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## Foreign Direct Investment, Production, and Welfare

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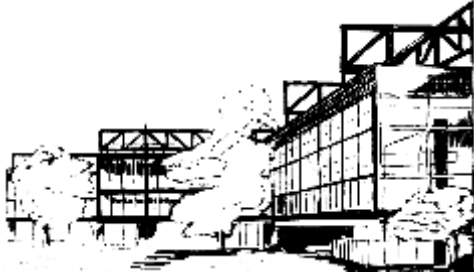
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**11**

# **Foreign Direct Investment, Production, and Welfare**

Alkis Otto

# Foreign Direct Investment, Production, and Welfare\*

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25th June 2003

## Abstract

We study the impact of foreign direct investment using 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 effects on production, exchange rates, exports, imports, and welfare. In the host country, FDI harms the established industries. Despite this incoming FDI increases welfare. In the home country, FDI lowers domestic output of the established industries, too, and decreases welfare.

*Keywords:* Foreign Direct Investment, small open economy, welfare effects  
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# 1 Introduction

The consequences of foreign direct investment (FDI) are an issue of major concern in the debate about international capital flows. Since the 1970s mainly developed but also developing countries experienced a remarkable increase of FDI. As a consequence, 2001 worldwide sales of foreign affiliates more than doubled the exports of goods and non-factor services (UNCTAD (2002)). This intensified international economic integration gives rise to the question of the macroeconomic effects of FDI on home and host countries.

FDI is a process that can be decomposed in two subsequent periods. In the first period, the *investment period*, firms acquire or build foreign production facilities. The investment period is mainly characterized by capital flows and, in the case of greenfield investments, by increased investment demand in home and host countries. The second period, which we call the *production period*, deals with the consequences that arise when foreign affiliates start production. The production period is characterized by changes of production processes and trade patterns both in the home and host countries.

This paper focuses on the production period. We explore the effects of foreign direct investment on production and welfare in home and host countries. At the core of the analysis is a monetary two-sector model of the small open economy. We consider horizontal greenfield investments, i.e. multinational companies set up new plants abroad to substitute for exports. Greenfield investments therefore increase the capacity of host countries. As a consequence, increased foreign production of goods affects the exchange rate and thereby induces welfare effects.

In contrast, other studies as Balcão Reis (2001) examine the welfare effects of FDI using an endogenous growth model with quality ladders. Here the welfare gain depends on a trade off between reduced innovation costs, higher capital costs, and the transfer of profits to foreigners. Razin and Sadka (2001) and Razin and Sadka (2003) consider information-based models of FDI. On the one hand there are conventional gains from opening up the economy to capital flows. On the other hand information asymmetries cause that overall welfare can go both ways. Empirical macroeconomic studies as Barrell and Pain (1997) and Borensztein, De Gregorio, and Lee (1998) examine the relation between FDI and growth. Barrell and Pain (1997) argue that FDI can enhance growth in host countries and increase welfare in home countries. Borensztein, De Gregorio, and Lee (1998) find a significant relationship Between FDI and growth only for host countries with a sufficient stock of human capital. Altogether the evidence on FDI and growth is rather mixed, as Lipsey (2002) points out.

Before proceeding to our model, we make some remarks about terminology. Common monetary open economy models usually assume total specialization of countries in one good. In a small open economy it is thus convenient to distinguish between the domestic good and the foreign good. This difference becomes blurred in a world with horizontal foreign direct investment, since this implies that a good is produced both at home and abroad. We therefore introduce the terms *original domestic good* and *original foreign good*. The term original domestic good describes the good that has been produced solely at home until foreign direct investments takes place, while the term original foreign good describes the good that has been produced solely abroad, respectively. Further we distinguish between the domestic output and foreign output of a good. Horizontal outward FDI thus leads to an increase of foreign output of the original domestic good.

