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Two-Way Capital Flows:
Cross-Hauling in a Model of Foreign Investment

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Abstract

This paper presents a simple model of a small open economy which is open to both commodity trade and foreign investment of a sector-specific kind, and which exhibits the phenomenon of "cross-hauling", or reverse flows of internationally mobile capital in two different sectors. The model, which assumes that 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, appears to be the simplest possible which permits cross-hauling as an endogenous phenomenon.

(90 words)

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1. Introduction

While nineteenth-century economic development was accompanied mainly by one-way flows of capital from the centre 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. A number of writers have drawn attention to this phenomenon, and different aspects of it have been variously labelled "cross investment" by Hymer and Rowthorn (1970), "cross-hauling" by Caves (1971a) and "mutual penetration of investment" by Bhagwati (1972). However, no attempt has been made to date to model these two-way flows formally.

The objective of this paper is to introduce a simple competitive model which is both of interest in itself and which gives rise to cross-hauling as an endogenous phenomenon. Section 2 introduces the model, which takes as its starting point the specific-factors approach of Jones (1971) and Samuelson (1971), as extended to the analysis of direct foreign investment by Caves (1971a). Section 3 examines the effects of exogenous shocks, paying special attention to whether or not they give rise to cross-hauling. Finally, Section 4 concludes with a
discussion of some other issues in international trade theory which are closely related to the phenomenon of cross-hauling.

2. The Model

The model we present is one of a small open economy which produces two commodities using labour and capital. While the domestic factor, labour, is in inelastic supply and perfectly mobile between sectors, the capital factor used in each sector is in perfectly elastic supply at fixed rentals determined on world markets but is not intersectorally mobile. One of the goods produced is not traded, as a result of which specialisation in production does not take place.\(^5\) We assume throughout that all domestic markets are competitive and that production takes place subject to constant returns to scale.
Fig. 1 illustrates the determination of the wage rate and the price of non-traded goods in this model. Each of the curves in the diagram 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 traded and non-traded sectors (labelled T and N) respectively. The location of the unit cost curve for the traded sector, cT, is determined by the technology in that sector and by the exogenously given price of its output. Since the return to capital in that sector, rT, is also exogenously determined, the wage rate in the economy must equal w if the traded sector is to cover its production costs. Faced with this wage rate and with its own exogenously given return to capital, rN, the non-traded sector must operate at point A if it also is to cover its costs. 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 traded good and the world returns to both types 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 from fig. 2. The downward-sloping line KK is a capital requirements locus, showing the combinations of capital stocks in each sector which are consistent with full
employment of the domestic factor, labour, and with the factor proportions already determined in each sector. This line is essentially the translation into capital space of the standard labour constraint in output space (i.e., the Rybczynski locus) and its equation is:

\[
\frac{a_{LT}}{a_{KT}} k_T + \frac{a_{LN}}{a_{KN}} k_N = L
\]

(1)

where \(a_{ij}\) is the amount of factor \(i\) used per unit of output in sector \(j\). Since techniques in each sector are fixed by world prices, the locus KK is a straight line, and the point on this locus at which the economy actually produces, \(A\), is then determined by demand. 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:

\[
k_N = a_{KN} D_N
\]

(2)

The initial equilibrium point A in fig. 2 corresponds to point A in fig. 1.
3. Conditions for Cross-Hauling to Occur

With the help of fig. 2, we are now ready to examine the key elements which determine when and how cross-hauling may occur following different kinds of exogenous shocks. In the first place, the diagram shows clearly that cross-hauling must inevitably result from any shock which shifts the equilibrium point along a given negatively-sloped KK locus, i.e., any shock which alters the demand for the non-traded good without changing production techniques or the economy's labour endowment (both of which determine the position of the KK locus). For example, a pure demand shift in favour of the non-traded good (as a result of a change in tastes or of a tariff on an imported good not produced domestically) would move the equilibrium in fig. 2 from A to B, with a consequent flow of capital into the non-traded sector and outflow of capital from the traded sector. Similarly, 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 labour supply (and hence the KK locus) unaltered.  

Secondly, fig. 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 to both sectors. In the remainder of this section, we examine how the demand for capital in both sectors is affected by two such exogenous shocks: firstly, a sector-specific shock in the form of a production subsidy to the traded sector, and secondly, an economy-wide shock which takes the form of an increase in the country's endowment of labour.

