TWO-WAY CAPITAL FLOWS: CROSS-HAULING IN MODELS OF FOREIGN INVESTMENT

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ABSTRACT

Two models are presented of economies which are open to both commodity trade and foreign investment of a sector-specific kind, and which exhibit the phenomenon of "cross-hauling", or reverse flows of internationally mobile capital in two different sectors. In the first model, a single domestic factor is combined with internationally mobile but sector-specific capital in each of two sectors, one of which produces a non-traded good. This appears to be the simplest possible model which permits cross-hauling as an endogenous phenomenon. The second model allows for three kinds of factor mobility, with each sector combining a specific immobile factor with intersectorally mobile but country-specific labor and internationally mobile but sector-specific capital. As well as suggesting explanations for cross-hauling, both models throw light on the "Dutch Disease" phenomenon and also show that trade and international capital flows may be complements rather than substitutes. In addition, the richer model allows for a variety of responses to exogenous disturbances, with the possibility and extent of cross-hauling depending on the substitutability or complementarity relationships between capital, labor and domestic resources.

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1. INTRODUCTION

While nineteenth-century economic development was accompanied mainly by one-way flows of capital from the center towards the periphery of the world economy, the second half of the twentieth century has witnessed an increasing tendency towards mutual interpenetration of the capital markets of different countries. However, the resulting phenomenon of "cross-hauling", or two-way flows of direct foreign investment, appears to be poorly explained by standard international trade theory, with its emphasis on intersectoral rather than international mobility of capital. In this paper we present two alternative models which explain cross-hauling as an endogenous phenomenon. In addition, these models throw light on related issues such as the Dutch-Disease-type squeeze of certain sectors following a boom elsewhere in the economy, and the question of whether international trade and capital movements are substitutes or complements for one another.

A natural vehicle for discussing the phenomenon of cross-hauling is the sector-specific-factor model of Jones (1971) and Samuelson (1971). By contrast with the Heckscher-Ohlin model, in which homogeneous capital is instantaneously mobile between

sectors, this model allows each sector to use a distinct kind of capital. This accords well with recent work on multinational corporations, arguably the principal conduit for direct foreign investment in the post-war world, which views such corporations as suppliers not just of physical capital but also of an industry-specific package of entrepreneurial and informational skills.* Viewed in this light, measured returns on capital include the rents to such "skill" capital. Competitive pressures tend to equalize the returns on this composite capital factor between the same industry in different countries, whereas the returns on capital in the various sectors within a single country may differ indefinitely.

In addition to providing a descriptively plausible framework for the study of two-way capital flows, the sector-specific-factor model exhibits a property which is highly suggestive of cross-hauling. As noted by Caves (1971a), an increase in the endowment of the capital factor specific to one sector raises the demand for the mobile factor and thus reduces the return to the capital factor specific to the other sector, giving rise to an incentive for an outflow of the second sector's capital to other countries.** While this mechanism contains the essential ingredient of two-way capital flows, it fails to capture them as *endogenous* phenomena, since no explanation is provided for the initial increase in the first sector's endowment of capital. In order to provide a complete explanation of cross-hauling it is necessary to assume that capital flows in both sectors are endogenous and to enquire how an initial equilibrium may be disturbed by a shock other than an exogenous movement of capital.***

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* For an outline of this approach, largely initiated by Hymer (1960), see Caves (1971a) and (1982).

** Caves's model of foreign investment, which extends the sector-specific-factor model to allow for international mobility of the factor specific to one of the two sectors, is formally identical to the "staples" model of primary production, as expounded by Chambers and Gordon (1966), Caves (1971b) and Easton and Reed (1980).

*** The desirability of distinguishing between endogenous capital flows and once-and-for-all international transfers of capital is pointed out in Ruane and Neary (1982).

In Section 2 we present what appears to be the simplest possible model which fulfills these requirements. In this model, a single domestic factor is combined with internationally mobile capital in each of two sectors. Incomplete specialization in production is guaranteed by assuming that one of the goods produced is not traded. (This assumption also captures the notion of foreign investment as a means of penetrating a country's domestic market.) However, the price which must be paid for the simplicity of this model is that all domestic prices are completely dictated by the prices which prevail on world commodity and capital markets. Such close links between domestic and world prices run counter to the common notion that the domestic availability of specific factors in a country may influence their own and other domestic prices, and that much foreign investment takes place in order to exploit such local divergences from prices elsewhere in the world. In order to investigate whether cross-hauling is likely under such conditions, Section 3 explores a second model with a richer production structure than the first which allows for different degrees of international and intersectoral factor mobility, and in so doing reveals how the nature of complementarity and substitutability between labor, capital and specific resources bears upon the cross-hauling phenomenon.

Both of the models considered in this paper are of a small open economy, which takes as given the terms on which it can trade commodities and capital with the rest of the world.* This is a perfectly satisfactory framework within which to investigate the likelihood of cross-hauling. However, it is not always realized that links between the home country and the rest of the world at more than one level of the production structure impose certain restrictions on the range of admissible exogenous shocks.

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*Models of international capital mobility in which some or all prices are determined endogenously by the conditions of world equilibrium have been considered by Batra and Ramachandran (1980), Berglas and Jones (1977), Jones and Dei (1981) and Dixit (1980). Markusen and Melvin (1979) have also examined the effects of international capital transfers in a fully specified two-country model, though without imposing any link between the returns to capital in the two countries.

These issues are considered in Section 4, which also shows how the assumption of exogenously fixed rentals on capital used in different sectors blurs the distinction between sector-specific and intersectorally mobile capital. Finally, Section 5 concludes with a discussion of some other issues in international trade theory which are closely related to the phenomenon of cross-hauling.

2. CROSS-HAULING IN A COMPLETELY DEPENDENT ECONOMY

It is clear that the simplest possible model which can exhibit cross-hauling must be one with two sectors, each using a sector-specific capital whose rental is exogenously determined by conditions in the world economy.* However, if commodity prices are also assumed to be fixed, a difficulty immediately arises if we attempt to graft these assumptions onto the standard sector-specific-factor model of Jones (1971) and Samuelson (1971). For, with real returns to capital fixed, cost-minimizing factor proportions in each sector are determined. Hence the model acquires a Ricardian flavour: entrepreneurs choose to produce only that good which has the lower unit labor costs.**

There are two possible escape routes from this straitjacket of specialization. One route, to be explored in the next section, assumes more than one internationally immobile factor whose price is determined endogenously. An alternative route is to retain the assumption of a single domestic factor, labor, and assume instead that one of the two final outputs is not traded internationally.*** In the present section we examine the properties of this simple model and derive conditions under which it exhibits cross-hauling of international capital.