The paper is organized as follows: In section 2 we set up the basic model. Section 3 considers the effects on trade, production, and welfare of horizontal FDI in the host country. In contrast section 4 discusses the impact of horizontal FDI 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 equals the world interest rate, i.e.  $i = i^*$ . The small open economy consists of two sectors producing two different goods. Sector 1 generates domestic output of good 1  $Y_1$ . Sector 2 which was raised by means of FDI generates domestic output of the original foreign good 2  $Y_2$ . Hence, from the perspective of the home country, domestic output of good 2 is used as a substitute for imports. 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 (see Carlberg (2002)) is given by

$$U = \alpha \log C_1 + \beta \log C_2 + \gamma \log S_1, \quad (1)$$

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.  $\alpha, \beta$ , 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 at every point of time. 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 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 analysis of the investment period 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 a FDI outflow is followed by an endogenous capital inflow of equal size. Hence, net foreign assets remain constant, i.e.  $\kappa = 0$ . Contrary to that, incoming FDI lowers net foreign assets, such that  $0 < \omega < 1$  (Otto (2002)). Taking account of the law of one price the individuals' budget constraint is

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

Here the term on the left hand side of the equation represents overall 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:

$$P_1C_1 = \alpha/\lambda,$$

$$eP_2^*C_2 = \beta/\lambda,$$

$$P_1S_1 = \gamma/\lambda.$$

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

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

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

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

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 a rise in domestic output of good 1  $Y_1$ , a rise in domestic output of good 2  $Y_2$ , and a rise in the exchange rate  $e$ .

We now proceed to the set-up of the goods market equations. For ease of exposition look at the market for the original foreign good 2. Suppose domestic demand for good 2 always exceeds domestic output of good 2  $C_2 > Y_2$ . This implies the economy always imports a fraction of its demand for good 2 and that domestic output of good 2 is sold entirely. As a consequence, domestic output of good 2 is limited by the capacity of capital stock in sector 2. And what is more, sector 2 always produces at full capacity. Hence, output of good 2 is given exogenously. The endogenous variable of the goods market equation of good 2 now is import  $Q_2$ , 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 an increase in foreign output of good 1 has no significant influence on foreign income so as to induce repercussion effects. In contrast, it causes a direct 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. Since the small open economy has no significant influence on world income, there are no repercussion effects. 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

$$X_1 = heP_2^*/P_1 - \bar{X}_1, \quad (7)$$

where we define  $h = \beta^*Y_2^*$  and  $\bar{X}_1 = Y_1^*$ . The parameter  $h$  can be interpreted as the exchange rate sensitivity of exports, whereas  $\bar{X}_1$  represents the exogenous decline of export demand due to the increase of 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:

$$Y_1 = \alpha(Y_1 + \omega eP_2^*Y_2/P_1) + heP_2^*/P_1 - \bar{X}_1.$$

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:

$$Y_1 = \alpha(Y_1 + \omega eP_2^*Y_2/P_1) + heP_2^*/P_1 - \bar{X}_1, \quad (10)$$

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

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

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  $P_1, P_2^*, Y_2$ , and  $M$  are exogenously given.

### 3 Host country effects of FDI

In this section we consider the effects of FDI on the host country. As stated above, domestic output of the original foreign good 2 is restricted by the capital stock in sector 2. Assume that the capital stock in sector 2 increases as a consequence of *transitory* incoming FDI. Due to the increase in capacity this results in a *permanent* increase of 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 differentials of eqs. (10) - (12) to obtain:

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

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

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

As a first finding, combining (13) and (15), gives

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

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):

$$dY_1 = -\frac{\omega h e P_2^*/P_1}{\omega Y_2 + h} dY_2. \quad (17)$$

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. Put differently, the increase in domestic output of good 2 has no effect on domestic demand for good 1,  $dC_1 = \alpha(dY_1 + \omega(P_2^*/P_1)(Y_2 de + e dY_2)) = 0$ . 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 as long as 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

