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## Multinational Activity in a Macroeconomic Model of the Small Open Economy

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# **HWWA Discussion Paper**

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# **Multinational Activity in a Macroeconomic Model of the Small Open Economy**

## **ABSTRACT**

We study the effects of FDI and increasing multinational activity utilizing a macroeconomic two-sector model of the small open economy with flexible exchange rates and perfect capital mobility. The focus is on horizontal greenfield investment and its impact on production, exchange rates, trade, and welfare. In the host country, an increase in multinational activity harms the established industries. Nevertheless it increases welfare. In the home country, an increase in multinational activity lowers domestic output of the established industries too and, thereby, decreases welfare.

**Keywords:** Foreign Direct Investment, Multinational activity, Welfare effects, Macroeconomic effects

**JEL classification:** F21, F41

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# 1 Introduction

The consequences of foreign direct investments (FDI) are an issue of major concern in the ongoing debate on international capital flows. Since the 1970s mainly developed, but also developing countries, experienced a remarkable increase in FDI. As a consequence in 2001 foreign affiliates accounted for nearly 11 percent of world GDP (UNCTAD (2002)). This highly intensified international economic integration gives rise to questions regarding the macroeconomic effects of foreign affiliate production on home and host countries, i.e. what happens to the terms of trade, trade patterns, domestic outputs, and welfare? Closely related to this set of questions are also important policy issues. Should governments promote, deter or simply neglect inward and outward FDI activities?

This paper incorporates horizontal foreign production into a monetary open economy model. Within this framework the effects of an increase in multinational activity on host and home countries are considered. Before proceeding to our model we briefly review the literature and present some important theoretical and empirical facts of FDI and multinational activity.

Early macroeconomic models analysed FDI within perfect competition, general-equilibrium trade models in the tradition of Heckscher-Ohlin. In those first models FDI was seen to arise as a pure matter of equity capital arbitrage. In his seminal contribution Hymer (1960) revealed that the predictions generated by those kinds of models were inconsistent with empirical observations. As is well known now, the Heckscher-Ohlin approach to FDI ignores important differences between portfolio investments and FDI, especially that portfolio capital flows are related to interest differentials while FDI flows are attached to a specific firm and, hence, do not enter any general financial market (Lipsey (1999)). As a consequence, interest differentials fail to explain FDI patterns. Furthermore an essential characteristic of FDI, as opposed to portfolio investments, is control of the investing firms over their foreign affiliates.<sup>1</sup>

A more coherent theoretical concept of multinational activity was developed within the industrial-organization approach to trade. Based on the OLI-Framework of Dunning (1981) and new trade models provided by Krugman (1979) and Helpman (1981) a series of studies like Markusen (1984), Brainard (1993), and Markusen and Venables (2000) explore the causes and consequences of horizontal multinational activity. In general, this class of models predicts that horizontal multinational activity emerges as a matter of trade costs and the requirement of a fixed input of resources at the firm and the plant level. Here multinational activity rests on a firm-specific, microeconomic trade-off between "proximity

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<sup>1</sup>Apart from interest rates, other important macroeconomic variables fail to explain FDI flows too. Recent empirical studies examine the causes and consequences of FDI and multinational activity in host and home countries. As to host country effects, Lipsey (2000) considers developed countries' FDI. He finds that neither the average nominal wage level nor the tax rate on companies significantly affect inward FDI. Summing up, we find that in developed countries FDI flows and multinational activity seem to be principally independent of important macroeconomic fundamentals like interest rates, average wage levels or tax rates on companies.

and concentration” to quote Brainard (1993). Furthermore, it relates the concept of the multinational firm to a world of monopolistic competition and heterogeneous goods. The latter is in sharp contrast to the aforementioned Heckscher-Ohlin approach to FDI.

