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Factor Mobility and International Trade

by

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FACTOR MOBILITY AND INTERNATIONAL TRADE*

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- * This paper is dedicated to the memory of Doug Purvis. I am grateful to Tony Venables for helpful comments and to the Centre for Economic Performance at the London School of Economics for research support.

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FACTOR MOBILITY AND INTERNATIONAL TRADE

ABSTRACT

This paper develops a two-country model of trade and factor mobility, in which capital is sector-specific but internationally mobile. The model avoids the implausible predictions of specialisation in Heckscher-Ohlin models and exhibits a rich variety of responses to exogenous shocks, including transfers, capital taxes and tariffs. The results throw light on the relationship between goods trade and factor trade, reconciling the conflicting views of previous writers. It is argued that the model holds out the possibility of a new paradigm in international trade theory, in which international factor movements play a central rather than a peripheral role.

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FACTOR MOBILITY AND INTERNATIONAL TRADE

TABLE OF CONTENTS

1. Introduction 1

2. The Model 3

3. International Transfers 8

4. Capital Taxes and the Volume of Trade 9

5. Tariffs and International Capital Flows 11

6. Conclusion 13

Appendix 14

References 18

FACTOR MOBILITY AND INTERNATIONAL TRADE

1. Introduction

International factor movements are a pervasive and integral part of the world economy. Yet the study of such factor movements remains peripheral in courses and textbooks on international trade theory. Many models of the process exist of course, but they are generally presented as ancillary rather than central to the theory. In part, this is because there is no simple general equilibrium model in which international trade and international factor mobility coexist. In this paper, I draw on work by Caves (1971), Jones (1979, 1987), Dixit and Norman (1980) and Markusen (1983) to develop a model which fills this gap.

There is, of course, a general equilibrium model of international factor mobility developed by Mundell (1957), who examined the consequences of allowing capital to be internationally mobile in the Heckscher-Ohlin model. His classic paper can be viewed in two different lights. On the one hand, by drawing attention to the substitutability between international trade and international factor mobility in the Heckscher-Ohlin model, it was a crucial step in the refinement of the factor-endowments view of trade. On the other hand, as a positive theory of international capital mobility, it made the implausible prediction that, if mobility were possible at all, then it would occur to an extent sufficient to bring about complete specialisation in either production or trade.

This deficiency of the Mundell approach to modelling international factor mobility might be thought to matter relatively little, given the widespread impression that the Heckscher-Ohlin model now plays a much less central role in international trade theory. But, on the contrary, that model has been used extensively in almost all the important recent developments in general equilibrium models of international trade, including work on intra-industry trade with monopolistic competition, on multinational corporations and on endogenous growth.¹ Indeed, some of the deficiencies of recent work on these topics

¹ See Helpman and Krugman (1985) and Grossman and Helpman (1991). The impression of the reduced importance of the Heckscher-Ohlin model reflects not its diminished status in general equilibrium analyses but rather the enormous increase in studies of trade issues in models with explicit imperfectly competitive foundations in which pure profits are earned in equilibrium. While some of this work has looked at international capital mobility or multinational corporations (e.g., Horstmann and

reflect in part its dependence on the Heckscher-Ohlin framework.² What seems to be needed is a core model of international trade and factor mobility alternative to that of Heckscher-Ohlin, which has less extreme properties and which can more easily be adapted to consider these and other issues. One way out of this dilemma was explored in the very first paper published by Doug Purvis (1972), which reexamined the Mundell proposition in a Heckscher-Ohlin model with international differences in technology.³ This avoids the conclusion of inevitable specialisation of the simple Heckscher-Ohlin approach but leads to an analysis of considerable complexity.

