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CROSS-HAULING OF DIRECT INVESTMENT*

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I. Introduction

Since Caves (1971) used the specific-factor model developed by Jones (1971) to analyse direct foreign investment, the specific-factor approach has prevailed in the literature.[1] The reason is that this approach captures the two characteristics of direct foreign investment, namely, sector-specificity and cross-hauling. Direct foreign investment usually takes the form of international capital flows between the same sectors in different countries. And when this occurs in one sector, another sector often experiences the reverse capital flows.

An important contribution to the analysis of two-way capital flows was made by Jones, Neary and Ruane, henceforth JNR (1983). They considered a small open economy using labour and two types of sector-specific capital to produce two commodities, one of which is a traded good and the other a nontraded good. They examined the effects on capital flows of various exogenous shocks such as the introduction of a production subsidy in the traded sector and an increase in the labour force.

This paper will present another model to examine the phenomenon of cross-hauling in a small open economy. Instead of assuming a nontraded good, we introduce land into the model in addition to labour and two types of capital. Land is assumed to be nationally mobile between sectors but immobile between countries like labour.[2] These factors of production are susceptible of several interpretations. Land and labour may be called skilled and unskilled labour. In a different context, sector-specific capital may be regarded as managerial resource and land as real capital.

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1. See, for example, Amano (1977), Berglas and Jones (1977), Burgess (1978), Falvey (1979), Dei (1979), Jones (1979), Batra and Ramachandran (1980), Neary (1980), Das (1981), Khandker (1981), Jones, Neary and Ruane (1981, 1983), and Jones and Dei (1983).
2. JNR (1981) developed the model in which two types of "land" with sector-specificity exist.

We will consider the effects of changes in endowments of labour and land and tariff changes on international capital flows and derive conditions under which cross-hauling occurs. JNR (1983, pp. 364–365) suggested the connection between the occurrence of cross-hauling and changes in rentals in the case of capital being immobile. This topic will be discussed.

II. The Model

Imagine the home country producing two commodities, 1 and 2, importing commodity 1 and exporting commodity 2. This country is a small country in world markets for commodities and faces constant world prices. The home government imposes tariffs on imports of commodity 1, while commodity 2 is freely exported. Therefore, the domestic price of commodity 1 is higher than its world price and is altered by a change in the tariff rate. The domestic price of commodity 2 comes into line with its world price. Each commodity is produced by the use of two generic factors of production, labour (L) and land (T), and sector-specific capital (K_j). Labour and land are internationally immobile, but each type of capital has international mobility. The home country is also a small country in world capital markets and is given constant rentals on capital ($\bar{r}_j$). There are no taxes on capital movements, so that domestic rentals are nailed down to world rentals.

The equality between unit costs and prices in a competitive equilibrium is represented by

$$(1) \qquad a_{L1}w + a_{T1}t + a_{K1}\bar{r}_1 = p_1 ,$$

$$(2) \qquad a_{L2}w + a_{T2}t + a_{K2}\bar{r}_2 = \bar{p}_2 ,$$

where a_{ij} denotes the quantity of factor i required per unit output of commodity j, w and t the wage rate and the rent respectively, p_1 the domestic price of commodity 1, $\bar{p}_2$ the domestic and world price of commodity 2. Under constant returns to scale, a_{ij} that firms must choose is determined by factor prices:

$$(3) \qquad a_{ij} = h_{ij}(w, t, \bar{r}_j) .$$

Assuming that labour and land are inelastically supplied and fully employed due to price flexibility, we have

$$a_{L1}X_1 + a_{L2}X_2 = L, \tag{4}$$

$$a_{T1}X_1 + a_{T2}X_2 = T, \tag{5}$$

where X_j denotes the domestic production of commodity j, L and T the home country's endowments of labour and land respectively. Let K_1 and K_2 represent the domestic demand for each type of capital. They are calculated as

$$K_1 = a_{K1}X_1, \tag{6}$$

$$K_2 = a_{K2}X_2. \tag{7}$$

If p_1 is given, equations (1) – (3) determine w, t, and a_{ij}. This implies that a_{ij} remains constant when p_1 is unchanged as we will assume in the next section. Since a_{ij} is known, equations (4) and (5) determine X_1 and X_2 if L and T are given. Finally, equations (6) and (7) determine K_1 and K_2.