The purpose of this paper is to consider the macroeconomic effects of an increase in multinational activity. Since FDI decisions depend on firmspecific rationale and fundamental macroeconomic variables fail to explain FDI flows we take FDI as given for the macroeconomy on the whole. Put differently, we treat FDI flows and resulting changes in output and trade patterns as exogenous shocks. By doing this we also distinguish FDI clearly from interest-driven portfolio flows.<sup>2</sup> As long as there is no strong interdependency between the macroeconomic causes and consequences of FDI this modelling strategy should not pose a problem.

Common monetary open economy models usually assume total specialization of countries in one good or a specific bundle of goods. In these models, one usually distinguishes domestic goods from foreign goods (or import goods). This distinction becomes blurred in a world with horizontal multinational activity, because the latter implies that a good is produced both at home and abroad. For instance, horizontal outward FDI leads to an increase in foreign output of the once domestic good.

To capture the consequences of horizontal multinational production we consider a two-sector model of the small open economy. Sector 1 produces the once domestic good 1 and sector 2, that has been raised by means of FDI, produces the once foreign good 2. Since FDI is about control we further assume that investment and output decisions in sector 2 are taken solely by the foreign investors. This could be justified by a lack of technology or knowledge such that domestic firms cannot produce good 2. This, again, contrasts sharply to the Heckscher-Ohlin models discussed earlier.

The paper is organized as follows: Section 2 develops the basic model. Section 3 explores the effects of horizontal multinational activity on trade, output, and welfare in the host country. In contrast section 4 discusses the impact of horizontal multinational activity on the home country.

## 2 The model

We consider a small open economy with flexible exchange rates and perfect capital mobility. The domestic interest rate  $i$  equals the world interest rate  $i^*$ , i.e.  $i = i^*$ . The economy consists of two sectors producing two different goods. Sector 1 generates domestic output of good 1  $Y_1$ . Sector 2, which has been raised by means of FDI, generates domestic output of the once foreign good 2  $Y_2$ . All individuals of the small open economy are assumed to have the same preferences and population size is normalized to 1. The representative individual’s utility function is given by

$$U = \alpha \log C_1 + \beta \log C_2 + \gamma \log S_1, \tag{1}$$

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<sup>2</sup>For a similar approach within a specific-factors model see Caves (1971).

with  $\alpha + \beta + \gamma = 1$  and  $\alpha, \beta, \gamma > 0$ . Here  $C_1$  denotes consumption of good 1,  $C_2$  denotes consumption of good 2, and  $S_1$  denotes savings measured in units of good 1.<sup>3</sup>  $\alpha, \beta$ , and  $\gamma$  denote the expenditure shares of good 1, good 2, and savings, respectively. The domestic price of good 1  $P_1$  and the foreign price of good 2  $P_2^*$  are assumed to be constant. Good 2 can be purchased either in the home and the host country. Therefore we suppose that the law of one price holds. Then the domestic price of good 2  $P_2$  (as measured in domestic currency) is  $P_2 = eP_2^*$ , where  $e$  denotes the nominal exchange rate. To be more precise  $e$  is the price of foreign currency in terms of domestic currency and  $P_2^*$  denotes the foreign price of good 2 (as measured in foreign currency). Assuming that  $P_2^*$  is given exogenously this implies that the domestic price of good 2  $P_2$  is a function of the nominal exchange rate  $e$ .

Individuals supply capital for domestic and foreign production of good 1. In addition they provide labour for the domestic production of good 1 and good 2. In return individuals receive  $P_1Y_1 + \kappa P_1Y_1^* + \omega P_2Y_2$ . Here the first term denotes the nominal value of domestic output of good 1. The second term denotes nominal interest earnings on outward FDI capital, where  $\kappa$  symbolizes the share of capital income in foreign output of good 1. Finally, the third term denotes the individuals' nominal income from sector 2, where  $\omega$  gives the share of labour income in domestic output of good 2 and, hence,  $(1 - \omega)$  gives the share of capital income of foreign direct investors. The macroeconomic analysis of capital flows reveals that for a small open economy with flexible exchange rates and perfect capital mobility outgoing FDI has no impact on net foreign assets. To be more precise an FDI outflow is followed by an endogenous capital inflow (portfolio investment) of equal size. Hence, net foreign assets remain constant, i.e.  $\kappa = 0$ . Contrary to that, one can show that incoming FDI lowers net foreign assets, such that  $0 < \omega < 1$ , see (Otto (forthcoming)). Taking account of the law of one price the individuals' budget constraint is