In the present paper, I explore an alternative approach to avoiding the implausible tendency towards specialisation of the Heckscher-Ohlin approach. This involves building on the specific-factors model of Jones (1971) and extending it to allow for international capital mobility. The rationale for this was presented by Caves (1971), who argued that capital should be seen as a composite factor embodying managerial and technical skills as well as more tangible factors of production. Caves argued further that this composite factor is not easily transferable between different sectors within a given country but may be much more easily transferable between countries within the same sector. This approach has been explored from the perspective of a single country by a number of authors⁴ but rather little in an explicitly two-country framework. (Exceptions include Jones (1979, 1987), Dixit and Norman (1980) and Markusen (1983).)

The plan of the paper is as follows. Section 2 introduces the model and illustrates the determination of equilibrium, using a diagram similar to one used by Neary and

Markusen (1987), Smith (1987), Motta (1992) and Rowthorn (1992)), its mainly partial equilibrium focus precludes an analysis of the interaction between factor endowments, commodity trade and international factor markets.

² An example is Helpman's model of multinational corporations (see Helpman and Krugman (1985) chaps. 14-15). Because of its Heckscher-Ohlin structure, this predicts implausibly that multinational corporations will not emerge between countries which have similar relative factor endowments. For similar criticisms, see Ethier (1986).

³ See also Kemp (1966) and Jones (1967).

⁴ See, for example, Amano (1977), Jones (1979) and (1989), Brecher and Findlay (1983) and Neary and Ruane (1988).

Purvis (1983).⁵ The remainder of the paper looks at the effects of a number of shocks to the equilibrium. Section 3 considers the effects of international transfers. Sections 4 and 5 then examine respectively the effects of barriers to international movements of factors and goods. This allows a reexamination of the question of whether goods and factor trade are substitutes or complements. As already noted, Mundell found that they are necessarily substitutes in the Heckscher-Ohlin model. By contrast, Markusen (1983) argued that, with sector-specific capital, goods and factor trade would necessarily be complements.⁶ This seems to contradict the "tariff factory" view, discussed by Haberler (1936, pp. 273-8), that tariffs will encourage a capital inflow into the protected sector. Our results allow a reconciliation of these conflicting positions. Finally, Section 6 summarises the model's conclusions and discusses its implications for a shift of paradigm in international trade, with implications for the study of multinational corporations and of the location patterns of productive activities. Technical details of the model's solution, as well as a table of symbols used, are given in the Appendix.

2. The Model

I assume a world of two countries, home and foreign, with variables for the latter distinguished by asterisks. There are two sectors in each country, manufacturing and agriculture, producing manufactures and food respectively.⁷ Food is taken as numeraire, with p denoting the relative price of manufactures. In each country, labour is intersectorally mobile and combines with two sector-specific factors, capital in manufacturing and land in agriculture. Labour and land are immobile between countries

⁵ Neary and Purvis allowed for international capital mobility in a small open economy producing traded and non-traded goods. The equilibrium relationships between the stock of capital and the relative price of non-traded goods (the real exchange rate) in their paper are less complicated than those illustrated below because of the absence of variables relating to the foreign country.

⁶ The question of whether goods and factor trade are complements or substitutes is also discussed by Jones and Neary (1984, Section 3.2), Markusen and Svensson (1985) and Wong (1986).

⁷ International capital mobility could lead one or both countries to specialise in production, though this is not inevitable as in the Heckscher-Ohlin case studied by Mundell. Throughout the paper, I confine attention to unspecialised equilibria.

and their levels are assumed fixed throughout (so they need not be made explicit). The key feature of the model is that capital, though specific to manufacturing, is internationally mobile. Such mobility takes time to effect, however, so we must distinguish between the short and the long run. In the short run, capital is country-specific and the model reduces to a two-country version of the specific-factors model of Jones (1971). Over time, international rental differentials encourage equilibrating international capital movements which bring about long-run equilibrium. If technology is the same in both countries and specialisation in production does not occur, this long-run equilibrium will exhibit international factor-price equalization. However, the algebra does not imply identical technology. To fix ideas, I focus for much of the paper on a base case in which the home country's imports of both manufactures and capital, denoted by m and k , are positive. The algebra is consistent with other configurations, of course.⁸

