interval [0,

n_t] locate in the home country in period t, and the remaining (n_t, 1] producers locate in the foreign country, where n_t is endogenous. The size of the world population is normalized to unity. We assume that in the home country, households inhabit the interval [0, s] and those in the foreign country inhabit the interval (s, 1].

Home and foreign households have perfect foresight and share the same utility function. The intertemporal objective of household $i \in (0, s)$ in the home country at time 0 is to maximize the following lifetime utility:[3]

$$U^i_0 = \sum_{t=0}^{\infty} \beta^t \left(\log C^i_t + \chi \log(M^i_t/P_t) - (\kappa/2)(\ell^{si}_t)^2\right), \quad (1)$$

where $0 < \beta < 1$ is a constant subjective discount factor, ℓ^{si}_t is the amount of labor supplied by household i in period t, and the consumption index C^i_t is defined as follows:

$$C^i_t = \left(\int_0^1 C^i_t(j)^{(\theta-1)/\theta} dj\right)^{\theta/(\theta-1)}, \ \theta > 1, \quad (2)$$

where θ is the elasticity of substitution between any two differentiated goods and $C^i_t(j)$ is the consumption of good j in period t for household i.[4] In addition, the second term in (1) is real money balances (M^i_t/P_t), where M^i_t denotes nominal money balances held at the beginning of period $t + 1$, and P_t is the home country consumption price index (CPI), which is defined as $P_t = \left(\int_0^1 P_t(j)^{1-\theta} dj\right)^{1/(1-\theta)}$, where $P_t(j)$ is the home-currency price of good j in period t. Analogously, the foreign country CPI is $P_t^* = \left(\int_0^1 P_t^*(j)^{1-\theta} dj\right)^{1/(1-\theta)}$,

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[3] In what follows, we mainly focus on the description of the home country because the foreign country is described analogously.

[4] Throughout the paper, we also use the index $j \in [0, 1]$ to refer to the product of firm j.

where $P_t^*(j)$ is the foreign-currency price of good j in period t. Under the law of one price, we can rewrite the price indexes as

$$P_t = \left(\int_0^{n_t} P_t(j)^{1-\theta} dj + \int_{n_t}^1 \left(\varepsilon_t P_t^*(j)\right)^{1-\theta} dj\right)^{1/(1-\theta)}, \; P_t^* = \left(\int_0^{n_t} \left(P_t(j)/\varepsilon_t\right)^{1-\theta} dj + \int_{n_t}^1 P_t^*(j)^{1-\theta} dj\right)^{1/(1-\theta)}.$$

Because there are no trade costs between the two countries, the law of one price holds for any variety j; i.e., $P_t(j) = \varepsilon_t P_t^*(j)$, where ε_t is the nominal exchange rate, defined as the home currency price per unit of foreign currency. Given the law of one price, a comparison of the above price indexes implies that purchasing power parity (PPP) is represented by $P_t = \varepsilon_t P_t^*$. In this context, we assume that there is an international risk-free real bond market and that real bonds are denominated in units of the composite consumption good. At each point in time, households receive returns on risk-free real bonds, earn wage income by supplying labor, and receive profits from all firms equally. Therefore, the household budget constraint can be written as:

$$P_t B^i_{t+1} + M^i_t = P_t(1+r_t)B^i_t + M^i_{t-1} + W^i_t \ell^{si}_t$$

$$+ \left(\int_0^{n_t} \Pi_t(j) dj + \int_{n_t}^1 \varepsilon_t \Pi_t^*(j) dj\right) - P_t C^i_t - P_t \tau^i_t, \tag{3}$$

where B^i_{t+1} denotes real bonds held by home agent i in period $t + 1$; r_t denotes the real interest rate on bonds that applies between periods $t - 1$ and t; $W^i_t \ell^{si}_t$ is nominal labor income, where W^i_t denotes the nominal wage rate of household i in period t; $\int_0^{n_t} \Pi_t(j) dj$ ($\int_{n_t}^1 \varepsilon_t \Pi_t^*(j) dj$) represents the total nominal profit flows of firms located in home (abroad) from sales of products; $P_t C^i_t$ represents nominal consumption expenditure; and τ^i_t denotes real lump-sum taxes. Note that all variables in (3) are measured in per capita terms. In the government sector, we assume that government spending is purely dissipative and that it is financed by lump-sum taxes and seigniorage revenues derived from printing the national currency. Hence, the government budget constraint in the home country is $sG_t = \tau_t + [(M_t - M_{t-1})/P_t]$, where sG_t denotes aggregate government spending, M_t is aggregate money supply, and $\tau_t = \int_0^s \tau_t^i di$.