$$P_1Y_1 + \omega eP_2^*Y_2 = P_1C_1 + eP_2^*C_2 + P_1S_1.$$

The term on the left hand side of the equation represents nominal income and the right hand side shows nominal expenditures for good 1, good 2, and savings. The Lagrangian of the individuals' optimization problem is  $\mathcal{L} = \alpha \log C_1 + \beta \log C_2 + \gamma \log S_1 - \lambda(P_1C_1 + eP_2^*C_2 + P_1S_1 - P_1Y_1 - \omega eP_2^*Y_2)$ . The individuals take  $Y_1, Y_2$ , and  $e$  as given. Maximizing the Lagrangian, the first order conditions are:  $P_1C_1 = \alpha/\lambda$ ,  $eP_2^*C_2 = \beta/\lambda$ , and  $P_1S_1 = \gamma/\lambda$ .

Now use the first order conditions together with the budget constraint to obtain the demand functions

$$C_1 = \alpha(Y_1 + \omega eP_2^*Y_2/P_1), \tag{2}$$

$$C_2 = \beta(P_1Y_1/eP_2^* + \omega Y_2), \tag{3}$$

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<sup>3</sup>In our utility function savings serve as a shortcut for future consumption. Since the model is not intended to explore intertemporal aspects of multinational activity this shortcut only simplifies notation.



$$S_1 = \gamma(Y_1 + \omega e P_2^* Y_2 / P_1). \quad (4)$$

Equation (2) is the consumption function of good 1. Consumption of good 1 is proportional to real income, as measured in good 1,  $Y_1 + \omega e P_2^* Y_2 / P_1$ , where  $e P_2^* Y_2 / P_1$  is output of good 2, as measured in good 1. An increase in domestic output of good 1  $Y_1$ , an increase in domestic output of good 2  $Y_2$ , and an increase in the exchange rate  $e$  lead to an increase in consumption of good 1  $C_1$ . As to the exchange rate the reason for higher consumption of good 1 is that a depreciation of the domestic currency increases the domestic price of good 2  $P_2 = e P_2^*$ . Therefore, the purchasing power of domestic output of good 2, as measured in good 1, increases. Equation (3) is the consumption function of good 2. Consumption of good 2 is proportional to real income, as measured in good 2,  $P_1 Y_1 / e P_2^* + \omega Y_2$ , where  $P_1 Y_1 / e P_2^*$  denotes domestic output of good 1, as measured in good 2.  $C_2$  is increasing in domestic output of good 1  $Y_1$  and domestic output of good 2  $Y_2$ .  $C_2$  is decreasing in the nominal exchange rate  $e$ . The latter is because an appreciation of the domestic currency lowers the purchasing power of domestic output of good 1, as measured in good 2. Equation (4) is the savings function. Savings  $S_1$  are proportional to real income, as measured in good 1. In analogy to consumption of good 1, savings increase in domestic output of good 1  $Y_1$ , in domestic output of good 2  $Y_2$ , and in the exchange rate  $e$ .