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* Amano (1977) claimed that diversified production is possible in the sector-specific-factor model even when both commodity prices and capital rentals are exogenously determined, but, as shown by Neary (1980), this is incorrect.

** In the notation to be introduced later in this section, only that good with the higher $(p_j - a_{Kj}r_j)/a_{Lj}$ is produced. The manner in which absolute labor costs (rather than comparative advantages) influence the international location of productive activities has been explored by Jones (1980).

*** The effects of exogenous changes in the stock of capital in one sector have been considered in a similar model by Burgess (1978).

Figure 1 illustrates the determination of domestic prices in this model. For reasons which will become apparent, we assume that all the output of the domestically-produced traded good is exported and that a second traded good, not produced at home, is imported solely for final consumption.* Hence we label the two goods which the home economy produces X for exported and N

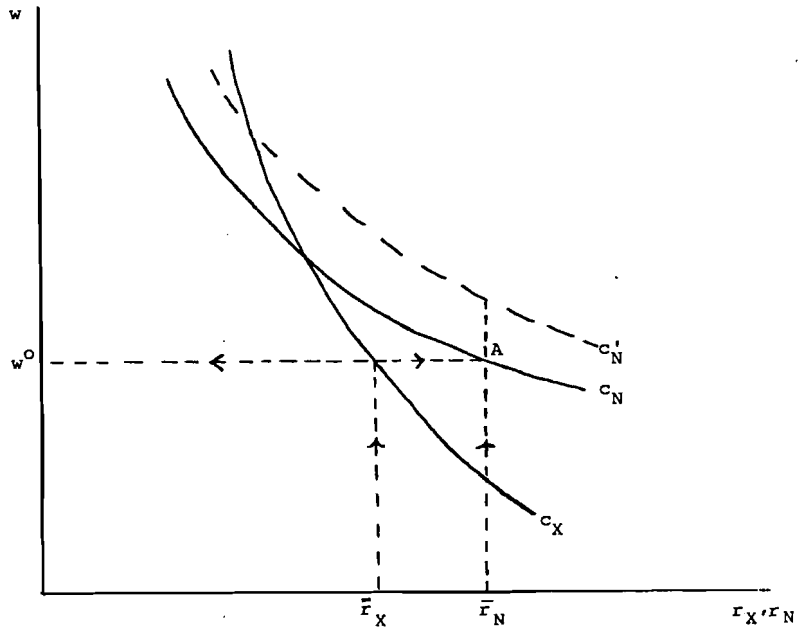

Figure 1. The determination of domestic prices in the simple sector-specific model.

for non-traded. Each of the curves in Figure 1 is a unit cost curve illustrating the combinations of the wage rate, w, and the return to capital, r, which are consistent with zero profits in the sector in question. The location of the unit cost curve for the export sector, c_X, is determined by the technology used in that sector and by the exogenously given price of its output. Since the return to capital in that sector, $\bar{r}_X$, is also exogenously determined, the wage rate in the economy must equal w^o (in the diagram) if the export sector is to cover its production costs. Faced with this wage rate and with its own exogenously-given return to capital, $\bar{r}_N$, the non-traded sector must operate

* These simplifying assumptions are taken from Jones (1974).

at point A if it also is to cover its costs.* Clearly, this cannot occur at any arbitrary price for the non-traded good: for example, if the price is such that the unit cost curve for the non-traded sector is given by the curve c_N' in Figure 1, entrepreneurs in that sector are making super-normal profits and the economy is not in equilibrium. Thus the price of the non-traded good must adjust endogenously in order to ensure that the unit cost curve for the sector passes through point A. In the resulting equilibrium, local technology, the world price of the exported good and the world return to each type of capital uniquely determine the wage rate, the price of the non-traded good and factor proportions in each sector.

The implications of these factor proportions for the derived demand for capital in each sector may be deduced by considering Figure 2. The downward-sloping line KK is a capital

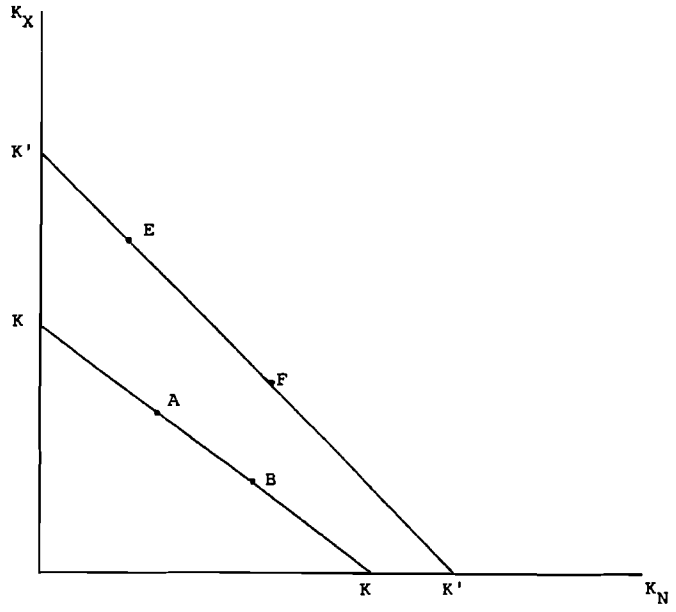

Figure 2. Possible capital requirements loci, KK and K'K'. The points A, B, E and F are discussed in the text.

*By drawing the unit cost curve for the non-traded sector flatter than that for the exporting sector, we are implicitly assuming that the non-traded sector is relatively labor-intensive. Apart from equation (5) below, nothing of substance in the model hinges on this.

requirements locus, which shows the combinations of capital stocks in use in each sector which are consistent with full employment of the domestic factor, labor, and with the factor proportions already determined in each sector. This line is essentially the translation into capital space of the familiar labor constraint in output space (i.e., the Rybczynski locus) with the equation:

$$a_{LX}X_X + a_{LN}X_N = L \quad , \tag{1}$$

where a_{ij} is the amount of factor i used per unit of output in sector j and X_j is the level of output in sector j. Since the capital in use in each sector is related to that sector's output level via the capital-output coefficient, $K_j = a_{Kj}X_j$, we may substitute into (1) to obtain:

$$\frac{a_{LX}}{a_{KX}} K_X + \frac{a_{LN}}{a_{KN}} K_N = L \quad . \tag{2}$$

With techniques in each sector fixed by world prices, equation (2) gives the downward-sloping straight-line capital requirements locus in Figure 2. The point on this locus at which the economy actually produces, A, is then determined by demand considerations. With given commodity prices and a given level of domestic income (since the quantities of factors of production owned by domestic residents are fixed) the level of demand for the non-traded good, D_N, is determined. This therefore translates into a derived demand for capital to be used in the non-traded sector, $a_{KN}D_N$. The initial equilibrium point A in Figure 2 corresponds to point A in Figure 1.