The effects on domestic prices of a production subsidy to the traded sector are shown in fig. 3. On impact, the unit cost curve for the traded sector shifts outwards from $C_T$ to $C_T'$. Since unit costs in the traded sector must rise by the full extent of the price increase, the wage rate must rise from $w_0$ to $w'$; this in turn requires an increase in the price of the non-traded good sufficient to move its production point from A to G, where zero-profit equilibrium is restored. Algebraically, these results may be stated as follows:

\[
\hat{w} = \frac{1}{\theta_{LT}} \hat{p}_T \\
\hat{p}_N = \theta_{LN} \hat{w} 
\]  

(3)  

(4)

where a circumflex (\(^\wedge\)) denotes a proportional rate of change (e.g., \(\hat{w} = \partial \ln w\)); \(\theta_{ij}\) 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 $j$.

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 both sectors, which clearly shifts the KK locus in fig. 2 outwards. To determine whether or not cross-hauling occurs, we must examine how the sectoral demands for capital change in response to this change in relative factor prices. A simple argument may be used to show that the traded sector demands more capital. With income effects absent, the rise in the price of non-traded goods must reduce the demand for these goods. Since the capital-labour ratio in the non-traded sector rises and output contracts, employment in this sector must fall, and the labour released must be absorbed by the traded sector. Finally, as we know that the capital-labour ratio in the traded sector must also rise, we can conclude that the absolute demand for capital in this sector increases unambiguously.

Since the production subsidy necessarily attracts capital to the traded sector, cross-hauling occurs if and only if the demand for capital in the non-traded sector falls. However, the two forces determining this demand, given by equation (2), pull in opposite directions. On the one hand, the capital-output ratio rises to an extent proportional to the wage increase and to the elasticity of substitution in the non-traded sector, $\sigma$: \[ \sigma^N \]
\[ \hat{a}_{KN} = \theta_{LN} \sigma_{N} \hat{w} \]  

(5)

On the other hand, the demand for the non-traded good must fall as already explained:

\[ \hat{D}_{N} = - \varepsilon_{N} \hat{p}_{N} = - \varepsilon_{N} \theta_{LN} \hat{w} \]  

(6)

where \( \varepsilon_{N} \) denotes the (positive) substitution elasticity of demand. The proportional 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 output and increased unit capital requirement is clearly revealed in (7):

\[ \hat{K}_{N} = \theta_{LN} (\sigma_{N} - \varepsilon_{N}) \hat{w} \]  

(7)

In summary, for the introduction of a production subsidy in the traded sector 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 to the traded sector. Equation (7) shows that such a reduction in the demand for capital in 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).
We turn next to consider the effect of an increase in the labour force on capital flows, with the aid of fig. 4 (which is analogous to fig. 2 above). In this case, the initial equilibrium, A, is at the intersection of the capital requirements locus, KK, and an income-consumption curve, YY. Just as KK is the translation of the Rybczynski locus into capital space, so YY corresponds to the familiar income-consumption curve in commodity space, and shows the derived demands for capital in the two sectors implied by the combinations of traded and non-traded goods that are demanded at different levels of real income and the same relative price ratio. (The curve is upward-sloping on the assumption that both goods are normal in demand.) An increase in the labour force causes a parallel outward shift in the KK locus to K"K". (The slope of the locus, defined by equation (1), is unaffected by the increase in the labour force, since the factor intensities in both sectors are unchanged.) The curve YY, drawn with respect to given prices and wages, is unaffected by the change in the labour force. Hence the new equilibrium is at point J which implies that capital flows into both sectors, i.e., cross-hauling cannot result from an increase in the labour force.
4. Concluding Remarks

In a world in which factors of production are internationally mobile, cross-hauling is simply one form which resource reallocation may take following a disturbance to an initial equilibrium. In this paper we have introduced what is probably the simplest competitive model which exhibits cross-hauling as an endogenous phenomenon. By assuming that one sector produces a non-traded good but that capital is nevertheless freely mobile between that sector and the rest of the world, our model attempts to capture one of the principal motivations underlying direct foreign investment: the desire to exploit a protected home market, which here takes the extreme form of the sector's producing a good which is not traded.\textsuperscript{12}

Not surprisingly, since cross-hauling is by its nature a manifestation of asymmetric structural change in an economy, one of our findings is that cross-hauling is more likely to result from a disturbance which is sector-specific than from one which is economy-wide. This points to a strong connection between the phenomenon of cross-hauling and the so-called "Dutch Disease" syndrome of a change in the relative fortunes of different sectors (typically, though not necessarily, taking the form of a decline in manufacturing industry as a result of a resource-based boom). Since one reflection of the latter is an asymmetric change in the rentals on specific capital
(which measure the relative profitability of different sectors)\textsuperscript{13} 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 it by reallocating between countries.