We now proceed to the set-up of the goods market equations. For ease of exposition we begin with the market for good 2:

$$C_2 = Q_2 + Y_2,$$

where  $Q_2$  denotes imports. This equation states that domestic demand for good 2 can be served by imports and domestic output of good 2. We assume that domestic demand for good 2 always exceeds domestic output of good 2, i.e.  $C_2 > Y_2$ . This (realistically) ensures that the sign of imports is always positive and that domestic output of good 2 is sold entirely. In the short run, output of good 2 is determined by a limitational production function  $Y_2 = \min\{a_2 N_2, b_2 K_2\}$  with labour  $N_2$  and capital  $K_2$  as inputs and  $a_2$  and  $b_2$  as sector-specific productivities of labour and capital, respectively. We presume unemployment, so labour is not the limiting factor of production. Then domestic output of good 2 is limited by the capital stock installed in sector 2. Now, given that  $C_2 > Y_2$ , sector 2 always produces at full capacity. Hence, output of good 2 is given too. Now the endogenous variable of the goods market equation of good 2 is imports  $Q_2$ , which is the difference of domestic consumption of good 2 and domestic output of good 2

$$Q_2 = C_2 - Y_2.$$

Using equation (3) yields

$$Q_2 = \beta(P_1 Y_1 / e P_2^* + \omega Y_2) - Y_2. \quad (5)$$

For given levels of  $Y_2$ ,  $P_1$ , and  $P_2^*$  imports are increasing in domestic output of good 1  $Y_1$  and decreasing in the nominal exchange rate  $e$ . The latter stems from a deterioration of the *terms of trade*, that is associated with a depreciation of the domestic currency.

Domestic output of good 1 is determined endogenously by the demand for domestic output of good 1:

$$Y_1 = C_1 + X_1, \quad (6)$$

where  $C_1$  denotes domestic demand for good 1 and  $X_1$  denotes exports of good 1, i.e. foreign demand for domestic output of good 1. While  $C_1$  can be gathered from (2), the export equation will be derived in analogy to the import equation (5). Note that the small open economy, by increasing foreign output of good 1, has no significant influence on foreign income so as to induce repercussion effects. In contrast, an increase in foreign output of good 1 causes an immediate decline of exports since foreigners substitute imports of good 1 for foreign output of good 1. The import function of foreigners which corresponds to the domestic export function then is  $Q_1^* = X_1 = \beta^*(eP_2^*Y_2^*/P_1) - Y_1^*$ . Here  $Q_1^*$  is foreign import of good 1,  $Y_2^*$  is foreign output of good 2,  $Y_1^*$  is foreign output of good 1, and  $\beta^*$  is the foreign expenditure share of good 1. Foreign output of good 1  $Y_1^*$ , in analogy to domestic output of good 2  $Y_2$ , is given exogenously. Thus, the only endogenous variable left in the export function is the nominal exchange rate  $e$ . The export function can be restated as

$$X_1 = heP_2^*/P_1 - Y_1^*, \quad (7)$$

where we define  $h = \beta^*Y_2^*$ . The parameter  $h$  can be interpreted as the exchange rate sensitivity of exports, whereas  $Y_1^*$  represents the exogenous decline of export demand due to the increase in foreign output of good 1. We are now in a position to set up the goods market equation of good 1. Combine (2) and (7) with (6) to arrive at the goods market equation of good 1:

$$Y_1 = \alpha(Y_1 + \omega eP_2^*Y_2/P_1) + heP_2^*/P_1 - Y_1^*.$$

Finally, we set up the money market equation. The behavioural functions are

$$M = const, \quad (8)$$

$$L = k(P_1Y_1 + \omega eP_2^*Y_2). \quad (9)$$

Equation (8) is the money supply function. It states that the monetary authority fixes nominal money supply  $M$ . Equation (9) is the money demand function. Nominal money demand  $L$  increases in domestic income of sector 1  $Y_1$ , domestic income of sector 2  $Y_2$ , and the nominal exchange rate  $e$ .  $k$  is a parameter with  $k > 0$ . The money market is in equilibrium if nominal money demand equals nominal money supply:  $M = L$ . Taking

account of the behavioural functions we reach the money market equation:

$$M = k(P_1Y_1 + \omega eP_2^*Y_2).$$

The model can now be summarized as consisting of three equations:

$$Y_1 = \alpha(Y_1 + \omega eP_2^*Y_2/P_1) + heP_2^*/P_1 - Y_1^*, \quad (10)$$

$$Q_2 = \beta(P_1Y_1/eP_2^* + \omega Y_2) - Y_2, \quad (11)$$

$$M = k(P_1Y_1 + \omega eP_2^*Y_2). \quad (12)$$

Equation (10) is the goods market equation of good 1, equation (11) is the goods market equation of good 2, and equation (12) is the money market equation. The endogenous variables are  $Y_1, Q_2$ , and  $e$ , while  $Y_1^*, Y_2, P_1, P_2^*$  and  $M$  are exogenous.

### 3 Host country effects of FDI

In this section we consider the effects of an increase in multinational activity on the host country. As stated above, domestic output of the once foreign good 2 is restricted by the capital stock in sector 2. Assume that incoming FDI increases the capital stock in sector 2. Due to the increase in capacity this results in an increase in domestic output of good 2. What are the consequences for domestic output of good 1, imports of good 2, and the nominal exchange rate? Take the total differential of the system (10) - (12) to obtain:

$$dY_1 = \alpha(dY_1 + \omega(P_2^*/P_1)(Y_2de + edY_2)) + h(P_2^*/P_1)de, \quad (13)$$

$$dQ_2 = \beta\left(\frac{P_1}{P_2^*}\left(\frac{edY_1 - Y_1de}{e^2}\right) + \omega dY_2\right) - dY_2, \quad (14)$$

$$0 = P_1dY_1 + \omega P_2^*(Y_2de + edY_2). \quad (15)$$

For a first finding, combine (13) and (15):

$$de = -\frac{\omega e}{\omega Y_2 + h}dY_2. \quad (16)$$

A rise in domestic output of good 2 leads to an appreciation of the domestic currency,  $e$  declines. By means of (16) we can now eliminate  $de$  in (13):

$$dY_1 = -\frac{\omega heP_2^*/P_1}{\omega Y_2 + h}dY_2. \quad (17)$$

That is, an increase in domestic output of good 2 causes a decline of domestic output in sector 1. A very useful way to interpret this result is to divide (15) by  $P_1$ . Now insert this term into equation (13). It is easy to see that domestic demand for good 1  $C_1$  does not alter. This is because  $C_1$  is a function of real income, as measured in good 1, which remains constant. Put differently, the increase in domestic output of good 2 has no effect on domestic demand for good 1,  $dC_1 = \alpha(dY_1 + \omega(P_2^*/P_1)(Y_2de + edY_2)) = 0$ . Instead, the change in domestic output of good 1 arises as a pure consequence of the decline in export demand for good 1, thus:  $dY_1 = h(P_2^*/P_1)de = dX_1$ . The reason for the decline in exports simply lies in the appreciation of the domestic currency, hence:

$$dX_1 = -\frac{\omega h e P_2^*/P_1}{\omega Y_2 + h} dY_2. \quad (18)$$

What is the chain of cause and effect? An increase in domestic output of good 2 raises income in sector 2. Therefore money demand increases and the domestic interest rate rises. Portfolio capital flows into the country, forcing the exchange rate to appreciate. As a consequence, export demand and domestic output of good 1 decrease till the decline of nominal income in sector 1 equals the increase in nominal income in sector 2.

Making use of the results obtained above we now derive the change of imports. Insert (16) and (17) in (14) to get

$$dQ_2 = \left( \frac{-\omega\beta h + \omega\beta P_1 Y_1 / e P_2^*}{\omega Y_2 + h} - (1 - \omega\beta) \right) dY_2. \quad (19)$$

Taking account of (10) and rearranging then leads us to

$$dQ_2 = - \left( \frac{\omega\beta}{\beta + \gamma} \frac{P_1 Y_1^* / e P_2^*}{\omega Y_2 + h} + \frac{(1 - \omega)\beta + \gamma}{\beta + \gamma} \right) dY_2.$$

Observe that the term in parenthesis is positive. That is to say, an increase in domestic output of good 2 causes a decline in imports. Though both the appreciation and the rise in income of sector 2 increase domestic demand for good 2, the increase in domestic output of good 2 exceeds the increase in domestic demand for good 2, i.e.  $dC_2/dY_2 < 1$ .