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

Observe that the term in parenthesis is negative. 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 observed that both exports and imports decline in succession

to an increase in output of good 2. We are now interested in the behaviour of net exports  $H$ . Here we have to take into consideration that the decline in exports has been measured in units of good 1 while the decline in imports has been measured in units of good 2. We suppose the unit of account for net exports to be good 1. Therefore we have to convert imports into units of good 1 using the real exchange rate  $eP_2^*/P_1$ . 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  $H_1 = heP_2^*/P_1 - \bar{X}_1 - \beta(Y_1 + \omega eP_2^*Y_2/P_1) + eP_2^*Y_2/P_1$ . The appropriate 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

$$dH_1 = (1 - \omega) \frac{eP_2^*/P_1}{\omega Y_2 + h} dY_2.$$

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

Our foregoing analysis indicates that an increase in domestic output of good 2 corresponds to a decrease in domestic output of good 1. What are the consequences for overall real income? To begin with, divide the money market equation (12) by  $P_1$ , to obtain  $M/P_1 = k(Y_1 + \omega eP_2^*Y_2/P_1)$ . This expression has it, that real income in terms of good 1,  $Y_1 + \omega eP_2^*Y_2/P_1$ , is proportional to  $M/P_1$ . Since  $M$  and  $P_1$  are constant, real income measured in good 1 has to be constant too. As a direct consequence, an increase in output of good 2 has no effect on real income measured in good 1. Now divide the money market equation (12) by  $eP_2^*$ , to derive  $M/eP_2^* = k(P_1Y_1/eP_2^* + \omega Y_2)$ . Notice that overall real income measured in good 2  $P_1Y_1/eP_2^* + \omega Y_2$  now is proportional to  $M/eP_2^*$ . Again  $M$  is constant but since the nominal exchange rate  $e$  lowers endogenously in response to an increase in output of good 2, the domestic price of good 2  $eP_2^*$  is endogenous either. Hence, an increase in output of good 2 changes overall real income measured in good 2. As a consequence, the effect of an increase of domestic output of good 2 on real income depends on the numeraire. This dichotomy will be explored in greater detail when we consider 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 an increase of 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.

As an interim result we record that horizontal incoming FDI increases domestic output of the original foreign good 2. This causes an appreciation of the domestic currency which lowers exports and domestic output of the original domestic good 1. Furthermore imports of good 2 decrease. All in all FDI increases welfare in the host country.

## 4 Home country effects of FDI

In the preceding section we considered the effects of FDI on the host country. Next we turn our attention to the effects of FDI 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 original domestic good 1  $Y_1^*$ .

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

$$Y_1 = \alpha(Y_1 + \omega e P_2^* Y_2 / P_1) + h e P_2^* / P_1 - \bar{X}_1,$$

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

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

The export function of the small open economy still is  $X_1 = h e P_2^* / P_1 - \bar{X}_1$ . 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. From the derivation of the export function (section 2) we know  $\bar{X}_1 = Y_1^*$ . An increase of foreign output of good 1  $Y_1^*$  therefore initially leads to an immediate decline of exports, such that  $d\bar{X}_1 = dY_1^*$ . What are the consequences of this initial shock? The endogenous variables in equations (10)-(12) are  $Y_1, Q_2$  und  $e$ . Taking the total differentials then gives

$$dY_1 = \alpha(dY_1 + (\omega P_2^* Y_2 / P_1)de) + (h P_2^* / P_1)de - d\bar{X}_1, \quad (24)$$

$$dQ_2 = \beta \frac{P_1}{P_2^*} \left( \frac{edY_1 - Y_1 de}{e^2} \right), \quad (25)$$