The long-run equilibrium may be described by the following four equations:

$$E(p, u, k) = T - (r - \rho)'k + t'm, \quad (1)$$

$$E^*(p^*, u^*, \bar{k} - k) = -T + (r - \rho)'k, \quad (2)$$

$$E_p(p, u, k) + E_p^*(p^*, u^*, \bar{k} - k) = 0, \quad (3)$$

$$g_k(p, k) = g_k^*(p^*, \bar{k} - k) + \rho. \quad (4)$$

Equations (1) and (2) give the budget constraints for the home and foreign countries respectively and equations (3) and (4) give the equilibrium conditions in the world markets for goods and capital respectively. The first three equations are expressed in terms of the *trade expenditure function*, which equals the excess of national expenditure over GNP, with each of the latter denoted by standard expenditure and GNP functions respectively:

⁸ The algebra is also consistent with arbitrary numbers of goods and factors, so that p , m and k are vectors, provided there are at least as many non-traded factors as there are traded goods. In the equations, all vectors are column vectors and a prime (') denotes a transpose. In the text, I give the intuition for the case where all these variables are scalars. For an alternative treatment of the multidimensional case, focussing on normative rather than positive questions, see Neary (1993).

$$E(p, u, k) = e(p, u) - g(p, k), \quad (5)$$

and similarly for the foreign country. T is a transfer from the foreign to the home country (effected in terms of the numeraire); t (equal to $p - p^*$) is the home country's specific tariff on manufactures; $\bar{k}$ is the world stock of capital; and ρ (equal to $r - r^*$) is the home country's tax on its capital imports k . Subscripts denote partial derivatives. Hence, $E_p(p, u, k)$ in (3) is the home country's net imports of manufactures, m ; and $g_k(p, k)$ in (4) is the rental on capital in the home country, r . Throughout the exposition, we assume that capital is specific to manufacturing, implying that the cross-derivatives g_{pk} and $g_{p^*k}^*$ are positive.

The four equations (1) to (4) determine the values of the four endogenous variables (u, u^*, p, k) as functions of the exogenous variables (T, ρ, t) . The full expressions obtained when the equations are totally differentiated are given in the Appendix. In this section I illustrate how, for given values of the exogenous variables, the behaviour of the model can be summarised in terms of two variables, the price of manufactures, p , and the level of capital imports, k . I simplify throughout the paper by assuming that the tariff t and the tax on capital imports ρ are initially zero.

Consider first the market for international capital. Equation (4) shows that equilibrium in this market requires that rentals are equalised between the two countries. Differentiating this, deviations from capital-market equilibrium are related to changes in p and k as follows:

$$d(r - r^*) = -\phi' dp - \bar{S}_k dk. \quad (6)$$

The coefficient of dp shows that changes in the price of manufactures will disturb equilibrium to an extent determined by the parameter ϕ . This is a measure of *supply-side asymmetry* between countries, defined as positive when manufactures are more capital-intensive abroad than at home.⁹ When ϕ is positive, a rise in the world price of manufactures moves the international rental differential in favour of the foreign country, making it a more attractive location for capital and encouraging a capital outflow from the home country. This case is illustrated by the downward-sloping KK locus in Figure 1.

⁹ Capital-intensity is defined here in the general equilibrium sense: $\phi \equiv g_{p^*k}^* - g_{pk}$.

Figure 2 illustrates the alternative case: ϕ is now negative, so manufactures are more capital-intensive at home and an increase in their price encourages a capital inflow. As for the coefficient of dk in equation (8), the substitution parameter $\bar{S}_k$ is always positive, since a capital inflow always tends to lower the home rental and increase the foreign rental.¹⁰ Hence, in both figures, the capital market is stable in isolation, as illustrated by the horizontal arrows.