We have already pointed out that both exports and imports decline. We are now interested in the behaviour of net exports  $H$ . Note that exports are measured in units of good 1 while imports are measured in units of good 2. We assume the unit of account for net exports to be good 1. Multiplying with the real exchange rate  $eP_2^*/P_1$  then converts imports measured in good 2 into imports measured in good 1. Then net exports  $H_1$  in terms of good 1 are:  $H_1 = X_1 - eP_2^*Q_2/P_1$ . Insert (7) and (5) to receive  $H_1 = h e P_2^*/P_1 - Y_1^* - \beta(Y_1 + \omega e P_2^* Y_2 / P_1) + e P_2^* Y_2 / P_1$ . The total differential is

$$dH_1 = (h + Y_2 - \beta\omega Y_2) \frac{P_2^*}{P_1} de - \beta dY_1 + (e - \beta\omega e) \frac{P_2^*}{P_1} dY_2.$$

Finally, with help of (16) and (17) we derive

$$dH_1 = (1 - \omega) \frac{heP_2^*/P_1}{\omega Y_2 + h} dY_2.$$

As a result an increase in domestic output of good 2 leads to an increase in net exports.

Up to this point we have shown that an increase in domestic output of good 2 causes a decrease in domestic output of good 1. Obviously, this is not favorable to firms and individuals employed in sector 1. We are now interested whether the economy gains or loses on the whole. Therefore we address the important issue of welfare effects.

### 3.1 Welfare effects

As a point of reference for the examination of welfare effects, recall the individual's utility function (1). The total differential of the utility function is

$$dU = \alpha \frac{dC_1}{C_1} + \beta \frac{dC_2}{C_2} + \gamma \frac{dS_1}{S_1}. \quad (20)$$

The change in utility equals the sum of the relative changes of consumption of good 1, good 2, and of the relative change in savings, each of them weighted with their respective expenditure shares. The total differentials of equations (2) - (4) are

$$dC_1 = \alpha(dY_1 + \omega(P_2^*/P_1)(Y_2de + edY_2)), \quad (21)$$

$$dC_2 = \beta \left( \frac{P_1}{P_2^*} \left( \frac{edY_1 - Y_1de}{e^2} \right) + \omega dY_2 \right), \quad (22)$$

$$dS_1 = \gamma(dY_1 + \omega(P_2^*/P_1)(Y_2de + edY_2)). \quad (23)$$

From the total differential of the money market equation (15) we immediately conclude  $dC_1 = 0$  and  $dS_1 = 0$ . This arises from the fact that both consumption of good 1 and savings are functions of real income measured in good 1, which, as was pointed out above, stays constant. On the other hand, the change in consumption of good 2 can be calculated using equations (16) and (17) in combination with (22):

$$dC_2 = \frac{\beta(P_1Y_1/eP_2^* + \omega Y_2)}{\omega Y_2 + h} dY_2 = \frac{\omega C_2}{\omega Y_2 + h} dY_2.$$

An increase in domestic output of good 2 leads to an increase in consumption of good 2. The underlying reason is the appreciation of the domestic currency that lowers the domestic price of good 2  $P_2 = eP_2^*$ . This enables the individual to consume more of good 2. Now insert the differentials obtained above into (20) to arrive at

$$dU = \frac{\omega\beta}{\omega Y_2 + h} dY_2.$$

Hence, for an increase in domestic output of good 2 domestic welfare increases either. The welfare gain can be attributed to the rise in consumption of good 2.