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

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

$$de = \frac{P_1}{P_2^* (\omega Y_2 + h)} d\bar{X}_1. \quad (27)$$

That is to say, an increase in foreign output of the original 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:

$$dY_1 = -\frac{\omega Y_2}{\omega Y_2 + h} d\bar{X}_1, \quad (28)$$

with  $-1 < dY_1/d\bar{X}_1 \leq 0$ . Again the decline of domestic output of good 1 mirrors the decline of export demand  $X_1$ . Indeed the change in exports is  $dX_1 = (hP_2^*/P_1)de - d\bar{X}_1 = -(\omega Y_2/(\omega Y_2 + h))d\bar{X}_1$ , which equals  $dY_1$ . 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 (given  $Y_2 > 0$ ) due to the depreciation, export demand rises endogenously which partly offsets the initial export shock. To see this more clearly, let's take a closer look at the chain of cause and effect: 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 after-shock equilibrium the decline in domestic output of good 1 is smaller than the initial shock  $d\bar{X}_1$ .

Next we consider imports:

$$dQ_2 = -\frac{P_1}{eP_2^*} \left( \frac{P_1 Y_1 / eP_2^* + \omega Y_2}{\omega Y_2 + h} \right) d\bar{X}_1.$$

An increase of foreign output of good 1 causes a decrease of 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  $H_1 = h e P_2^* / P_1 - \bar{X}_1 - \beta(Y_1 + \omega e P_2^* Y_2 / P_1) + e P_2^* Y_2 / P_1$ . The total differential is

$$dH_1 = h \frac{P_2^*}{P_1} de - d\bar{X}_1 - \beta \left( dY_1 + \omega Y_2 \frac{P_2^*}{P_1} de \right) + Y_2 \frac{P_2^*}{P_1} de$$

Now substitute  $de$  and  $dY_1$  by means of the preceding results to obtain

$$dH_1 = \frac{(1 - \omega)Y_2}{\omega Y_2 + h} d\bar{X}_1.$$

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

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

$$dC_2 = \beta \left( \frac{P_1}{P_2^*} \left( \frac{edY_1 - Y_1de}{e^2} \right) \right), \quad (31)$$

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

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

$$dC_2 = dQ_2 = -\frac{P_1}{eP_2^*} \left( \frac{P_1Y_1/eP_2^* + \omega Y_2}{\omega Y_2 + h} \right) d\bar{X}_1.$$

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

$$dU = -\frac{P_1/eP_2^*}{(\omega Y_2 + h)} d\bar{X}_1.$$

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

## 5 Concluding Remarks

We have considered the macroeconomic effects of horizontal foreign direct investment on a small open economy with flexible exchange rates and perfect capital mobility. The focus has been on effects of the production period. Here we proposed a two-sector model, where sector 1 produces the original domestic good 1 and sector 2 produces the original foreign good 2. In the host country an increase of output of good 2 leads to an appreciation of the domestic currency and thereby to a decrease of exports. As a consequence, output in sector 1 deteriorates. Simultaneously imports of good 2 decline due to the higher domestic output of good

2. The increase in domestic output of good 2 is associated with a welfare gain.

In the home country an increase of foreign output of the original domestic good 1 causes a depreciation of the domestic currency and a decrease of domestic output of good 1. Additionally imports of good 2 decline. As to welfare, an increase of foreign output of good 1 leads to a welfare loss.



## A Appendix: An extended microfoundation

This section presents a more detailed version of the microfoundation presented in section 2. Consider three different individuals. Individual 1 provides labour and capital for sector 1, individual 2 works exclusively in sector 2, and individual 3 is unemployed and receives transfer payments from individual 1 and individual 2. We assume identical preferences for consumption of good 1, consumption of good 2, and savings (measured in good 1). The utility function is of the Cobb-Douglas type. Individual 1's utility function  $U_1$  is

$$U_1 = \alpha \log C_{11} + \beta \log C_{21} + \gamma \log S_{11}, \quad \alpha + \beta + \gamma = 1, \quad \alpha, \beta, \gamma > 0, \quad (33)$$