The purpose of this paper is to show how K_1 and K_2 are affected by changes in L, T and p_1. When K_1 and K_2 conversely change, we say that cross-hauling of direct foreign investment occurs. Note that we are not concerned with the difference between capital stocks owned by the home country and those demanded at home, i.e. the pattern of lending and borrowing each type of capital. We focus our attention on the possibility that capital in one sector flows out of the home country and capital in the other sector flows into this country, whether home capital or foreign capital.

III. Changes in Labour and Land

In this section, it is assumed that the tariff rate is kept constant and p_1 is fixed: Hence a_{ij} is also fixed. As equations (4) and (5) show, the effects of changes in L and T on outputs are identical with those in the standard Heckscher-Ohlin model. Differentiating equations (4) and (5) totally, we get

$$a_{L1}dX_1 + a_{L2}dX_2 = dL, \tag{8}$$

$$a_{T1}dX_1 + a_{T2}dX_2 = dT. \tag{9}$$

Solving these yields

$$(10) \qquad (\mu_2 - \mu_1)a_{L1}dX_1 = \mu_2 dL - dT\,,$$

$$(11) \qquad (\mu_2 - \mu_1)a_{L2}dX_2 = dT - \mu_1 dL\,,$$

where μ_1 and μ_2 denote the land/labour ratio in each sector, and are defined as

$$\mu_1 \equiv a_{T1}/a_{L1}\,, \quad \mu_2 \equiv a_{T2}/a_{L2}\,.$$

In what follows we assume, without loss of generality, that commodity 1 is labour-intensive and commodity 2 is land-intensive in the sense that

$$(12) \qquad \mu_2 > \mu_1\,.$$

If dL and dT are given, equations (10) and (11) determine dX_1 and dX_2. The Rybczynski theorem is easily checked. For the home country to be incompletely specialized, the aggregate land/labour ratio must lie between μ_1 and μ_2.

Since a_{K1} and a_{K2} are constant in equations (6) and (7), outputs and capital stocks move in the same direction. Therefore, when labour grows and land is unchanged, capital flows into sector 1 whose production increases and capital flows out of sector 2 whose production decreases. When land expands and labour is unchanged, the reverse inflow and outflow are caused. If both labour and land change, outputs in both sectors can increase or decrease, leading to inflows or outflows of both types of capital. Cross-hauling of direct foreign investment occurs whenever changes in labour and land increase one sector's output and reduce the other sector's output: capital flows into the expanding industry and capital flows out of the contracting industry.

IV. Tariff Changes

In the preceding section, we have analysed the case in which L and T change, with p_1 held constant. We assume here that L and T are unchanged, and consider the case in which p_1 changes due to a raise or a reduction in the tariff rate.

A change in p_1 causes changes in w and t. Let us assume that p_1 changes by a small amount. Total differentiation of equations (1) and (2) yields

(13) $$\theta_{L1}\hat{w} + \theta_{T1}\hat{t} = \hat{p}_1 ,$$

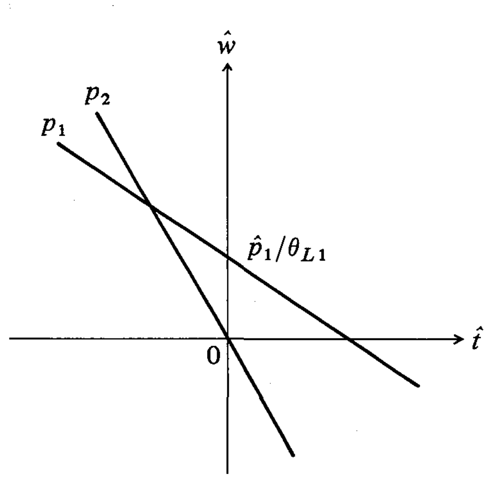
(14) $$\theta_{L2}\hat{w} + \theta_{T2}\hat{t} = 0 ,$$

which show how w and t change. θ_{ij} refers to the share of factor i's cost in the unit cost of commodity j. A hat (ˆ) indicates the relative change in a variable, e.g. $\hat{w} = dw/w$. Since each industry uses three factors of production, $\theta_{Lj} + \theta_{Tj} < 1$. In deriving equations (13) and (14), we have used $w da_{Lj} + t da_{Tj} + \bar{r}_j da_{Kj} = 0$ which is implied by the firm's cost-minimization behaviour.