Figure 2 allows us to examine the key elements determining when and how cross-hauling may occur following different kinds of exogenous shocks. In the first place, it shows clearly that cross-hauling must inevitably result from any shock which shifts the equilibrium point along a given negatively-sloped KK locus. The only exogenous shocks which have this effect are those which alter the demand for the non-traded good without changing

production techniques or the economy's labor endowment (both of which determine the position of the KK locus). Thus, a pure demand shift in favor of the non-traded good would move the equilibrium in Figure 2 from A to B, with a consequent flow of capital into the non-traded sector and outflow of capital from the exporting sector. Such a pure demand shift might be induced by a change in tastes towards the non-traded good or by a tariff on the imported good. (The latter is equivalent to a pure shift in tastes towards the non-traded good, since the imports are not produced domestically.) Furthermore, a capital transfer or gift to the home country (of either type of capital) would also result in cross-hauling, since it would increase the demand for the non-traded good (through its effect on income), while leaving production techniques and labor supply (and hence the KK locus) unaltered.*

Secondly, Figure 2 shows that any exogenous shock which affects both the demand for the non-traded good and the KK locus may, but does not inevitably, give rise to cross-hauling. If, for example, some exogenous shock shifts the KK locus outwards to K'K', then the new equilibrium may lie at some point such as E, implying that there has been cross-hauling, or alternatively at F, implying that there has been capital inflow in both sectors. In the remainder of this section we consider two exogenous shocks: firstly, the imposition of an export subsidy, and secondly, an increase in the economy's labor endowment. To determine whether cross-hauling occurs, we must examine how the demand for capital in both sectors is affected by such exogenous shocks. We turn first to consider the effects of introducing a small export subsidy, which raises the domestic price of exported goods, while the world prices for traded goods and capital remain fixed.

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* Since a gift of capital alters the ownership but not the productivity of capital in the receiving country, it must induce some capital outflow. In particular, note that a gift of capital specific to the exporting sector leads to an actual reduction in the amount of this type of capital used in the receiving country (as less exports are required for factor payments abroad), and a rise in the amount of capital used in the non-traded sector (in response to the increased demand for the non-traded good).

The effects of an export subsidy on domestic prices are shown in Figure 3, where the direct effect of the imposition of the subsidy is to shift the unit cost curve for the exported good outwards from c_X to c'_X. In order to raise unit costs in the exporting sector by the full extent of the price increase,

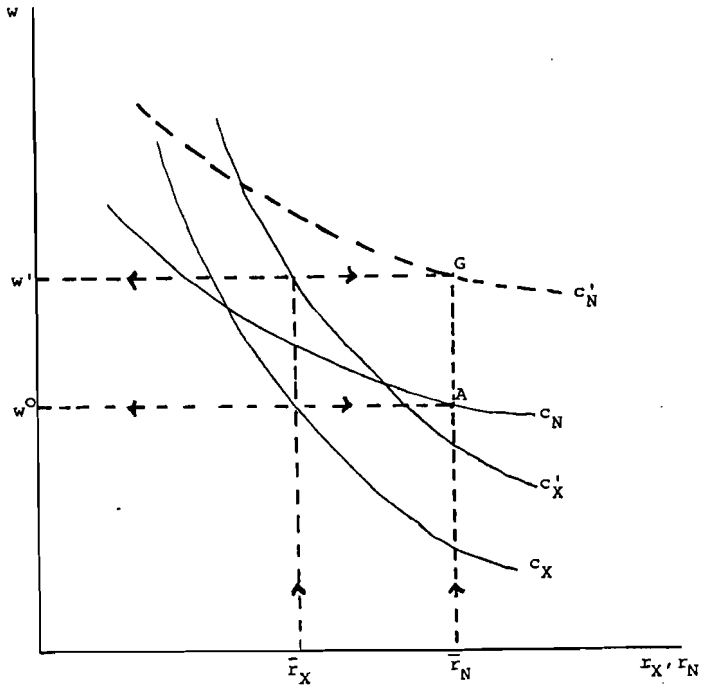

Figure 3. The effects of an export subsidy on domestic prices.

the wage rate must rise: this in turn requires an increase in the price of the non-traded good sufficient to move it from A to G, at which point zero-profit equilibrium has been restored. The resulting changes in relative prices may be read from the diagram, but for later use it is convenient to derive explicit expressions for them. To do this, we consider the competitive profit conditions which equate the change in the price of each sector's output to the change in unit costs facing it. Since rentals in each sector are determined in world markets, these conditions are:

$$\theta_{LN}\hat{w} = \hat{p}_N \tag{3}$$

$$\theta_{LX}\hat{w} = \hat{p}_X \tag{4}$$

where a circumflex (^) denotes a proportional rate of change (e.g., $\hat{w} = d \ln w$); θ_{ij} denotes the share of factor i in the value of sector j's output; and p_j denotes the price of the output of sector j. Equations (3) and (4) show that the export subsidy has a magnified effect on the wage rate and an ambiguous effect on the ratio of domestic prices of non-traded to exported goods, increasing this ratio if and only if the production of the non-traded goods is relatively labor-intensive (as has been assumed in Figures 1 and 3):

$$\hat{p}_N = \frac{\theta_{LN}}{\theta_{LX}} \hat{p}_X \quad . \tag{5}$$

The rise in the wage rate, with rentals on both types of capital pegged to world levels, induces a movement towards more capital-intensive techniques in each sector, which clearly shifts the KK locus outwards. To determine whether or not cross-hauling occurs, we must examine how the sectoral demand for capital changes in response to this change in relative factor prices. A simple argument may be used to show that the export sector demands more capital. With the price of (non-domestically-produced) imports constant, and with income effects absent,* the rise in the price of non-traded goods must reduce the demand for these goods. Since the capital-labor ratio in the non-traded sector is rising and output is contracting, employment in this sector must fall, and the labor released must be absorbed by the exporting sector. Finally, as we know that the capital-labor ratio in the exporting sector must also rise, we can conclude that the absolute demand for capital in this sector increases unambiguously.

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*A small export subsidy, like a small tariff starting from a free-trade position, has a second-order effect on national real income.