The other equilibrium condition in the model is that the world market for manufactures clear. To see the implications of this, differentiate (1), (2) and (3) to obtain the effects of changes in p and k on the world excess demand for manufactures (EDM):

$$d(EDM) = -\delta dp + [x_I^*(r-r^*) + \Phi]dk. \quad (7)$$

A rise in the price of manufactures has both substitution and income effects on world excess demand, which are summarised by the parameter δ :

$$\delta = \bar{S} + \beta(m' + k'g_{kp}). \quad (8)$$

This is simply the Marshall-Lerner condition, modified to incorporate foreign-owned capital. The substitution effects (given by the first term on the right-hand side) always give rise to excess supply and so are conducive to stability. The income effects (given by the second term) arise from the fact that a price rise redistributes income between countries: specifically, the foreign country gains at the expense of the home country, given the assumptions that the home country imports both manufactures and capital (so that $m' + k'g_{kp}$ is positive). The effect of this on world excess demand for manufactures depends on the parameter β , which measures the *demand-side asymmetry* between countries, and is defined as positive when the home country has a higher marginal propensity to consume the manufactured good.¹¹ Overall, the sign of δ is indeterminate

¹⁰ Terms in S and S_k denote substitution effects in the goods and capital markets respectively, with a bar denoting the total substitution effect for the world as a whole. Full expressions for these terms are given in Table 1.

¹¹ Specifically, $\beta \equiv x_I - x_I^*$. Here, x_I is the home Marshallian demand derivative, defined as e_{pu}/e_u . Throughout the paper, I normalise e_u , the marginal cost of utility (or the inverse of the marginal utility of income) to equal unity at home and abroad in the initial equilibrium.

in general but it is customary to assume that it is positive in equilibrium and I will do so in what follows. A rise in p thus induces excess supply of manufactures, so that the goods market is stable in isolation. This is shown by the vertical arrows converging towards the MM locus in Figures 1 and 2.

What about the effects of international capital flows on goods market equilibrium, given by the coefficient of dk in (7)? The first effect of this arises from the improved efficiency of the world capital market: a capital inflow into the home country (where the rental on capital is higher) raises income in the capital-exporting country and so raises demand for manufactures there. This effect does not arise for comparisons between long-run equilibria, in which r and r^* are equal. The remaining effect is captured by the parameter Φ :

$$\Phi = \phi + \beta k' S_k. \quad (9)$$

The first component of this is a differential supply effect which, by the reciprocity property of Samuelson (1953), is given by the same parameter ϕ already discussed in connection with equation (8). If this is positive, manufactures are more capital-intensive abroad and so a movement of capital into the home country lowers world output and tends to induce excess demand for manufactures. The second component is a differential demand effect, whose sign depends on the sign of the coefficient β . A capital inflow lowers the return to capital at home (to an extent determined by the substitution parameter S_k , defined as $-g_{kk}$) and thus redistributes income from the foreign to the home country; if β is positive this induces excess demand for manufactures.

Figures 1 and 2 illustrate two possible configurations of the KK and MM loci. Each assumes that the differential supply effect ϕ dominates the differential demand effect β sufficiently to ensure that Φ has the same sign as ϕ . Hence the MM locus has a slope opposite in sign to that of the KK locus at their intersection point. In the neighbourhood of world capital-market equilibrium (i.e., close to the KK locus), the slope of MM depends solely on the sign of Φ , since the effect of improved capital-market efficiency does not arise. Elsewhere, this effect serves to increase the region of excess demand for manufactures, so tending to give the MM locus an inverted-U shape as shown. Finally, the model is seen to be stable in both Figures 1 and 2.