In the home country, firm $j \in [0, n_t]$ hires a continuum of differentiated labor inputs domestically and produces a unique product in a single location according to the CES production function, $y_t(j) = (s^{-1/\phi}\int_0^s \ell_t^{di\ (\phi-1)/\phi} di)^{\phi/(\phi-1)}$, where $y_t(j)$ denotes the production of home-located firm j in period t, $\ell^{di}{}_t(j)$ is the firm j's input of labor from household i in period t, and $\phi > 1$ is the elasticity of input substitution. Given the home firm's cost minimization problem, firm j's optimal labor demand function for household i's labor input is as follows:

$$\ell^{di}{}_t(j) = s^{-1}(W^i_t/W_t)^{-\phi} y_t(j), \tag{4}$$

where $W_t \equiv (s^{-1}\int_0^s W_t^{i\ (1-\phi)} di)^{1/(1-\phi)}$ is a price index for labor input.

We now consider the dynamic optimization problem of households. In the first stage, households in the home (foreign) country maximize the consumption index C^i_t ($C^{i\,*}_t$) subject to a given level of expenditure $P_t C^i_t = \int_0^1 P_t(j) C^i_t(j) dj$ ($P_t^* C^{i\,*}_t = \int_0^1 P_t^*(j) C^{i\,*}_t(j) dj$) by optimally allocating differentiated goods. This static problem yields the following demand functions for good j in the home and foreign countries, respectively:

$$C^i_t(j) = (P_t(j)/P_t)^{-\theta} C^i_t, \quad C^{i\,*}_t(j) = (P_t^*(j)/P_t^*)^{-\theta} C^{i\,*}_t. \tag{5}$$

As in the NOEM literature, we also assume that the government's consumption index is the same as the household sector's, given by (2). Therefore, the government's demand functions for good j in the home and foreign countries are the same as those of the household sector. Aggregating the demands in (5) across all households worldwide and equating the resulting equation to the output of good j produced in the home country, $y_t(j)$, yields the following market-clearing condition for any product j in period t:

$$y_t(j) = sC^i_t(j) + (1-s)C^{i*}_t(j) + sG_t + (1-s)G_t^* = (P_t(j)/P_t)^{-\theta}(C_t^w + G_t^w), \tag{6}$$

where $P_t(j)/P_t = P_t^*(j)/P_t^*$ from the law of one price, and $C_t^w \equiv (sC^i_t + (1-s)C^{i*}_t)$ and $G_t^w \equiv (sG_t + (1-s)G_t^*)$ are aggregate per capita world consumption and government spending, respectively.[5] Similarly, for product j of the foreign located firms, we obtain $y_j^* = (P_t^*(j)/P_t^*)^{-\theta}(C_t^w + G_t^w)$. In the second stage, households maximize (1) subject to (3). The first-order conditions for this problem with respect to B^i_{t+1} and M^i_t can be written as

$$C^i_{t+1} = \beta(1 + r_{t+1})C^i_t, \tag{7}$$

$$M^i_t/P_t = \chi C^i_t((1 + i_{t+1})/i_{t+1}), \tag{8}$$

where i_{t+1} is the nominal interest rate for home-currency loans between periods t and $t+1$, defined as usual by $1 + i_{t+1} = (P_{t+1}/P_t)(1 + r_t)$. Equation (7) is the Euler equation for consumption and (8) is the one for money demand.

In the monopolistic goods markets, each firm has some monopoly power over pricing. Because home-located firm j hires labor domestically, given W_t, P_t, C^w_t, G^w_t,

[5] Throughout the paper, we use the superscript w for aggregated per capita world variables.

and n_t and subject to (4) and (6), home-located firm j faces the following profit-maximization problem: $\max_{P_t(j)} \Pi_t(j) = P_t(j)y_t(j) - \int_0^s W_t^i \ell_t^{di}(j)di = (P_t(j) - W_t)y_t(j)$. By substituting $y_t(j)$ from equation (6) into the firm's profit $\Pi_t(j)$ and then differentiating the resulting equation with respect to $P_t(j)$, we obtain the following price mark-up:

$$P_t(j) = (\theta/(\theta - 1))W_t. \tag{9}$$

Because W_t is given, from (9), all home-located firms charge the same price. In what follows, we define these identical prices as $P_t(j) = P_t(h)$, $j \in [0, n_t]$.[6] These relationships imply that each home-located firm supplies the same quantity of goods, and hence each firm requires the same quantity of labor; i.e., $\ell^{id}{}_t(j) = \ell^{id}{}_t(h)$, $j \in [0, n_t]$, where the firm index j is omitted because of symmetry. The price mark-ups of foreign-located firms are identical because $P_t^*(j) = P_t^*(f)$, $j \in (n_t, 1]$. Substituting (6) and (9) into the real profit flows of the home- and foreign-located firms, $\Pi_t(h)/P_t$ and $\Pi_t(f)^*/P_t^*$, respectively, yields

$$\Pi_t(h)/P_t = (1/\theta)(P_t(h)/P_t)^{1-\theta}(C_t^w + G_t^w),\ \Pi_t(f)^*/P_t^* = (1/\theta)(P_t^*(f)/P_t^*)^{1-\theta}(C_t^w + G_t^w). \tag{10}$$

The key feature of our model is that it allows firms to gradually adjust their locations. The model assumes that the driving force for relocation to other countries is a difference

6 We have used the index h to denote the symmetric values within the home country, and have used the index f for the foreign country.

in real profits between two bounded countries.[7] In addition, we assume that all firms are not allowed to relocate instantaneously even if there is the profit gap. Following the formulation in Johdo (2015), the above adjustment processes for relocation are formulated as follows:

$$n_t - n_{t-1} = \gamma[\Pi_t(h)/P_t - \Pi_t(f)^*/P_t^*] = \gamma[\Pi_t(h)/P_t - \varepsilon_t\Pi_t(f)^*/P_t], \tag{11}$$

where the third term can be rewritten by using PPP, and γ ($0 \leq \gamma < \infty$) is a constant positive parameter that determines the degree of firm mobility between the two countries: a larger value of γ implies higher firm mobility between two countries. Intuitively, the parameter γ reflects the costs falling on mobile firms in their new locations. Examples include the cost of finding appropriate plants, the cost of establishing the distribution networks, the cost of training the local workforce, the cost of coping with the foreign language, and the cost of adapting to the local legal system. Because of these costs, firms cannot move instantaneously to a better location even if a profit gap between two countries provides the motivation.

Following Corsetti and Pesenti (2001), we introduce nominal rigidities into the model in the form of one-period wage contracts under which nominal wages in period t are predetermined at time $t - 1$. In the monopolistic labor market, each household provides a single variety of labor input to a continuum of domestic firms. Hence, the equilibrium labor-market conditions for the home and foreign countries imply that $\ell^{si}{}_t$

[7] In the literature on multinational firms, Helpman et al. (2004) and Eckel and Egger (2009) derive the share of multinational firms endogenously by using this type of profit differential between exporting and multinational activity.

$=\int_0^{n_t} \ell_t^{di}(j)dj$, $i\in[0, s]$ and $\ell^{si*}{}_t = \int_{n_t}^{1} \ell_t^{di*}(j)dj$, $i\in(s, 1]$, respectively. By taking W_t, P_t, $y_t(j)$, and n_t as given, substituting $\ell^{si}{}_t = \int_0^{n_t} \ell_t^{di}(j)dj$ and equation (4) into the budget constraint given by (3), and maximizing the lifetime utility given by (1) with respect to $W^i{}_t$, we obtain the following first-order condition:

$$\kappa \ell^{si}{}_t{}^2 \phi (W^i{}_t/P_t)^{-1} = (\phi-1)(\ell^{si}{}_t/C^i{}_t). \tag{12}$$

The right-hand side of (12) represents the marginal consumption utility of additional labor income resulting from a decrease in the nominal wage rate. This term is positive because $\phi > 1$. The left-hand side represents the marginal disutility of an associated increase in labor effort.

The equilibrium condition for the integrated international bond market is given by $\int_0^s B_{t+1}^i di + \int_s^1 B_{t+1}^{*i} di = 0$. The money markets are assumed always to clear in both countries, so that the equilibrium conditions are given by $M_t = \int_0^s M_t^i di$ and $M^*{}_t = \int_s^1 M_t^{*i} di$, respectively.