Equations (13) and (14) are drawn as in Figure 1 when $\hat{p}_1 > 0$ due to a raise in the tariff rate. The slope of equation (13) can be rewritten as $-\theta_{T1}/\theta_{L1} = -\mu_1 t/w$, and the slope of equation (14) as $-\theta_{T2}/\theta_{L2} = -\mu_2 t/w$. Under the assumption about intensity (12), the line p_2 which represents equation (14) is steeper than the line p_1 which represents equation (13). The intercept of the line p_1 on $\hat{w}$-axis equals $\hat{p}_1/\theta_{L1}$. The line p_2 passes through the origin. It is clear from Figure 1 that we obtain the relationship,

(15) $$\hat{w} > \hat{p}_1 > 0 > \hat{t} .$$

Figure 1. Relative Changes in the Wage Rate and the Rent.



If $\hat{p}_1 < 0$, though not illustrated, we have

$$\hat{w} < \hat{p}_1 < 0 < \hat{t}. \tag{16}$$

(15) and (16) state that a rise in p_1 raises w and reduces t, while a fall in p_1 reduces w and raises t. Note that we keep p_2 fixed to obtain this result. (15) and (16) show that the Jones's magnification effect in the 2×2 model, i.e. $\hat{w} \underset{(<)}{>} \hat{p}_1 \underset{(<)}{>} \hat{p}_2 \underset{(<)}{>} \hat{t}$ also holds in our model if $\hat{p}_2$ is set to zero.

Such changes in w and t affect a_{ij} via equation (3). X_1 and X_2 change so as to maintain equations (4) and (5). Keeping L and T constant and differentiating equations (4) and (5) totally, we get

$$a_{L1} dX_1 + a_{L2} dX_2 = -(X_1 da_{L1} + X_2 da_{L2}), \tag{17}$$

$$a_{T1} dX_1 + a_{T2} dX_2 = -(X_1 da_{T1} + X_2 da_{T2}). \tag{18}$$

Noting that equations (17) and (18) correspond to equations (8) and (9) respectively and using equations (10) and (11), we have

$$\begin{aligned}(\mu_2 - \mu_1) a_{L1} dX_1 &= X_1(-\mu_2 da_{L1} + da_{T1}) \\ &\quad + X_2(-\mu_2 da_{L2} + da_{T2}),\end{aligned} \tag{19}$$

$$\begin{aligned}(\mu_2 - \mu_1) a_{L2} dX_2 &= -X_1(-\mu_1 da_{L1} + da_{T1}) \\ &\quad - X_2(-\mu_1 da_{L2} + da_{T2}).\end{aligned} \tag{20}$$

Once da_{Lj} and da_{Tj} are known, dX_1 and dX_2 are determined by both equations. Total differentiation of equation (3) yields

$$da_{Lj} = \frac{\partial h_{Lj}}{\partial w} dw + \frac{\partial h_{Lj}}{\partial t} dt, \tag{21}$$

$$da_{Tj} = \frac{\partial h_{Tj}}{\partial w} dw + \frac{\partial h_{Tj}}{\partial t} dt. \tag{22}$$

As is well known, the own substitution terms, $\partial h_{Lj}/\partial w$ and $\partial h_{Tj}/\partial t$ are nonpositive. Consider here the case in which $\hat{p}_1 > 0$. Then $dw > 0$ and $dt < 0$. Labour and land can be complements in our model where each sector uses three factors of production. Suppose that $\partial h_{Lj}/\partial t$ $(= \partial h_{Tj}/\partial w)$ is negative and has a sufficiently large absolute value. The above sign of equality comes from the symmetry of substitution terms. In this case,

$da_{Lj} > 0$ and $da_{Tj} < 0$. Equations (19) and (20) show that $dX_1 < 0$ and $dX_2 > 0$.