Since the export subsidy attracts capital to the exporting sector, cross-hauling occurs if the demand for capital in the non-traded sector falls. However, this is an open question since the two forces determining demand for capital in this sector pull in opposite directions: the capital-output ratio rises (as the wage rate rises relative to the fixed rental), whereas output, tied to demand, must fall. More formally, if the market for the non-traded good is to clear,

$$K_N = a_{KN} D_N \quad . \tag{6}$$

The rise in the capital-output ratio is proportional to the wage increase and to the elasticity of substitution in non-traded goods, σ_N, as shown in (7)*:

$$\hat{a}_{KN} = \theta_{LN} \sigma_N \hat{w} \quad . \tag{7}$$

As already mentioned, D_N depends only on the substitution effect of a rise in p_N, because income effects are absent and the price of the other (imported) commodity that is consumed remains unchanged. Therefore

$$\hat{D}_N = -\varepsilon_N \hat{p}_N = -\varepsilon_N \theta_{LN} \hat{w} \tag{8}$$

where ε_N denotes the (positive) substitution elasticity of demand. The relative change in the non-traded sector's demand for capital is the sum of $\hat{a}_{KN}$ and $\hat{D}_N$, so that the conflict between reduced

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* This equation is derived from Jones (1965) by combining the definition of the elasticity of substitution,

$$\hat{a}_{Lj} - \hat{a}_{Kj} = -\sigma_j (\hat{w} - \hat{r}_j)$$

with the envelope property implied by cost-minimizing behavior, i.e., that the value-share-weighted sum of changes in input-output coefficients is zero:

$$\theta_{Lj} \hat{a}_{Lj} + \theta_{Kj} \hat{a}_{Kj} = 0 \quad .$$

output and increased unit capital requirement is clearly revealed in (9)*:

$$\hat{K}_N = \theta_{LN}(\sigma_N - \varepsilon_N)\hat{w} \quad . \tag{9}$$

Cross-hauling is, therefore, more likely to occur following an export subsidy the greater the reduction in demand (i.e., the larger the value of ε_N) and/or the smaller the degree of flexibility in production techniques (i.e., the smaller the value of σ_N).

This line of argument, in which we solve for the capital flow consistent with market clearing of non-traded goods at the price implied by equation (5), can usefully be supplemented by examining the nature of the disequilibrium in the market for non-traded goods which would emerge at this price if capital were not mobile internationally. Figure 4 depicts this market with the initial equilibrium at A, corresponding to

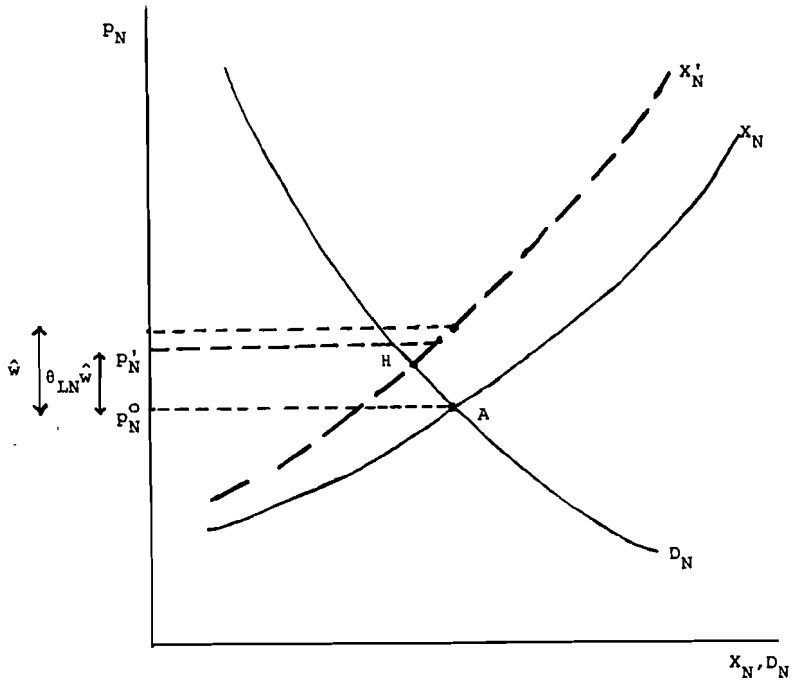

Figure 4. Adjustment to equilibrium in the market for non-traded goods.

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*The comparable expression for capital inflow to the export sector is $\lambda_{LX}\hat{K}_X = \{\lambda_{LX}\sigma_X + \lambda_{LN}(\theta_{KN}\sigma_N + \theta_{LN}\varepsilon_N)\}\hat{w}$, where λ_{Lj} denotes the fraction of the labor force employed in sector j. It is clear that all substitution possibilities in the economy, on both the demand and production sides, work towards attracting capital into the export sector.

the points denoted by A in Figures 2 and 3. The supply curve, X_N, is drawn contingent on the initial stock of capital. The export subsidy shifts this supply schedule upwards in proportion to the increase in the wage level, since output would remain unaltered if entrepreneurs could have an increase in p_N that matched the wage rise. Point H in Figure 4 illustrates the equilibrium position of the non-traded goods market, given that there is no capital inflow. In more formal terms, the expression for the change in the equilibrium price of the non-traded good *at the initial stock of capital*, is given by

$$\hat{p}_N = \frac{e_N}{e_N + \varepsilon_N} \hat{w} \quad , \tag{10}$$

where e_N is the supply elasticity at that capital stock.* However, in this completely dependent economy the actual change in the price of the non-traded good is given by equation (5), and may be greater or less than the change implied by equation (10), i.e., by the move from A to H. Figure 4 illustrates the case in which the price of the non-traded good which would clear the market, if capital were not internationally mobile (shown by H), falls short of the price necessary for factor-market equilibrium, p_N', which corresponds to the price for the non-traded good at G in Figure 3. We see that at the price p_N' in Figure 4 there is an excess supply of the non-traded good; thus, when capital becomes internationally mobile, it flows out of the non-traded sector.

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* Equation (10) is derived from the demand curve for the non-traded good (equation (8) above) and the supply curve, with the capital stock remaining at a constant level:

$$\hat{X}_N = e_N(\hat{p}_N - \hat{w}) \quad .$$

We recall that the supply elasticity, e_N, is related to the elasticity of substitution between capital and labor, σ_N, as follows:

$$e_N = \theta_{LN} \sigma_N / \theta_{KN} \quad .$$

Expression (9) depicts the opposing forces affecting capital flows in the non-traded sector in terms of the elasticity of substitution and the elasticity of demand. The equivalent formulation (9') translates these forces into a comparison between the price of the non-traded good that would clear the market in the absence of capital flows, and the price which must obtain because of the nation's strong links with the rest of the world (given by equation (5)):

$$\hat{K}_N = (e_N + \varepsilon_N)\{\frac{e_N}{e_N + \varepsilon_N} - \theta_{LN}\}\hat{w} \quad . \qquad (9')$$

The former represents a standard comparison between elasticities of demand and supply, whereas the latter reflects the labor intensity of production in the non-traded sector.