3. A symmetric steady state

In this section, we derive the solution for a symmetric steady state in which all endogenous and exogenous variables are constant, initial net foreign assets are zero ($B_0 = 0$), $G_0 = G^*{}_0 = 0$ and $s = s^* = 1/2$. The superscript i and the index j are omitted because households and firms make the same equilibrium choices within and between countries. Henceforth, we denote the steady-state values by using the subscript ss. In the symmetric steady state, given the Euler equation for consumption (equation (7)), the steady-state real interest rate is given by

$$r_{ss} = (1 - \beta)/\beta \equiv \delta, \tag{13}$$

where δ is the rate of time preference. The steady-state allocation of firms is

$$n_{ss} = 1/2. \tag{14}$$

Hence, from (12), we obtain

$$\ell^{s}_{ss} = \ell^{s*}_{ss} = C_{ss} = C^{*}_{ss} = C^{w}_{ss} = y_{ss}(h) = y_{ss}^{*}(f) = ((\phi-1)/\phi)^{1/2}((\theta - 1)/\theta)^{1/2}(1/\kappa)^{1/2}. \tag{15}$$

Substituting C^{w}_{ss} from equation (15) into equation (11) yields the following steady-state levels of real profit for home- and foreign-located firms, which are equal:

$$\Pi_{ss}(h)/P_{ss} = \Pi_{ss}(f)^{*}/P_{ss}^{*} = (1/\theta)((\phi-1)/\phi)^{1/2}((\theta - 1)/\theta)^{1/2}(1/\kappa)^{1/2}. \tag{16}$$

4. Log linearizing around the steady state

To examine the macroeconomic effects of an unanticipated permanent government spending shock, we solve a log-linear approximation of the system around the initial, zero-shock steady state with $B_{ss,0} = 0$, as derived in the previous section. For any variable X, we use $\hat{X}$ to denote 'short run' percentage deviations from the initial steady-state value; i.e., $\hat{X} = dX_1 / X_{ss,0}$, where $X_{ss,0}$ is the initial, zero-shock steady-state value and subscript 1 denotes the period in which the shock takes place. These short-run percentage deviations are consistent with the length of nominal wage contracts. Thus, nominal wages and goods prices can be determined as $\hat{W} = \hat{W}^* = \hat{P}(h) = \hat{P}^*(f) = 0$ in the short-run log-linearized equations. In addition, we use $\overline{X}$ to denote 'long run' percentage deviations from the initial steady-state value; i.e., $\overline{X} = dX_2/X_{ss,0} = dX_{ss}/X_{ss,0}$, which is consistent with flexible nominal wages. Note that $X_2 = X_{ss}$ because the new steady state is reached at period 2.

By log-linearizing equation (11) around the symmetric steady state and setting $\hat{P}(h) = \hat{P}^*(f) = 0$, we obtain the following short-run log-linearized expression for the international distribution of firms:

$$\hat{n} = 2\gamma\left(\frac{\phi - 1}{\phi}\right)^{1/2}\left(\frac{\theta - 1}{\theta}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}\hat{\varepsilon}\,. \tag{17}$$

Equation (17) shows that an exchange rate depreciation induces global relocation of firms towards the home country.[8] Intuitively, with fixed nominal wages, which cause nominal product prices to be sticky because of mark-up pricing by monopolistic product suppliers, the depreciation increases relative home production through the 'expenditure-switching effect'; i.e., $\hat{y}(h) - \hat{y}^*(f) = \theta\hat{\varepsilon}$. This increases the relative profits of home-located firms, and consequently, other firms relocate to the home

[8] This result is consistent with the evidence found in the empirical literature on the relationship between exchange rates and FDI (e.g., Cushman, 1988, Caves, 1989, Froot and Stein, 1991, Campa, 1993, Klein and Rosengren, 1994, Blonigen, 1997, Goldberg and Klein, 1998, Bénassy-quéré et al, 2001, Chakrabarti and Scholnick, 2002, Kiyota and Urata, 2004, Bolling et al, 2007, and Udomkerdmongkol et al, 2008).

country.[9] Equation (17) also shows that nominal exchange rate changes have greater effects the greater is the flexibility of relocation (the larger is γ). By contrast, when relocation costs are high (γ = 0), nominal exchange rate changes have a negligible effect on the relocation of firms.