If the firm's cost-minimization behaviour is considered, however, it will be clear that such a case can never happen. Let variables without a prime denote values before a change, while let variables with a prime denote values after a change.

$$w'a'_{Lj} + t'a'_{Tj} + \bar{r}_j a'_{Kj} \leq w'a_{Lj} + t'a_{Tj} + \bar{r}_j a_{Kj} \,,$$

$$wa_{Lj} + ta_{Tj} + \bar{r}_j a_{Kj} \leq wa'_{Lj} + ta'_{Tj} + \bar{r}_j a'_{Kj} \,,$$

both must hold. Therefore, adding these inequalities yields

$$(w' - w)(a'_{Lj} - a_{Lj}) + (t' - t)(a'_{Tj} - a_{Tj}) \leq 0 \,,$$

which also has to be satisfied. Rewriting this inequality for a small change, we have

$$dwda_{Lj} + dtda_{Tj} \leq 0 \,. \tag{23}$$

(23) reveals that when $dw > 0$ and $dt < 0$, there is no case in which $da_{Lj} > 0$ and $da_{Tj} < 0$. In other words, it is impossible that the demand for expensive labour increases and the demand for cheap land decreases. This warns us that it is misleading to discuss under the ad hoc assumptions about substitution terms.

When $\hat{p}_1 > 0$, the case in which $da_{Lj} > 0$ and $da_{Tj} < 0$ never occurs. Even so, is there the possibility that $dX_1 < 0$ and $dX_2 > 0$? Profit maximization by each firm implies profit maximization for the whole economy. Hence we obtain

$$\begin{aligned} &p'_1 X'_1 + \bar{p}_2 X'_2 - w'L - t'T - \bar{r}_1 K'_1 - \bar{r}_2 K'_2 \\ &\qquad \geq p'_1 X_1 + \bar{p}_2 X_2 - w'L - t'T - \bar{r}_1 K_1 - \bar{r}_2 K_2 \,, \end{aligned}$$

$$\begin{aligned} &p_1 X_1 + \bar{p}_2 X_2 - wL - tT - \bar{r}_1 K_1 - \bar{r}_2 K_2 \\ &\qquad \geq p_1 X'_1 + \bar{p}_2 X'_2 - wL - tT - \bar{r}_1 K'_1 - \bar{r}_2 K'_2 \,. \end{aligned}$$

Adding both inequalities yields

$$(p'_1 - p_1)(X'_1 - X_1) \geq 0 \,,$$

which turns to

(24) $$dp_1 dX_1 \geq 0 .$$

(24) says that it never happens that $dX_1 < 0$ when $dp_1 > 0$. A rise in the price of commodity 1 does not decrease its domestic production at all. On the other hand, it is clear that a decrease in the price of commodity 1 does not increase its output. The price of commodity 2 is assumed to be constant. We cannot have a general restriction on a change in the output of commodity 2.

Next, we will investigate changes in a_{Lj} and a_{Tj} which are consistent with (23) and (24) and make the variation of outputs definite from equations (19) and (20). Suppose that a_{Lj} and a_{Tj} change as shown in (25):

(25) $$p_1 \uparrow(\downarrow), \quad \begin{matrix} a_{L1} \downarrow (\uparrow), \; a_{T1} \uparrow (\downarrow), \; a_{K1} \rightarrow \uparrow (\rightarrow \downarrow), \\ a_{L2} \downarrow (\uparrow), \; a_{T2} \uparrow (\downarrow), \; a_{K2} \rightarrow \downarrow (\rightarrow \uparrow), \end{matrix}$$

where an arrow attached to a_{ij} indicates the direction of its change caused by a change in p_1. $a_{K1} \rightarrow \uparrow$, for instance, denotes that a_{K1} is constant or increases. In this case, outputs react as follows:

(26) $$p_1 \uparrow (\downarrow), \quad X_1 \uparrow (\downarrow), \quad X_2 \downarrow (\uparrow) .$$

The constraints (23) and (24) are fulfilled.