In summary, for the introduction of an export subsidy to lead to cross-hauling in this model, there must be a flow of capital out of the non-traded sector, since the subsidy unambiguously generates a capital inflow in the exporting sector. Such a reduction in the demand for capital by the non-traded sector occurs when the negative effects of the fall in output (in response to reduced demand) outweigh the positive effects of the increased capital intensity of production (in response to relatively higher wages). Two equivalent formal expressions, (9) and (9'), reflect these opposing forces.*

Our analysis thus far indicates that cross-hauling is a possible but not a certain outcome of any exogenous sector-specific shock, such as an export subsidy, while it is an inevitable consequence of any shock which affects demand only. Another type of shock which it seems appropriate to examine is an economy-wide shock, which affects all sectors of the economy in a similar manner. We now consider the effect of an increase in the labor

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* We have loaded the dice in favor of cross-hauling by our assumption that the exported good is not consumed at home. If this assumption is relaxed and the exported and non-traded goods are assumed to be substitutes in consumption, then an export subsidy has the additional effect of raising the demand for non-traded goods. This shifts the demand schedule for non-traded goods in Figure 4 outwards, thereby making cross-hauling less likely.

force on capital flows, with the aid of Figure 5 (which is analogous to Figure 2 above). In this case, we show the initial equilibrium, A, at the intersection of the capital requirements

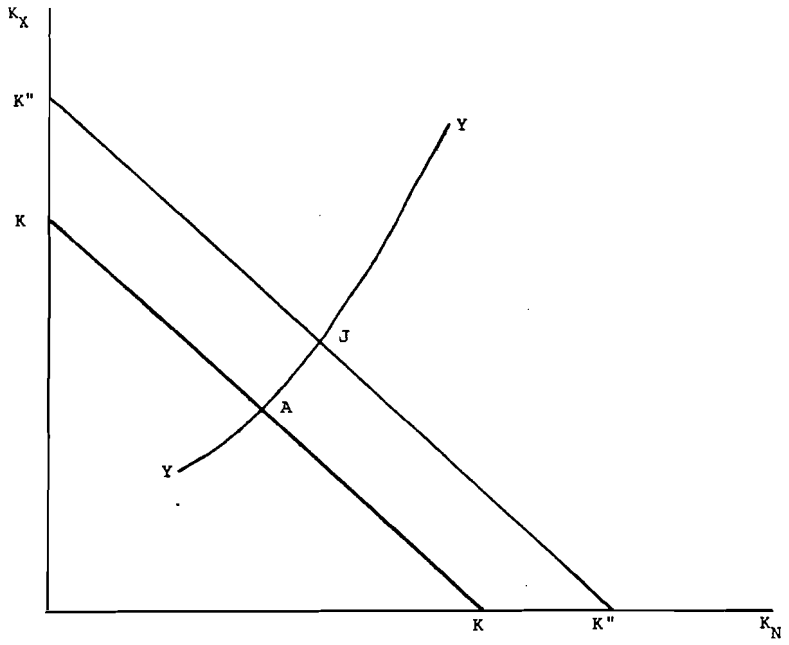

Figure 5. Possible capital requirements loci, KK and K"K". YY is the income-consumption curve and A and J are discussed in the text.

locus, KK, and the income-consumption curve, YY. The latter is the translation into capital space of the familiar income-consumption curve in commodity space, which shows the combinations of imported and non-traded goods that are demanded at different levels of real income. (Since the relative prices of traded goods are fixed, the demand for the imported good may be expressed in terms of the exported good.) An increase in the labor force shifts the KK locus parallel and outwards to K"K". (The slope of the locus, defined by equation (2), is unaffected by the increase in the labor force, since the factor intensities in both sectors are unchanged.) The income-consumption curve,

drawn with respect to given prices and wages, is unaffected by the change in the labor force. Hence the new equilibrium is at J, which implies that capital flows into both sectors, i.e., cross-hauling cannot result from an increase in the labor force.

This comparison suggests that cross-hauling does not result from economy-wide shocks which push both sectors in the same direction, but may result from a sector-specific shock, which, by altering the relative position of one sector with respect to the other, tends to push the domestic rentals on initial capital stocks in opposite directions. However, this result is dependent on the fact that in our model relative factor prices, and hence factor intensities, are unaffected by the economy-wide shock. By contrast, in the model discussed in the next section, a change in the endowment of labor does affect factor prices, and hence has different sectoral effects depending on factor intensities. As might be expected, these sectoral differences give rise to the possibility of cross-hauling, even if the initial shock is not sector-specific.

3. INTERNATIONAL CAPITAL MOBILITY WITH NATIONAL SPECIFIC FACTORS

The model discussed in the previous section appears to be the simplest possible model which exhibits cross-hauling as an endogenous phenomenon. However, it does so at the cost of imposing the "local factor-price equalization" property: all domestic prices (of both goods and factors) are determined independently of domestic factor endowments. This runs counter to the observation that most countries possess internationally immobile factors whose returns are not completely dependent on world commodity prices and rates of return on capital. In the present section, we introduce an alternative model with a richer production structure, one in which factor prices can be influenced by domestic factor endowments. This allows us to investigate how the interaction between domestic endowments and factor prices might affect the likelihood of cross-hauling.

The model discussed in this section resembles that outlined above in that each sector uses labor (mobile between sectors

but not internationally) and a type of capital specific to that commodity but available on world markets at an exogenously determined rate of return. In addition, each sector makes use of a resource, employed only in that sector, whose quantity is given and cannot be increased by trade. The model thus considers two goods and five factors, the prices of three of which are determined endogenously. With three degrees of freedom in domestic factor-price determination, fixing both commodity prices does not drive the economy to specialize in production, and so we assume that both goods are produced and traded at fixed world prices.* As we shall see, one of the interesting features of the model is that the possibility of substituting towards or away from the domestic sector-specific factors plays a similar role in this model to that played by the non-traded final good in the model given in the previous section.

Using this model, we wish to find out whether cross-hauling will result from an exogenous shock which disturbs the initial equilibrium. As in the previous section, we distinguish between shocks which are economy-wide, and those which are sector-specific. We analyze the effects of a change in the labor force, as an example of an economy-wide shock, and two sector-specific shocks. We consider, firstly, the effects of a domestic tariff on the traded good which is a net import; this shock is analogous to the export subsidy in the previous section. Secondly, we examine the effects of a change in the endowment of the natural resource used in one sector; the richer production structure of this model compared with that in Section 2 allows us to analyze this additional sector-specific shock. Because factor prices in this case are influenced by domestic endowments, both economy-wide and sector-specific shocks affect the capital intensity of production, and hence the demand for capital by both sectors. In order to determine the direction of capital flows, we first derive general expressions

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* This model is formally identical to that of Burgess (1980) though his interpretation is very different. Since he interprets the input in each sector whose price is fixed in world markets as an intermediate good (identical to the output of the other sector), the question of how the levels of use of these inputs is affected by exogenous shocks is of little substantive interest.

for changes in outputs, techniques of production and factor prices, and then use these expressions to examine the impact of a particular sector-specific or economy-wide shock. To avoid unnecessary algebra, we assume in deriving our general expressions that certain exogenous variables are not subjected to shocks; in particular, denoting the specific resources used in producing the commodities X_1 and X_2 by V_1 and V_2, respectively, we consider, without any loss in generality, changes in p_1 and V_1 only.