One immediate application of the model is to illustrate the so-called Singer-Prebisch

hypothesis. This is interpreted by Brecher and Choudhri (1982) as a case where a capital inflow induces an immiserizing change in world prices. To see how this could emerge, note first that home welfare depends on the price of manufactures and the level of capital imports:

$$du = - (m' + k' g_{kp}) dp + k' S_k dk. \quad (10)$$

At constant prices, a capital inflow has a direct effect which depresses the rental that must be paid on existing foreign-owned capital and so raises welfare. However, the capital inflow causes the equilibrium to move to the right along the MM curve and its full welfare effect depends on the induced change in world prices. Since manufactures are imported we would expect a rise in their price to depress welfare (although this normal effect could be reversed if m and k were of opposite signs or if g_{kp} was negative).

Assuming this to be the case, Figure 2 corresponds to the case where the Singer-Prebisch outcome cannot occur. As capital flows into the home country, the induced fall in the world price of manufactures leads to an additional gain. By contrast, in Figure 1 the Singer-Prebisch outcome may (though it need not) apply as the terms of trade deterioration tends to reduce welfare. Of course, in these examples the capital inflow has been treated as exogenous, whereas in a full analysis it should be itself endogenous. I turn now to such a case.

3. International Transfers

The first shock I consider in this model is a transfer of food from the foreign to the home country. This redistribution of purchasing power alters world demand for manufactures to an extent which, at the initial capital allocation k_0 , depends solely on the demand-side asymmetry term β . This reflects the familiar result of Samuelson, that a transfer worsens the terms of trade of the receiving country if and only if that country has a higher marginal propensity to consume its import good; in this case, p rises if and only if β is positive (so the home country has a higher marginal propensity to consume manufactures). Thus, if β is positive, the MM locus shifts up and the home terms of trade worsen, as illustrated by the move from A to B in Figure 3; while if β is negative the MM locus shifts down as in Figure 4. Moreover, the transfer does not impinge directly on the market for international capital, so the KK locus is unaffected. Hence, the

Samuelson result holds in the long run as well as in the short run.¹²

From (6), the short-run change in p changes the incentives for international capital allocation to an extent depending on the sign of ϕ . Thus the change in the international rental differential and hence the long-run response of k depends on the *product* of β and ϕ . If these have the same sign, then capital flows out of the receiving country, as illustrated by the move from B to C in Figure 3; whereas Figure 4 illustrates the converse case. There is in general no reason to assume that the two asymmetry terms, β and ϕ , need have the same sign.

A final issue which can be considered in this model is whether the price of manufactures will overshoot its long-run value in the short run or not. Overshooting is what the Le Chatelier-Samuelson principle would lead us to expect and the substitution effects of the capital reallocation tend to encourage it. However, overshooting will not occur if the KK and MM loci have the same slope, as illustrated in Figure 4. In this case, the income effects of the induced capital flows tend to magnify rather than to dampen the short-run price change. From the earlier discussion, the condition for the two loci to have the same slope and hence for overshooting to occur, is that ϕ and Φ have the same sign.¹³

The results of this section may be summarised as follows:

Proposition 1: A transfer to the home country raises the price of manufactures in both the short and long runs if and only if β is positive; the price overshoots its long-run value in the short run if and only if ϕ and Φ have the same sign; and a long-run capital outflow from the home country occurs if and only if β and ϕ have the same sign.

¹² Crucial in giving rise to this result is fact that the model has no direct links (such as variable factor supplies or non-traded goods) between consumer and producer behaviour. Hence, at initial prices, a transfer has demand effects only.

¹³ Formally, the condition for overshooting is that the sign of dp/dT should be the same as the difference in sign between dp/dT in the short run and the long run. From the equations in the Appendix, a necessary and sufficient condition for this is that the long-run Marshall-Lerner condition, Δ , should exceed the short-run Marshall-Lerner condition, δ . This in turn is equivalent to requiring that ϕ and Φ have the same sign.