Therefore, if a_{Kj} changes as in (25), we obtain

(27) $$p_1 \uparrow (\downarrow), \quad K_1 \uparrow (\downarrow), \quad K_2 \downarrow (\uparrow),$$

which implies the occurrence of cross-hauling of direct investment. That is, when a_{ij} changes as in (25), a raise in the tariff rate causes an inflow of capital into the import-competing industry and an outflow of capital from the export industry, while a reduction in the tariff rate leads to an outflow of capital from the import-competing industry and an inflow of capital into the export industry.

Let us adduce examples to consider the case in which a_{ij} actually changes as in (25). The simplest example is one in which capital-output coefficients, a_{K1} and a_{K2}, are fixed, and each sector's a_{Lj} and a_{Tj} construct a smooth unit isoquant which is convex to the origin as in 2-factor model. Labour and land are substitutes. In response to a change in p_1, a_{Lj} and a_{Tj} move as (25) shows.

Observe that a_{T1} and a_{K1} can change in the same direction in the first row of (25), and suppose that land and capital are used at a fixed ratio in sector 1, i.e. $a_{K1}/a_{T1} = \bar{c}$, $\bar{c}$: a constant. The cost-minimization problem for the firm is reduced to choosing a_{L1} and a_{T1} so as to minimize $a_{L1}w + a_{T1}(t + \bar{c}\bar{r}_1)$. If we regard one unit of land and $\bar{c}$ units of capital as one unit of the composite factor, its factor price is $t + \bar{c}\bar{r}_1$. If this composite factor and labour give the regular isoquants, an increase in p_1 raises w and depresses t, leading to a decrease in a_{L1} and an increase in a_{T1} and a_{K1}. Accordingly, the first row of (25) is satisfied.

With respect to the third row of (25), we can consider the case in which a_{L2} and a_{K2} change in the same direction. If labour and capital are utilized at a fixed ratio in sector 2, an argument similar to that in the above example will show that the third row of (25) is fulfilled.

As we have seen, outputs change as in (26) and cross-hauling of direct investment occurs as in (27), if capital-output coefficient is fixed or land and capital are used at a fixed ratio in sector 1, and if capital-output coefficient is fixed or labour and capital are employed at a fixed ratio in sector 2.

Needless to say, (25) is a sufficient condition for cross-hauling to occur. There are other cases that give rise to cross-hauling. Equations (19) and (20) say that if a_{ij} changes as follows:

$$(28)\quad p_1 \uparrow (\downarrow), \quad \begin{array}{l} a_{L1} \downarrow (\uparrow), \; a_{T1} \uparrow (\downarrow), \; a_{K1} \rightarrow \uparrow (\rightarrow \downarrow), \\ a_{L2} \rightarrow (\rightarrow), \; a_{T2} \rightarrow (\rightarrow), \; a_{K2} \rightarrow \downarrow (\rightarrow \uparrow), \end{array}$$

then outputs change as in (26). In this case, the inequalities (23) and (24) are satisfied, and capital stocks change as in (27). We can see cross-hauling again.

Since the first row of (28) is the same as that of (25), the previous analysis is applicable to sector 1. Therefore, we only have to consider sector 2 here. The case in which all input coefficients in sector 2 are fixed is easily thought of. Alternatively, we can assume that labour and land in sector 2 are used at a constant ratio. In the latter case, we have $a_{T2}/a_{L2} = \bar{\mu}_2$, $\bar{\mu}_2$: a constant. Equation (14) is equivalent to $a_{L2}dw + a_{T2}dt = 0$, so that $dw + \bar{\mu}_2 dt = 0$. This implies that if one unit of labour and $\bar{\mu}_2$ units of land are regarded as one unit of the composite factor, its factor price does not change. Since the remaining rental on capital is also constant, the input coefficients of the composite factor and capital become constant and all input coefficients in sector 2 are held constant.