5. Government spending shocks

We now consider the macroeconomic effects of an unanticipated infinitesimal permanent increase in the relative spending level of the home government in period 1: $\overline{G} - \overline{G}^* = \hat{G} - \hat{G}^* > 0$, where $\hat{G} \equiv dG_t / C^w_{ss,0}$ and $\overline{G} \equiv dG_{t+1} / C^w_{ss,0}$. In particular, we analyze the influence of the government spending shock on relative consumptions, the nominal exchange rate, and the international distribution of firms. The closed-form solutions for the three key variables are as follows:

$$\hat{C} - \hat{C}^* = -\left(\frac{1}{A}\right)\left(\frac{1+\delta}{\delta}\right)\left(\overline{G} - \overline{G}^*\right) < 0, \tag{19}$$

$$\hat{\varepsilon} = \left(\frac{1}{A}\right)\left(\frac{1+\delta}{\delta}\right)\left(\overline{G} - \overline{G}^*\right) > 0, \tag{20}$$

$$\hat{n} = \left(\frac{2\gamma}{A}\right)\left(\frac{\phi-1}{\phi}\right)^{1/2}\left(\frac{\theta-1}{\theta}\right)^{3/2}\left(\frac{1}{\kappa}\right)^{1/2}\left(\frac{1+\delta}{\delta}\right)\left(\overline{G} - \overline{G}^*\right) > 0, \tag{21}$$

[9] The expenditure-switching effect arises intuitively because exchange rate depreciation causes a decrease in the relative real price of home goods for households in both countries so that world consumption demand switches toward home goods. Corsetti et al (2005) also define this as 'competitive effect'.

where $A=\tilde{\delta}+\delta^{-1}\tilde{\theta}\left[\dfrac{\theta-1+4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}\tilde{\kappa}^{1/2}}{\theta+1+4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}\tilde{\kappa}^{1/2}}\right]+\tilde{\theta}^{2}\left[\theta+4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{1/2}\tilde{\kappa}^{1/2}\right]$, $\tilde{\delta}\equiv(1+\delta)/\delta$, $\tilde{\theta}\equiv(\theta-1)/\theta$, $\tilde{\phi}\equiv(\phi-1)/\phi$, $\tilde{\kappa}\equiv1/\kappa$.[10] Equation (19) indicates that an unanticipated rise in domestic government spending results in a proportionate decrease in the relative home consumption level. This result is similar to that obtained from Obstfeld and Rogoff's (1995, 1996) models, in which the location of firms is assumed to be fixed. However, the mechanism for the relative consumption effect is different. The result in (19) can be explained intuitively as follows. First, under a given exchange rate, a rise in the domestic government spending results in the crowding out of home consumption, because the rise in the home country's government spending does not increase home output sufficiently to offset the rise in taxes. Hereafter, we shall call this the 'crowding-out effect'. The decrease in home consumption then leads to exchange rate depreciation. This happens because, given that the demand for real money balances is increasing with consumption, the home currency must depreciate and reduce the supply of real money balances in the home country to restore money market equilibrium (see equation (20)). The exchange rate depreciation causes consumption switching as world consumption demand shifts toward home goods because of the fall in the relative price of home goods. This in turn causes firms abroad to relocate to the home country because of the increase in the relative profits of firms located in the home country (see equation (21)). As a result, the relocation raises the relative labor income in the home country, which then raises the short-run relative consumption level in the home country. Hereafter, we shall call this the 'relocation effect'. Thus, the net response of relative

[10] Given that $\hat{\varepsilon}=\bar{\varepsilon}$ holds from the money-market equilibrium conditions, and given that $\hat{C}-\hat{C}^{*}=\overline{C}-\overline{C}^{*}$ also holds from the Euler consumption equations, the short-run equilibrium also holds in the long run.

home consumption levels depends on the relative strengths of these competing pressures. However, from equation (19), the negative crowding-out effect always dominates the positive relocation effect, and therefore such a government spending rise unambiguously leads to a decrease in the short-run relative home consumption.

It can also be seen from equation (19) that an increase in γ weakens the decreasing effects of a government spending shock on the relative home consumption level. Intuitively, under the negative crowding-out effect of the government spending, as the relocation of firms becomes more flexible (as γ increases), there is a greater relative increase in home labor income because more firms relocate to the home country, and therefore the positive relocation effect is greater.[11] Therefore, an increase in γ weakens the reduction in the short-run relative home consumption through the larger relocation effect. In addition, an increase in γ also weakens the effect of the government spending shock on the exchange rate depreciation. This is because the impact of the government spending shock on the exchange rate depends on the scale of the response of relative home consumption through adjustment in money markets.