4. Capital Taxes and the Volume of Trade

The next disturbance to equilibrium we consider is the imposition of a tax on capital imports by the home country. This has a direct effect on the capital market, tending to drive down the home rental and discourage capital imports. As shown in Figures 5 and 6, the KK locus must shift downwards. But the tax also has an indirect income effect. In the short run, it serves to transfer income from the foreign to the home country in exactly the same way as a straightforward transfer. Hence, as examined in the last section, it generates excess demand for manufactures in the world as a whole and shifts up the MM locus if and only if the capital-importing country (home) has a higher marginal propensity to consume its imported good; i.e., if and only if β is positive. Figure 5 illustrates the case where β and ϕ have the same sign: capital imports unambiguously decline but the price of manufactures may rise or fall.¹⁴ Figure 6 illustrates a case where β and ϕ have opposite signs: now, the price of manufactures must fall in both the short and long run but capital imports could conceivably be encouraged rather than discouraged.¹⁵

In terms of throwing light on the question of whether goods and factor trade are substitutes or complements, the relevant question here is the long-run effect of a capital tax on goods imports. This is considered formally in the Appendix, where it is shown that the income effects of the tax are ambiguous but the substitution effects stimulate goods imports under our assumption that capital is used solely in the import-competing sector. This is of course the "tariff-factor" argument of Haberler (1936) and it contradicts the suggestion by Markusen (1983) that capital and goods trade must be complements when the Heckscher-Ohlin assumption of intersectoral capital mobility is relaxed in the Mundell analysis. The difference in results reflects Markusen's assumption that capital is used in producing the exportable good, implying that (with m and k positive) g_{pk} and g_{pk}^* are negative. Hence, whether goods and factor trade are substitutes

¹⁴ As shown in the Appendix, a tax on capital imports raises the price of manufactures in the long run if and only if $\beta k' - \Phi S_k^{-1}$ is positive. This is equivalent to the condition that $\beta k' S_k^* - \phi$ is positive.

¹⁵ As shown in the Appendix, a tax on capital imports leads to a capital inflow if and only if $1 + \phi' \delta^{-1} \beta k'$ is negative. This is equivalent to the condition that $S + \beta(m' + k' g_{kp}^*)$ is negative. Since δ must be positive for stability, this in turn requires that β is negative and ϕ is positive.

(in the sense that restrictions on factor trade will reduce the volume of goods trade) depends on the assumptions made about factor intensities.

Summarising the results of this section:

Proposition 2: A tax on capital imports lowers the price of manufactures in both the short and long runs if β and ϕ have opposite signs, but could raise it otherwise; capital imports fall if β and ϕ have the same signs but they could rise otherwise; and goods imports tend to rise in the long run (although income effects could reverse this).

5. Tariffs and International Capital Flows

The final shock to be considered is the effect of restrictions on goods trade rather than on factor trade.¹⁶ I confine attention to the case of a home-country tariff and consider first its effects in the short run. The tariff drives a wedge between the home and foreign prices of manufactures, with substitution effects tending to raise the former and lower the latter. The "normal" case where these substitution effects dominate is illustrated in Figure 7. The free-trade MM curve lies between the post-tariff curves relating home and foreign prices to the international allocation of capital, $M'M'$ and $M''M''$, so in the short run p rises and p^* falls. However, income effects can offset either of these normal outcomes, as the full expression for the change in excess demand for manufactures (obtained by differentiating the goods-market equilibrium locus (3)) shows:

$$d(EDM) = -\delta_2 dp - \delta_1 dp^* \quad (11)$$

$$= -(S + \beta k' g_{kp}) dp - (S^* + \beta m') dp^*. \quad (12)$$

Thus, if the foreign country has a higher propensity to consume manufactures ($\beta < 0$), either of two "paradoxes" is possible. At the initial domestic price, the fall in foreign income caused by the tariff may be sufficient to induce excess supply of manufactures ($\delta_1 < 0$), so causing a short-run *Metzler Paradox*: the terms of trade improve by more than

¹⁶ The response of domestic and foreign prices to the imposition of tariffs in this model has been considered by Jones (1987), in the special cases of demand symmetry and supply symmetry ($\beta = 0$ and $\phi = 0$ in my notation respectively).

the tariff so that it reduces the home price and fails to protect domestic producers.¹⁷ This case is illustrated in Figure 8, where both the $M'M'$ and $M''M''$ loci lie below the free-trade MM locus. Alternatively, at the initial world price the redistribution of capital income induced by the tariff may be sufficient to induce excess demand for manufactures ($\delta_2 < 0$), so causing a short-run *Lerner Paradox*: the terms of trade worsen and the domestic price rises by more than the tariff.