So far we have discussed the examples which cause cross-hauling. Next, we will adduce the example which does not lead to cross-hauling. As argued just above, when labour and land in sector 2 are used at a fixed ratio, $da_{L2} = da_{T2} = da_{K2} = 0$. Furthermore, assuming that labour and land are used at a fixed ratio ($\bar{\mu}_1$) in sector 1, we have $-\bar{\mu}_1 da_{L1} + da_{T1} = 0$, so that $dX_2 = 0$ from equation (20). Equation (19) can be rewritten as $(\bar{\mu}_2 - \bar{\mu}_1) a_{L1} dX_1 = X_1(-\bar{\mu}_2 + \bar{\mu}_1) da_{L1}$. Noting that $dw + \bar{\mu}_2 dt = 0$, we obtain $dw + \bar{\mu}_1 dt = (-\bar{\mu}_2 + \bar{\mu}_1) dt$. If one unit of labour and $\bar{\mu}_1$ units of land in sector 1 are regarded as one unit of the composite factor, its factor price equals $w + \bar{\mu}_1 t$. This price rises when p_1 rises, w rises and t falls. Thus a_{L1} and a_{T1} decrease and a_{K1} increases, leading to an increase in X_1 and K_1. X_2 and K_2 are kept constant. For sector 2, the equality sign holds in (23). For sector 1, the left-hand side of (23) can be written as $da_{L1}(dw + \bar{\mu}_1 dt) = da_{L1}(-\bar{\mu}_2 + \bar{\mu}_1)dt$. This will ensure that the inequality (23) is fulfilled. (24) also holds.

This example shows that when labour and land are used at a fixed ratio in each sector, capital in sector 1 changes in parallel with the price of commodity 1, while capital in sector 2 becomes constant, so that cross-hauling does not occur.

V. Immobility of Capital

In the model discussed above, the rental on capital is fixed and the demand for capital is endogenously determined. If capital were immobile internationally, the rental on capital would be endogenously determined. JNR (1983, pp. 364–365) pointed that the phenomenon of cross-hauling is strongly connected with asymmetric changes in rentals on capital which loses international mobility: one type of capital whose domestic rental falls will escape abroad and the other type of capital whose domestic return rises will pile into the home country.

In this section, we will use a more general model which can include our previous model and the model of JNR (1983) as special cases to examine such a connection. We maintain, as before, the assumptions that the economy consists of two sectors and each sector uses sector-specific capital as one of factors of production.

In general, factor prices depend upon commodity prices and factor endowments. The rentals on sector-specific capital, therefore, can be written as $r_i = r_i(K_1, K_2, Z)$, where Z denotes the vector of variables other than K_1 and K_2. Let $dr_{i|\bar{K}_1,\bar{K}_2}$ represent $\frac{\partial r_i}{\partial Z}dZ$, i.e., a change in the rental when K_1 and K_2 are kept constant.[3] The total change in the rental is given by

$$dr_i = \frac{\partial r_i}{\partial K_1}dK_1 + \frac{\partial r_i}{\partial K_2}dK_2 + dr_{i|\bar{K}_1,\bar{K}_2} .$$

When capital is mobile at a fixed rental, $dr_i = 0$. In this case we obtain

$$(29) \qquad \begin{bmatrix} \frac{\partial r_1}{\partial K_1} & \frac{\partial r_1}{\partial K_2} \\ \frac{\partial r_2}{\partial K_1} & \frac{\partial r_2}{\partial K_2} \end{bmatrix} \begin{bmatrix} dK_1 \\ dK_2 \end{bmatrix} = - \begin{bmatrix} dr_{1|\bar{K}_1,\bar{K}_2} \\ dr_{2|\bar{K}_1,\bar{K}_2} \end{bmatrix}$$

Define the adjustment mechanism in the capital markets as, with a given $\bar{Z}$,

$$\dot{K}_1 = \alpha(r_1(K_1, K_2, \bar{Z}) - \bar{r}_1),$$
$$\dot{K}_2 = \beta(r_2(K_1, K_2, \bar{Z}) - \bar{r}_2),$$

where α and β are positive constants, and the dot denotes a time derivative. We linearize this system in the neighbourhood of an equilibrium and assume the linear approximation system to be stable. The necessary and sufficient conditions for the stability are

$$(30) \qquad \alpha \frac{\partial r_1}{\partial K_1} + \beta \frac{\partial r_2}{\partial K_2} < 0$$