6. Welfare effects

Following Obstfeld and Rogoff (1995, 1996), we focus on the real component of an agent's utility, which comprises terms involving consumption and labor effort. By defining this real component as U_0^R, we can rewrite equation (1)

[11] Equation (21) shows that an increase in γ magnifies the response of the relocation of firms to a government spending shock.

as $U_0^R = \sum_{t=0}^{\infty}\beta^t\left(log\, C_t - (\kappa/2)\ell_t^{s2}\right)$. Given that the new steady state is reached after just one period, total differentiation of this equation yields

$$dU_0^R = \hat{C} - \kappa\ell_{0,ss}^{s2}\hat{\ell}^s + (1/\delta)\left(\overline{C} - \kappa\ell_{0,ss}^{s2}\overline{\ell}^s\right), \tag{22}$$

where $\ell^s{}_{0,ss}$ denotes the initial steady-state level of labor supply. From (20) and (21), the changes in short-run relative labor efforts is

$$\hat{\ell}^s - \hat{\ell}^{s*} = 2\hat{n} + \hat{y} - \hat{y}^* = 2\hat{n} + \theta\hat{\varepsilon} = A^{-1}\tilde{\delta}\left[\theta + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}\tilde{\kappa}^{1/2}\right]\left(\overline{G} - \overline{G}^*\right) > 0\,, \tag{23}$$

and the changes in long-run relative labor efforts is

$$\overline{\ell}^s - \overline{\ell}^{s*} = A^{-1}\tilde{\delta}\left[\frac{\theta + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}\tilde{\kappa}^{1/2}}{\theta + 1 + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}\tilde{\kappa}^{1/2}}\right]\left(\overline{G} - \overline{G}^*\right) > 0\,. \tag{24}$$

Therefore, from (19), (22), (23), and (24), the impact of unanticipated government spending shocks on relative home welfare levels is then as follows:

$$\begin{aligned} &dU^R - dU^{*R} \\ &= -A^{-1}\tilde{\delta}\left\{\tilde{\delta} + \tilde{\phi}\tilde{\theta}\left[\theta + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}(1/\kappa)^{1/2}\right] + \left(\frac{\tilde{\phi}\tilde{\theta}}{\delta}\right)\left[\frac{\theta + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}(1/\kappa)^{1/2}}{\theta + 1 + 4\gamma\tilde{\phi}^{1/2}\tilde{\theta}^{3/2}(1/\kappa)^{1/2}}\right]\right\}\left(\hat{G} - \hat{G}^*\right) < 0 \end{aligned} \tag{25}$$

The result in (25) shows that an unanticipated rise in relative domestic government spending leads to a proportionate decrease in relative welfare levels. This is because a rise in the domestic government spending not only decreases relative home consumption, but also increases relative labor efforts. However, the relationship between the result of (25) and the degree of γ is ambiguous. Intuitively, on one hand, as the relocation of firms becomes more flexible (as γ increases), there is a smaller decrease in relative home consumption (see equation (19)), and therefore the decrease in the relative welfare level is smaller. On the other hand, as γ increases, there is a greater increase in relative home labor efforts because more firms relocate to the home country (see equation (23)), and therefore the decrease in relative welfare levels is greater. Accordingly, the net response of relative home welfare levels to γ is ambiguous.

7. Conclusion

In this paper, we generalized a NOEM model to allow for international relocation of firms between two countries. We used this generalized model to consider the question of how allowing for international relocation of firms between two countries affects the responses of relative consumptions, the exchange rates, and relative welfare levels to government spending shocks. The main findings of our analysis are that i) a home country government spending shock results in a proportionate decrease in the relative home consumption level and depreciation of the home currency, ii) the depreciation then decreases (increases) the relative real profits of firms located in the home country (abroad), and consequently firms relocate to the home country, iii) an increase in the degree of firm mobility weakens the effect of government spending shocks on relative consumptions and the exchange rate.

The model developed here is rather simple in a number of respects. This suggests many directions for future research. This paper may yield more interesting results if the present model is modified to include sunk costs, as in Russ (2007),[12] or non-tradable goods, as in Hau (2000), or trade protection such as tariffs, as in Fender and Yip (2000) and Reitz and Slopek (2005).[13] These issues remain for future research.

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[12] Campa (1993) finds a negative effect of sunk costs (e.g., investments in advertising and media promotion) on industry entry into the United States during the 1980s. Brainard (1997) also finds that overseas production by multinationals decreases the higher is the fixed cost of production.

[13] Reitz and Slopek (2005) extended the Fender and Yip framework to include the intertemporal linkages by taking short-run current account imbalances into consideration and showed different mechanisms for consumption and welfare effects of a tariff to those obtained from the benchmark Fender and Yip model. Other related references include Ryou (2002), Novy (2010), Hwang and Turnovsky (2013) and Wang and Zou (2013).

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