The next step is to consider the effects of the tariff on the incentives for capital reallocation. Differentiating the capital-market equilibrium condition (4) gives:

$$d(r-r^*) = g_{kp}dp - g_{kp}^*dp^*. \quad (13)$$

Because of our assumption that the import good is the one produced with mobile capital, this equation shows that, at *either* the initial value of p or p^* , the rental differential moves in favour of the home country, encouraging a capital inflow. Geometrically, the KK locus is moved to the right in both countries, irrespective of its slope, as illustrated in Figures 7 and 8.

Taking the shifts in the two loci together, Figure 7 illustrates what might be considered the "normal" response to a tariff. There are no tariff paradoxes in the short run, and so the long-run response is a capital inflow. By contrast, Figure 8 illustrates a possible outcome whereby a short-run Metzler Paradox leads to such a fall in the home price that (with manufacturing more capital-intensive at home, $\phi < 0$) the home rental falls relative to that abroad. As a result, both home and foreign prices overshoot their new long-run levels in the short run and capital flows out of the home country in the long run. The link between short-run tariff paradoxes and long-run capital flows is confirmed by the algebraic derivations in the Appendix, which yield:

$$dk \propto (g_{kp}\delta^{-1}\delta_1 + g_{kp}^*\delta^{-1}\delta_2)dt. \quad (14)$$

This shows that the long-run change in k is proportional to a weighted average of the factor-intensity terms (g_{kp} and g_{kp}^*), where the weights are the short-run Metzler and

¹⁷ The condition for this outcome, $\delta_1 < 0$, may be manipulated to give a more familiar condition for the Metzler Paradox: $px_1 < \{p/(g_p^* - e_p^*)\} \{d(g_p^* - e_p^*)/dp\}$; i.e., the home marginal propensity to import must be less than the foreign elasticity of export supply.

Lerner Paradox coefficients respectively.

Note that, given our assumption that capital is specific to the import-competing sector, no tariff paradoxes are possible in the short run, and goods and factor trade are necessarily substitutes, if β is positive or zero. Finally, the equations in the Appendix show that a Metzler Paradox (a fall in the home price of manufactures following a tariff) is more likely in the long run than in the short run if and only if Φ is negative; whereas a Lerner Paradox (an improvement in the terms of trade following a tariff) is more likely in the long run than in the short run if and only if Φ is positive.¹⁸

Summarising the results of this section:

Proposition 3: Assuming that capital is specific to the import-competing sector, a tariff leads to a capital inflow provided there are no short-run tariff paradoxes (i.e., the home price rises and the world price falls).

6. Conclusion

This paper has presented a simple two-country model of international trade and capital mobility. Variants of the model have been discussed by a number of previous writers but its comparative statics properties have never been systematically analysed. I have shown how they can be expressed in a form familiar from standard presentations of general equilibrium trade theory, and how they can be understood in terms of a simple diagram. The model exhibits a rich variety of responses to exogenous shocks while avoiding the implausible propensity to specialise of the Heckscher-Ohlin model with international factor mobility.

The detailed responses of the model to international transfers, capital taxes and tariffs are summarised in the propositions and need not be repeated. One overall conclusion which can be drawn is that goods and factor trade are likely to be substitutes (just as they are in the Heckscher-Ohlin model) given that internationally mobile capital is used in the import-competing sector. However, if capital were used in the export sector, this finding would be reversed: restrictions on one kind of trade would tend to discourage rather than to stimulate the other kind. Thus the model is able to reconcile the apparently conflicting predictions of Haberler (1936) and Markusen (1983) on this issue.