In conclusion, it should be noted that all of the exogenous disturbances to the initial equilibrium we have considered have been of a \textit{domestic} kind, and, in particular, we have not considered the effects of exogenous changes in traded goods prices or in the returns to the internationally mobile factors. The reason for this is that it is not legitimate to consider exogenous changes in such prices \textit{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. In general, it is necessary to know something about technology and factor endowments in the rest of the world before we can specify which combinations of exogenous changes in relative commodity and factor prices a small country may legitimately be assumed to face. From a different perspective, however, the assumption of fixed world rentals effectively blurs the distinction between intersectorally mobile and sector-specific capital, since it allows the two types of capital to be aggregated into a single Hicksian composite factor. The model we have presented may therefore be reinterpreted as giving conditions under which cross-hauling of \textit{homogeneous} capital may occur.
This paper was stimulated by the Workshop on Trade and Investment in a World with Internationally Mobile Factors of Production at the Institute for International Economic Studies, University of Stockholm, August 1980, and was written at the International Institute for Applied Systems Analysis, Laxenburg, Austria. We are grateful to both institutes for their hospitality, and to Jagdish Bhagwati and three anonymous referees for helpful comments. Ronald Jones's research was supported by the National Science Foundation under Grant No. SES-7806159, and Frances Ruane's by the Arts and Social Sciences Research Benefaction Fund of Trinity College Dublin.

1 Caves (1983) presents a review of theoretical and empirical work on these and other aspects of multinational corporations.

2 As one of the referees has pointed out, the study of these issues using models of imperfect competition is likely to prove a fruitful direction for future research. Our concern in this paper is to examine whether these phenomena can be explained within the standard competitive framework of international trade theory.
3 Analyses which are highly suggestive of cross-hauling have been presented by Caves (1971a) and Burgess (1978), who show that an increase in the endowment of the capital factor specific to one sector can generate an incentive for an outflow of another sector's capital to other countries. However, in their models no explanation is provided for the initial increase in the first sector's endowment of capital.

4 Caves's model is formally identical to the "staples" model of primary production, as expounded by Chambers and Gordon (1966), Caves (1971b) and Easton and Reed (1980).

5 If output price and the return to capital are fixed for both sectors in the specific-factors model, specialisation in production is inevitable as entrepreneurs choose to produce only that good with the lower unit labour cost. (See Caves (1971a), Amano (1977) and Neary (1980).) The manner in which absolute labour costs (rather than comparative advantages) influence the international location of productive activities has been explored by Jones (1980).

6 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 traded sector leads to an actual reduction in the amount of this type of capital used in the receiving country (as fewer traded goods are
required to make 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).

7 Equations (3) and (4) show that the production subsidy has a magnified effect on the wage rate and an ambiguous effect on the ratio of non-traded to traded goods prices, increasing this ratio if and only if the production of the non-traded good is relatively labour-intensive, as
has been assumed in figs. 1 and 3.

8 A small production subsidy does not alter the prices of traded goods faced by consumers and has only a second-order effect on national real income.

9 An explicit expression for the capital inflow to the traded sector is: 

\[ \lambda_{LT} K_T = \left( \lambda_{LT} \sigma_T + \lambda_{LN} (\theta_{KN} \sigma_N + \theta_{LN} \epsilon_N) \right) \hat{w}, \]

where \( \lambda_{Lj} \) denotes the fraction of the labour force employed in sector \( j \), and the remaining parameters are defined in the text. It is clear that all substitution possibilities in the economy, on both the demand and production sides, work towards attracting capital into the traded sector.

10 This expression is derived in Jones (1965).

11 An alternative expression for equation (7) is the following:

\[ \hat{K}_N = (e_N + \epsilon_N) \left( \frac{e_N}{e_N + \epsilon_N} - \theta_{LN} \right) \hat{w}, \]  

\[(7') \]

where \( e_N \) (which equals \( \theta_{LN} \sigma_N / \theta_{KN} \)) is the price-elasticity of supply of the non-traded good. The first term in brackets in \( (7') \) gives the change in the price of the non-traded good which would clear the market if capital were not internationally mobile, while the second gives the price change which must actually occur (from equation (4)). Equation \( (7') \) therefore shows that the latter term must dominate if cross-hauling is to take
place. The condition given in equation (7) is formally identical to that obtained by Neary (1978) for the employment effects of a capital subsidy in a very different model.

12 An alternative motivation for foreign investment is the desire to exploit domestic resources which must be combined with factors located in the home country if they are to contribute to production. In another paper (Jones, Neary and Ruane, 1982), we reconsider the likelihood of cross-hauling in a model which attempts to capture this aspect of direct foreign investment.

13 See Corden and Neary (1982).
References

Amano, A., 1977, Specific factors, comparative advantage and international investment, Economica 44, 131-144.


82-37.


Fig. 3

Fig. 4