where  $C_{11}$  denotes individual 1's consumption of good 1. Here the first subscript indicates the number of the good and the second subscript indicates the individual's number. Thus  $C_{21}$  denotes individual 1's consumption of good 2 and  $S_{11}$  denotes individual 1's savings. Individual 1's income equals sector 1 output, which is used to finance individual 1's consumption of good 1, consumption of good 2, savings, and transfers to individual 3. Let  $t$  symbolize the transfer rate. Then individual 1's budget constraint is  $(1 - t)P_1Y_1 = P_1C_{11} + eP_2^*C_{21} + P_1S_{11}$ . Optimization leads to the following consumption and savings functions:

$$C_{11} = \alpha(1 - t)Y_1, \quad (34)$$

$$C_{21} = \beta(1 - t)P_1Y_1/eP_2^*, \quad (35)$$

$$S_{11} = \gamma(1 - t)Y_1. \quad (36)$$

Analogous to individual 1, individual 2's utility function  $U_2$  is

$$U_2 = \alpha \log C_{12} + \beta \log C_{22} + \gamma \log S_{12}, \quad \alpha + \beta + \gamma = 1, \quad \alpha, \beta, \gamma > 0. \quad (37)$$

Individual 2 uses sector 2's output to finance consumption, savings, and transfers. The budget constraint therefore is  $(1 - t)\omega eP_2^*Y_2 = P_1C_{12} + eP_2^*C_{22} + P_1S_{12}$ . And the consumption and savings functions are

$$C_{12} = \alpha(1 - t)\omega eP_2^*Y_2/P_1, \quad (38)$$

$$C_{22} = \beta(1 - t)\omega Y_2, \quad (39)$$

$$S_{12} = \gamma(1 - t)\omega eP_2^*Y_2/P_1. \quad (40)$$

Finally individual 3's utility function  $U_3$  is

$$U_3 = \alpha \log C_{13} + \beta \log C_{23} + \gamma \log S_{13}, \quad \alpha + \beta + \gamma = 1, \quad \alpha, \beta, \gamma > 0. \quad (41)$$

Individual 3 receives transfers from individual 1 and individual 2. The budget constraint is  $t(P_1 Y_1 + \omega e P_2^* Y_2) = P_1 C_{13} + e P_2^* C_{23} + P_1 S_{13}$ . Maximizing utility then leads to

$$C_{13} = \alpha t (Y_1 + \omega e P_2^* Y_2 / P_1), \quad (42)$$

$$C_{23} = \beta t (P_1 Y_1 / (e P_2^*) + \omega Y_2), \quad (43)$$

$$S_{13} = \gamma t (Y_1 + \omega e P_2^* Y_2 / P_1). \quad (44)$$

Now aggregate the three individual consumption functions of good 1 to obtain aggregate consumption of good  $C_1$ :

$$\begin{aligned} C_1 &= C_{11} + C_{12} + C_{13} = \alpha(1-t)Y_1 + \alpha(1-t)\omega e P_2^* Y_2 / P_1 + \alpha t (Y_1 + \omega e P_2^* Y_2 / P_1) \\ &= \alpha(Y_1 + \omega e P_2^* Y_2 / P_1). \end{aligned}$$

Along these lines we also derive aggregate consumption of good 2  $C_2$  and aggregate savings  $S_1$ , respectively:

$$\begin{aligned} C_2 &= C_{21} + C_{22} + C_{23} = \beta(1-t)P_1 Y_1 / e P_2^* + \beta(1-t)\omega Y_2 + \beta t (P_1 Y_1 / (e P_2^*) + \omega Y_2) \\ &= \beta(P_1 Y_1 / e P_2^* + \omega Y_2). \end{aligned}$$

and

$$\begin{aligned} S_1 &= S_{11} + S_{12} + S_{13} = \gamma(1-t)Y_1 + \gamma(1-t)\omega e P_2^* Y_2 / P_1 + \gamma t (Y_1 + \omega e P_2^* Y_2 / P_1) \\ &= \gamma(Y_1 + \omega e P_2^* Y_2 / P_1). \end{aligned}$$

The aggregate functions are exactly the same as in section 2.

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