## 4 Home country effects of FDI

In the preceding section we considered the effects of multinational production on the host country. Next we turn our attention to the effects of increased multinational activity on the home country, i.e. the country that invests. What are the macroeconomic consequences for a small open economy that invests abroad and, by doing that, increases foreign output of the once domestic good 1  $Y_1^*$ ?

Again, the analysis is based on the model summarized by the equations (10) - (12):

$$Y_1 = \alpha(Y_1 + \omega e P_2^* Y_2 / P_1) + h e P_2^* / P_1 - Y_1^*,$$

$$Q_2 = \beta(P_1 Y_1 / e P_2^* + \omega Y_2) - Y_2,$$

$$M = k(P_1 Y_1 + \omega e P_2^* Y_2).$$

The export function of the small open economy still is  $X_1 = h e P_2^* / P_1 - Y_1^*$ . The first term on the right hand side represents the part of the export function that reacts endogenously to changes of the exchange rate while the second term is exogenous. An increase of foreign output of good 1  $Y_1^*$  therefore initially leads to an immediate decline of exports of the same size. What are the consequences of this initial shock? The endogenous variables in equations (10)-(12) are  $Y_1, Q_2$ , and  $e$ . Taking the total differential then gives

$$dY_1 = \alpha(dY_1 + (\omega P_2^* Y_2 / P_1)de) + (h P_2^* / P_1)de - dY_1^*, \quad (24)$$

$$dQ_2 = \beta \frac{P_1}{P_2^*} \left( \frac{e dY_1 - Y_1 de}{e^2} \right), \quad (25)$$

$$0 = P_1 dY_1 + \omega P_2^* Y_2 de. \quad (26)$$

Let us start with the exchange rate. Combining (24) and (26) we can express the change in the exchange rate as

$$de = \frac{P_1}{P_2^* (\omega Y_2 + h)} dY_1^*. \quad (27)$$

That is to say, an increase in foreign output of the once domestic good 1 leads to a depreciation of the domestic currency. Now insert the preceding result into (24) to find out that in the new equilibrium domestic output of good 1 falls below its pre-shock level:

$$dY_1 = -\frac{\omega Y_2}{\omega Y_2 + h} dY_1^*, \quad (28)$$

with  $-1 < dY_1/dY_1^* \leq 0$ . Again the decline of domestic output of good 1 mirrors the

decline of exports  $X_1$ . Indeed the change in exports is  $dX_1 = (hP_2^*/P_1)de - dY_1^* = -(\omega Y_2/(\omega Y_2 + h))dY_1^*$ , which equals  $dY_1$ . Given  $Y_2 > 0$ , it is easy to see that in the new equilibrium the (overall) decline of exports is smaller than the initial export shock. The reason is that, due to the depreciation, export demand rises endogenously and partly offsets the initial export shock. To see this more clearly, take a closer look at how the shock pervades: The rise in foreign output of good 1  $Y_1^*$  directly diminishes export demand and, hence, domestic output of good 1. This lowers income of the domestic sector 1 and thus results in lower money demand. The domestic interest rate falls below the international interest rate and portfolio capital holders immediately shift their wealth to foreign countries. As a consequence the exchange rate climbs up until the interest gap is closed. The depreciation promotes higher export demand, such that in the new equilibrium the decline in domestic output of good 1 is smaller than the initial shock  $dY_1^*$ .

Next consider imports. Use (27) and (28) in combination with (25) to derive:

$$dQ_2 = -\beta \frac{P_1}{eP_2^*} \left( \frac{P_1 Y_1 / eP_2^* + \omega Y_2}{\omega Y_2 + h} \right) dY_1^*.$$

An increase in foreign output of good 1 causes a decrease in imports for two reasons. First, the fall of income in sector 1 lowers demand for good 2 and, second, due to the depreciation of the domestic currency the terms of trade deteriorate and lead to a lower demand for good 2 either. Notice further that the decrease in imports corresponds to the decline in demand for good 2. Since  $dQ_2 = dC_2 - dY_2$  and  $dY_2 = 0$  the change in imports reduces to  $dQ_2 = dC_2$ .