3. In our previous model
$$dr_{i|\bar{K}_1,\bar{K}_2} = \frac{\partial r_i}{\partial p_1}dp_1 + \frac{\partial r_i}{\partial L}dL + \frac{\partial r_i}{\partial T}dT,$$
while in JNR (1983) $dr_{i|\bar{K}_1,\bar{K}_2} = \frac{\partial r_i}{\partial p_1}dp_1 + \frac{\partial r_i}{\partial p_2}dp_2 + \frac{\partial r_i}{\partial L}dL$.

and

$$(31)\qquad \Delta \equiv \begin{vmatrix} \dfrac{\partial r_1}{\partial K_1} & \dfrac{\partial r_1}{\partial K_2} \\ \dfrac{\partial r_2}{\partial K_1} & \dfrac{\partial r_2}{\partial K_2} \end{vmatrix} > 0 .$$

Equations (29) can be solved with respect to dK_1 and dK_2:

$$(32)\qquad dK_1 = -\frac{1}{\Delta} \begin{vmatrix} dr_{1\,|\bar{K}_1,\bar{K}_2} & \dfrac{\partial r_1}{\partial K_2} \\ dr_{2\,|\bar{K}_1,\bar{K}_2} & \dfrac{\partial r_2}{\partial K_2} \end{vmatrix} ,$$

$$(33)\qquad dK_2 = -\frac{1}{\Delta} \begin{vmatrix} \dfrac{\partial r_1}{\partial K_1} & dr_{1\,|\bar{K}_1,\bar{K}_2} \\ \dfrac{\partial r_2}{\partial K_1} & dr_{2\,|\bar{K}_1,\bar{K}_2} \end{vmatrix} .$$

As shown by equations (32) and (33), the information that $dr_{1\,|\bar{K}_1,\bar{K}_2} \underset{(<)}{>} 0$ and $dr_{2\,|\bar{K}_1,\bar{K}_2} \underset{(>)}{<} 0$ does not necessarily mean that $dK_1 \underset{(<)}{>} 0$ and $dK_2 \underset{(>)}{<} 0$. However, there is a sufficient condition to give such a relationship. If

$$(34)\qquad \begin{bmatrix} \dfrac{\partial r_1}{\partial K_1} & \dfrac{\partial r_1}{\partial K_2} \\ \dfrac{\partial r_2}{\partial K_1} & \dfrac{\partial r_2}{\partial K_2} \end{bmatrix} = \begin{bmatrix} - & - \\ - & - \end{bmatrix} ,$$

that is, if the effects of a change in the endowment of each type of capital upon the returns to both types of capital have the same pattern as in the simple specific-factor model of Jones (1971), the strong connection suggested by JNR (1983) is obtained.[4] As equations (29) show, we cannot pin down the sign of $dr_{i|\bar{K}_1,\bar{K}_2}$ from the information that $dK_1 \underset{(<)}{>} 0$ and

4. By assumption, the matrix (34) must satisfy condition (31). Condition (30) is automatically satisfied.

$dK_2 \underset{(>)}{\lessgtr} 0$, even if the sign pattern (34) is assumed.

VI. Concluding Remarks

We have analysed the effects of changes in labour and land which are immobile internationally and the tariff change on international flows of sector-specific capital in a small open economy. Changes in labour and land cause a parallel movement of the output and the capital stock in each sector. In the case of the tariff change, we have shown the sufficient conditions for cross-hauling to occur and the examples in which capital flows out of the export industry and flows into the import-competing industry when the tariff rate is raised.[5]

JNR (1983) suggested that cross-hauling can be inferred from asymmetric changes in rentals in the case of capital being immobile. By using a more general model, we have shown that this inference becomes valid when an increase in each type of capital stock reduces the rentals on both types of capital.

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5. Falvey (1979, p. 81) showed that when a tariff on imports is introduced, this pattern of capital flows is the inevitable result in his model with a two-tier process.

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