Turning to the formal structure of the model, the competitive profit conditions, which in the previous section were given by equations (3) and (4), are now given by the following:

$$\theta_{V1}\hat{s}_1 + \theta_{L1}\hat{w} = \hat{p}_1 \tag{11}$$

$$\theta_{V2}\hat{s}_2 + \theta_{L2}\hat{w} = 0 \quad , \tag{12}$$

where s_1 and s_2 are the returns to the two specific national factors, V_1 and V_2, respectively.*

With both commodity prices given and with world returns to capital fixed, equations (11) and (12) are still not sufficient to determine the three domestic factor prices, s_1, s_2 and w; unlike the model of Section 2, the structure of national factor prices is no longer completely dependent upon the world market. Instead, the endowments of domestic factors also play a role, through the conditions for full employment. In the labor market, this condition is identical to equation (1) in the last section (with appropriate relabelling) except that production techniques are no longer determined by world prices:

$$a_{L1}X_1 + a_{L2}X_2 = L \quad . \tag{13}$$

Each output level is further constrained to equal the quantity of the resource specific to it divided by the resource requirement per unit of output: $X_j = V_j/a_{Vj}$. Since we assume that V_2

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*As before, the θ_{ij} denote distributive shares, but the sum of θ_{Vj} and θ_{Lj} falls short of unity by the fraction of revenue earned by internationally mobile capital in the jth sector.

remains constant, but allow for the possibility of parametric changes in the labor force, L, and in the quantity of the national resource specific to the first sector, V_1, we may write:

$$\hat{X}_1 = \hat{V}_1 - \hat{a}_{V1} \tag{14}$$

$$\hat{X}_2 = \quad - \hat{a}_{V2} \quad . \tag{15}$$

Substituting these output changes into the differentiated form of equation (13) yields equation (16):

$$\lambda_{L1}(\hat{a}_{L1} - \hat{a}_{V1}) + \lambda_{L2}(\hat{a}_{L2} - \hat{a}_{V2}) = \hat{L} - \lambda_{L1}\hat{V}_1 \quad . \tag{16}$$

Next, we must relate the changes in input coefficients to changes in factor prices. Each sector uses three inputs, and therefore each input-output coefficient depends upon three factor prices. As the rentals on capital are constant throughout, only wage changes and changes in the s_j can influence production techniques. In general

$$\begin{aligned} \hat{a}_{Lj} &= E^L_{Lj}\hat{w} + E^V_{Lj}\hat{s}_j \\ \hat{a}_{Vj} &= E^L_{Vj}\hat{w} + E^V_{Vj}\hat{s}_j \end{aligned} \tag{16a}$$

where the E's denote partial elasticities of substitution in production. For example, E^L_{Vj} shows the impact of a one percent increase in the wage rate on the use of specific national resource V_j per unit of output X_j. The own-price elasticities, E^L_{Lj} and $E^{j_V}_{Vj}$, must be negative (or zero if technical coefficients are inflexible). The cross elasticities, E^V_{Lj} and E^L_{Vj}, may be of either sign: a positive sign reflects substitutability, and a negative sign complementarity, between labor and the specific national factor. Substituting these terms into (16) we obtain equation (17)*:

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*This procedure parallels that described in more detail in Jones and Easton (1982).

$$\xi_1\hat{s}_1 + \xi_2\hat{s}_2 - \xi_3\hat{w} = \hat{L} - \lambda_{L1}\hat{V}_1 \qquad (17)$$

where

$$\xi_1 = \lambda_{L1}(E^V_{L1} - E^V_{V1})$$

$$\xi_2 = \lambda_{L2}(E^V_{L2} - E^V_{V2})$$

$$\xi_3 = \lambda_{L1}(E^L_{V1} - E^L_{L1}) + \lambda_{L2}(E^L_{V2} - E^L_{L2}) \quad .$$

Although we allow complementarity between factors, we impose limits on the degree of complementarity: for example, an increase in the wage rate may reduce the use of specific factor V_j as well as the use of labor (with K_j used more intensively per unit output), but at most by the same relative amount. Thus ξ_1, ξ_2 and ξ_3 are all positive.

The set of equations (11), (12) and (17) may be solved for the factor-price changes. These solutions are shown formally in (18)*:

$$\hat{s}_1 = \frac{1}{\Delta}\{[\theta_{L2}\xi_2+\theta_{V2}\xi_3]\hat{p}_1 + \theta_{L1}\theta_{V2}(\hat{L}-\lambda_{L1}\hat{V}_1)\}$$

$$\hat{s}_2 = \frac{1}{\Delta}\{ -\theta_{L2}\xi_1\,\hat{p}_1 + \theta_{L2}\theta_{V1}(\hat{L}-\lambda_{L1}\hat{V}_1)\} \qquad (18)$$

$$\hat{w} = \frac{1}{\Delta}\{ \theta_{V2}\xi_1\,\hat{p}_1 - \theta_{V1}\theta_{V2}(\hat{L}-\lambda_{L1}\hat{V}_1)\}$$

where

$$\Delta = \theta_{V1}\theta_{V2}\{\frac{\theta_{L1}}{\theta_{V1}}\,\xi_1 + \frac{\theta_{L2}}{\theta_{V2}}\,\xi_2 + \xi_3\} > 0 \quad .$$

The final step in our analysis is to derive expressions for the demand for capital in both sectors, into which these solutions for endogenous factor-price changes may be substituted. Since each K_j equals $a_{Kj}X_j$ and output X_j in turn equals V_j/a_{Vj},

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* The term $\Delta/\theta_{V1}\theta_{V2}$ indicates the percentage fall in the demand for labor that would be induced by a one percent increase in the wage rate.

the changes in capital stocks in the two sectors may be derived from (16a):

$$\hat{K}_1 = \hat{V}_1 + (E^V_{K1} - E^V_{V1})\hat{s}_1 + (E^L_{K1} - E^L_{V1})\hat{w}$$

$$\hat{K}_2 = (E^V_{K2} - E^V_{V2})\hat{s}_2 + (E^L_{K2} - E^L_{V2})\hat{w} \quad . \tag{19}$$

Equations (18) and (19) provide formal expressions for our analysis of cross-hauling. We first consider separately the effects on capital flows of two sector-specific shocks: the imposition of a tariff and an increase in the endowment of a specific resource. We then analyze the effects of an economy-wide shock, namely an increase in the labor force.