Net exports, as measured in good 1, are  $H_1 = heP_2^*/P_1 - Y_1^* - \beta(Y_1 + \omega eP_2^*Y_2/P_1) + eP_2^*Y_2/P_1$ . The total differential is

$$dH_1 = h \frac{P_2^*}{P_1} de - dY_1^* - \beta \left( dY_1 + \omega Y_2 \frac{P_2^*}{P_1} de \right) + Y_2 \frac{P_2^*}{P_1} de$$

Now substitute  $de$  and  $dY_1$  by means of (27) and (28) to obtain

$$dH_1 = \frac{(1 - \omega)Y_2}{\omega Y_2 + h} dY_1^*.$$

An increase of foreign output of good 1 increases net exports, as measured in good 1.

#### 4.1 Welfare effects

How does an increase of foreign output of good 1 affects welfare of the open economy? Again, recall the individual's Cobb-Douglas utility function (1) and take the total differential

$$dU = \alpha \frac{dC_1}{C_1} + \beta \frac{dC_2}{C_2} + \gamma \frac{dS_1}{S_1}. \quad (29)$$

The changes of consumption of good 1, good 2, and of savings are

$$dC_1 = \alpha(dY_1 + \omega Y_2(P_2^*/P_1)de), \quad (30)$$

$$dC_2 = \beta \left( \frac{P_1}{P_2^*} \left( \frac{e dY_1 - Y_1 de}{e^2} \right) \right), \quad (31)$$

$$dS_1 = \gamma(dY_1 + \omega Y_2(P_2^*/P_1)de). \quad (32)$$

Making use of the total differential of the money market equation (26) immediately shows that  $dC_1 = dS_1 = 0$ . As mentioned before, the change in consumption of good 2 equals

$$dC_2 = dQ_2 = -\frac{P_1}{eP_2^*} \left( \frac{C_2}{\omega Y_2 + h} \right) dY_1^*.$$

The decrease in consumption in good 2 stems from the deterioration of terms of trade and the decline of income in sector 1. Insert those results into (29) to see

$$dU = -\beta \frac{P_1/eP_2^*}{(\omega Y_2 + h)} dY_1^*.$$

Therefore, increasing foreign output of good 1 results in a welfare loss. The reason is the lower consumption of good 2.

## 5 Concluding Remarks

The macroeconomics of FDI and multinational activity are an important but so far rather neglected issue of international economics. To shed some light on these effects, we have considered a macroeconomic model of horizontal multinational activity for a small open economy with flexible exchange rates and perfect capital mobility. We proposed a macroeconomic two-sector model, where sector 1 produces the once domestic good 1 and sector 2 produces the once foreign good 2. In the host country an increase of foreign affiliate production, i.e. an increase in output of good 2, leads to an appreciation of the domestic currency and, thereby, to a decrease in exports. As a consequence, output in sector 1 deteriorates. Obviously, this is not favorable to firms and workers in sector 1. Simultaneously, imports of good 2 decline due to the higher domestic output of good 2. However, for the host country on the whole, an increase in domestic output of good 2 is associated with a welfare gain. In the home country an increase in foreign output of the original domestic good 1 causes a depreciation of the domestic currency and a decrease in domestic output of good 1. Additionally imports of good 2 decline. As to welfare effects, an increase in foreign output of good 1 leads to a welfare loss.

Taking into account welfare effects of horizontal greenfield investments, our results suggest that countries confronted with high outflows and comparably low inflows can



suffer welfare losses. On the other hand, countries that face low outflows and comparably high inflows are likely to benefit. Thus, the model presented here strongly supports the view that economic policy should tend to keep the domestic economy attractive for foreign investors.

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