3.1 Tariff Protection

The effect on local factor prices of protecting X_1 may be deduced from (18): an increase in p_1 raises the return both to the national specific factor used in the first sector and to labor. This increase in the wage rate serves (by equation (12)) to squeeze the return to specific factor V_2.

The solutions for capital flows given by (19) suggest a "presumption" for cross-hauling. $\hat{V}_1$ is zero in this case. The presumption follows from the positive coefficients of $\hat{s}_1$ and $\hat{s}_2$ and the fact that protection raises s_1 and lowers s_2. In the first industry, the increase in s_1 (with the return to capital held constant) encourages a more intensive use of capital per unit of the national resource. Since V_1 is kept constant, this implies an inflow of K_1. Similarly, in the second sector the fall in s_2 encourages a fall in K_2/V_2, or, since V_2 is constant, a capital outflow. However, cross-hauling is only a presumption since this reasoning ignores the effect of the rise in wages on techniques of production. The coefficients of $\hat{w}$ in (18) may take either sign, depending upon the relative extent to which labor substitutes for capital, on the one hand, and for the national specific resource, on the other.

A "neutral" case is that of separability, in which the coefficients of $\hat{w}$ are both zero. In this case cross-hauling is a necessary consequence of protection. An alternative special case is that of complete inflexibility in the requirements for the national specific resource per unit output; each a_{Vj} is constant. In this extreme case, all the benefits of protection accrue to the national specific factor V_1. The wage rate remains constant, s_1 rises by a magnified amount (given by $\hat{p}_1/\theta_{V1}$) and s_2 is unchanged. Techniques of production are unaltered and, since the total quantities V_j are constant, so also are capital requirements and output levels. Protection results in no movements of capital. This case is extreme, but it illustrates the need for some alteration in the use of the national specific factor per unit output if outputs are to change.

If the a_{Vj} are flexible, it may nonetheless be reasonable to suppose that the rise in the wage rate allows a greater degree of substitution of capital (than of the national resource) for labor in each sector. That is, suppose that the coefficients of $\hat{w}$ in (19) are both positive. This serves to encourage a greater inflow of capital into the protected sector, but tends to stem, if not reverse, the outflow of capital from the unprotected (export) sector. One impact of protection has been to raise wages in both sectors. With rates of return to capital unchanged because of the link to world capital markets, the substitution of capital for labor in each sector is encouraged: if the scope for substitution is large, capital may flow into both sectors. In this case, therefore, the induced wage change is sufficient to offset the direct effect of the tariff protection in encouraging cross-hauling.

3.2 Resource Expansion

Suppose that new discoveries of the national resource specifically used in the first sector are made and that commodity prices remain constant. The impact on local factor prices may again be deduced from equation (17): the increase in V_1 unambiguously depresses s_1. With the returns to capital held constant, labor must gain, and this increase in the wage rate must also reduce s_2.

Equation (19) suggests that there is a direct presumption that K_1 will expand if the supply of the national resource, V_1, increases. Although the reduction in s_1 by itself tends to discourage the use of capital, the presumption remains that the combined effect of the first two terms in the equation for $\hat{K}_1$ is positive.* As for K_2, the reduction in s_2 promotes a capital outflow. Thus cross-hauling is to be expected, unless the direct effect of the wage rise is sufficient to induce a strong substitution effect towards K_2 in the X_2 sector.

Once again it proves useful to consider the special case in which each national specific resource is linked rigidly to each sector's output level, i.e., the a_{Vj}'s are completely rigid. The expressions for capital flows now reduce to:

$$\begin{aligned} \hat{K}_1 &= \hat{V}_1 + E^L_{K1}\hat{w} \\ \hat{K}_2 &= \quad E^L_{K2}\hat{w} \quad . \end{aligned} \tag{19'}$$

Since a_{Vj} is constant, the remaining two factors in each sector, capital and labor, must be substitutes for each other. Thus, the E^L_{Kj} are both positive, and cross-hauling is ruled out. The expansion in the first sector encourages a capital inflow, but the rise in wages that is passed on to the second sector causes an increase in capital intensity per unit output. With a_{V2} and V_2 fixed, output in the second sector does not change. The case in which the second sector loses capital, i.e., in which cross-hauling occurs, requires some flexibility in a_{V2} so that output in the second sector can contract.

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*The first two terms sum to

$$-\frac{\hat{V}_1}{\Delta}\{\theta_{V2}\lambda_{L1}[\theta_{L1}(E^V_{L1} - E^V_{K1}) + \theta_{V1}(E^L_{V1} - E^L_{L1})]$$

$$+ \theta_{V1}\lambda_{L2}[\theta_{L2}(E^V_{L2} - E^V_{V2}) + \theta_{V2}(E^L_{V2} - E^L_{L2})]\} \quad .$$

Of the four terms showing differences in the elasticities, the last three are all positive, while the first is ambiguous in sign. If resources and capital are complementary, the sign of the first term must be positive.

3.3 Growth in the Labor Force

One of the characteristics of this model is that an expansion in the nation's labor force has qualitatively the opposite effect on factor prices to an expansion in sector-specific V_1. In the set of three equations determining changes in factor prices, endowment changes appear only in the term $(\hat{L} - \lambda_{L1}\hat{V}_1)$ in equation (16). An increase in the labor force depresses the wage rate and increases the returns to both national specific factors.

With reference to equation (19), cross-hauling is now not to be expected since, with V_1 (and V_2) constant, the rise in both s_1 and s_2 encourages a more intensive use of capital. Ignoring the effect of the fall in wages, such an expansion in the labor supply promotes an inflow of capital in both sectors. As before, the impact of the wage change on capital flows depends on the asymmetry, if any, in the degree of substitutability between capital and labor on the one hand, and between the specific resource and labor on the other. If labor may easily be substituted for capital in both sectors, the fall in wages tends to discourage capital inflow. Indeed, if the a_{Vj} are completely inflexible, growth of the nation's labor force must cause capital to be expelled from each sector as outputs remain constant and labor substitutes for capital throughout the economy. Thus, while cross-hauling is unlikely to result from this economy-wide shock, it may occur if the degree of factor substitutability in the two sectors is sufficiently different. This result contrasts with that obtained in our earlier model, where, because a change in the labor force cannot affect factor prices, an economy-wide shock cannot give rise to cross-hauling.

This section has shown how cross-hauling may occur in response to both economy-wide and sector-specific shocks. We have argued that, in the case of a sector-specific shock, there is a "presumption" for cross-hauling, as the returns to the resource factors move in opposite directions. Cross-hauling, however, is not inevitable, because the change in the wage rate brought about by such a shock has an anti-cross-hauling impact, as it affects both sectors in the same way. Thus, the mobility of labor between

the two sectors tends to defuse the impact of any given sectoral shock, so that its effects on capital flows are analogous to those of an exogenous economy-wide shock.

4. ON MODELING FOREIGN INVESTMENT IN SMALL OPEN ECONOMIES

So far we have considered whether cross-hauling is likely to arise as a result of various disturbances to the initial equilibrium in each of the models presented. However, all of the disturbances considered here have been exclusively of a domestic kind (such as a change in the endowment of a factor specific to the home country or the imposition of restrictions on its trade with the rest of the world). In particular we have not considered the effects of exogenous changes in commodity prices or in the returns to the internationally mobile factors. The reason for this is that, while it is quite acceptable to take these prices as exogenously given for a small open economy, it is not legitimate to consider exogenous changes in such prices one at a time, since any perturbation in the rest of the world which changes relative commodity prices may also be expected to change relative returns to capital in the two sectors.

To illustrate this point, consider the model described in Section 3 and assume that the rest of the world has the same structure as the small open economy we have already examined. Suppose now that tastes in the rest of the world shift towards good 1. From the point of view of the small open economy this will give rise to a change in not one but three relative prices: with X_2 as numeraire, these are the price of X_1 and the returns to the two internationally mobile factors. In the "normal" case (by analogy with the three-factor model of Jones (1971)), the return to capital specific to X_1 is likely to rise and that to capital specific to X_2 to fall, both in real terms, as a result of the demand-induced rise in the relative price of X_1. In general, however, it is necessary to know something about the technology and factor endowments of the other country before we can specify which combinations of exogenous changes in relative commodity and factor prices the small home country may legitimately be assumed to face.

There is, however, one special case in which we can be certain that cross-hauling will not occur: the case in which the two countries are identical except for scale. For, since the second country is effectively a closed economy, the changes in relative prices which take place there are just sufficient to ensure continued full employment of all its domestic factors. Thus the same changes in relative prices in the relatively much smaller home economy can be accommodated simply by reallocation of domestic factors. This highlights the fact that the asymmetric outcome of cross-hauling following a shock which affects both countries to an equal extent will only take place if there are asymmetries between the two countries (whether in technology or in relative endowments of country-specific factors).

A final point which may be made concerning the implications of the small open economy assumption for the analysis of foreign investment is that, if there are no foreign shocks so that relative rentals on the two capital stocks do not change, then these may be aggregated to form a Hicksian composite factor.* Thus the assumption of a small open economy effectively blurs the distinction between intersectorally mobile and sector-specific capital. As long as the relative prices of traded goods (and the relative rentals on internationally mobile factors) remain fixed, the two models we have presented may be related to the extensive body of work stemming from Mundell (1957), which views capital as being both internationally and intersectorally mobile. Of course, the sector-specificity of capital in our models is still central to their interpretation if not to their behavior: whereas Mundell and the papers based on his work were concerned with the net flow of capital between countries, the issue of cross-hauling is fundamentally concerned with the direction of the gross flows of capital into and out of different sectors.

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* For example, in Figure 2, we may draw through point B a downward-sloping line with a slope equal to the ratio of rentals on the two kinds of capital. Whether the aggregate stock of capital in the home country (measured at world prices) rises or falls following a domestic disturbance may then be determined simply by noting whether the new equilibrium lies above or below this line.

5. CONCLUDING REMARKS

In a world in which factors of production are both internationally and intersectorally mobile, cross-hauling is simply one way in which international resource reallocation may take place following a disturbance to the initial equilibrium. In this paper we have considered the conditions under which cross-hauling may occur in two models which highlight different motivations for direct foreign investment: on the one hand, the desire to exploit a protected home market (where protection takes the extreme form of the good not being traded), and, on the other hand, the desire to use domestic resources which must be combined with factors located in the home country if they are to contribute to production.

While the two models considered are thus somewhat different and while the results presented do not lend themselves to any simple summary, some general conclusions may be noted. Firstly, since cross-hauling is by its nature a manifestation of asymmetric structural change in an economy, it is more likely to follow a disturbance which is sector-specific than one which is economy-wide. Secondly, even a sector-specific shock need not give rise to cross-hauling if its impact is diffused fairly evenly throughout the economy: for example, in the model discussed in Section 3, an induced increase in the wage rate encourages increased use of capital in both sectors and so tends to work against cross-hauling. Finally, in both models, an asymmetric change in capital stocks is more likely the greater the change in the composition of outputs. Thus, in the model discussed in Section 3, the less the responsiveness to factor prices of the amount of the specific resource required per unit of output in each sector, the smaller the changes in outputs can be; hence the economy-wide change in the wage rate is more likely to dominate, making cross-hauling less likely. Similarly, in the model discussed in Section 2, low substitutability in the demand for the non-traded good means that the change in the output of that sector induced by any shock is likely to be small, which works against cross-hauling.

This focus on output effects points to a strong connection between the phenomenon of cross-hauling and the so-called "Dutch Disease" syndrome which has attracted both empirical and theoretical attention in recent years. Though frequently used to refer to a decline in manufacturing industry induced by a resource-based boom, this term may be applied more generally to any structural change which manifests itself in the form of a change in the relative fortunes of different sectors. As noted by Corden and Neary (1982), the term in this general context has a number of possible interpretations, two of which are of particular interest here. Firstly, it may refer to an asymmetric change in outputs, in which case, as already noted, it is closely related to cross-hauling of internationally mobile factors. Secondly, it may refer to an asymmetric change in capital rentals, or more generally to changes in the relative profitability of different sectors. In this sense the models we have presented cannot exhibit the Dutch Disease as such, but, in those cases where they predict that cross-hauling will take place, they may be interpreted as depicting a medium-run or long-run equilibrium which will result from a short-run situation where relative capital rentals (and so the incentives for international as well as intersectoral resource reallocation) exhibit the Dutch Disease pattern. Viewed from this perspective, the occurrence of cross-hauling means that a mechanism of the Dutch-Disease type is at work, but that capital owners have been able to escape from it by reallocating between countries.

Finally, the analysis we have presented also throws some light on the issue raised by Mundell (1957) of whether international trade and international factor movements are complements or substitutes. In the context of the Heckscher-Ohlin model, Mundell showed that they are substitutes, in the sense that impediments to trade stimulate international factor movements and vice versa. However, as noted by Purvis (1972) and Schmitz and Helmberger (1970), this conclusion is sensitive to the assumption of internationally identical technology and to the exclusion of sector-specific resources. Our results reinforce the agnostic

conclusion that there is no general presumption concerning the effects of trade impediments on international factor movements.

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