¹⁸ The condition for a long-run Metzler paradox is that $\delta_1 + \Phi S_k^{-1} g_{kp}^*$ is negative; while the condition for a long-run Lerner paradox is that $\delta_2 - \Phi S_k^{-1} g_{kp}$ is negative.

A feature of the model's responses to exogenous shocks is that they can largely be expressed in terms of two key asymmetries, in supply and demand, between the two countries. The demand asymmetry term is familiar from Samuelson's analysis of the transfer problem, but the importance of supply asymmetries between countries is a novel feature which is highlighted in the present model. Of course, the fact that supply and demand asymmetries are not necessarily related means that the model yields a wide variety of comparative statics predictions; but this should be seen as a strength rather than a weakness.¹⁹

The tractability of the model should permit many extensions. For example, it would be desirable to investigate the circumstances in which particular trade patterns (taken as given in this paper) are implied by underlying parameters of the world economy. An even more important extension would be to allow for product-market imperfections and increasing returns to scale. Indeed, the research agenda suggested here is similar to that proposed by Krugman (1991) in his work on economic geography: no more nor less than a departure from the "Classical paradigm" of constant returns to scale and fixed national factor endowments in favour of a paradigm in which increasing returns and international factor mobility are centre stage. By developing a tractable model in which international factor mobility does not necessarily eliminate goods trade, the present paper hopefully points towards a rich research agenda in which international factor movements will be central rather than peripheral to the analysis.

¹⁹ An alternative approach, pursued by Jones (1987) is to argue that there is a presumption in favour of one particular configuration of these asymmetries. In the case of the demand asymmetry term, β , Jones argues that there is a presumption in favour of the case where βm is positive, so that each country has a higher marginal propensity to consume its import good. (He calls this the "anti-orthodox" case, referring to debates on the transfer problem.) He argues that, if we know nothing about a country other than its trade pattern, we are more likely to be correct in guessing that it has a relatively high marginal propensity to consume its import good than the converse. As for the supply asymmetry, Jones argues for a presumption that ϕm should be negative. Finally, Jones suggests that the sign of mk may be identified with different stages in the Vernon product cycle. In the early stages of the product cycle, one country exports both manufactures and the specific capital needed to produce them, so that mk is positive (as assumed in this paper). By contrast, in the later stages of the product cycle, the country which originated the product ceases to export it but continues to export the necessary capital goods, so that mk is negative.

Appendix

Totally differentiating the four equilibrium conditions (1) to (4) yields:

$$du = dT + k'd\rho + m'dt - (m' + k'g_{kp})dp + k'S_k dk. \quad (15)$$

$$du^* = -du + (r - r^*)dk. \quad (16)$$

$$- \bar{S}dp + \phi dk + x_I du + x_I^* du^* = -S^* dt, \quad (17)$$

$$\phi'dp + \bar{S}_k dk = -dp + g_{kp}^* dt. \quad (18)$$

The last of these gives the KK locus, while eliminating du and du^* from the first three gives the full expression for the MM locus:

$$\delta dp - [x_I^*(r - r^*) + \Phi]dk = \beta dT + \beta k'd\rho + \delta_1 dt. \quad (19)$$

Combining the two equilibrium loci and evaluating at $r = r^*$ gives the long-run changes in p and k :

$$\Delta dp = \beta dT + (\beta k' - \Phi \bar{S}_k^{-1})d\rho + (\delta_1 + \Phi \bar{S}_k^{-1} g_{kp}^*)dt, \quad (20)$$

$$\Delta_k dk = -\phi'\delta^{-1}\beta dT - (1 + \phi'\delta^{-1}\beta k')d\rho + (g_{kp}\delta^{-1}\delta_1 + g_{kp}^*\delta^{-1}\delta_2)dt. \quad (21)$$

The two determinants Δ and Δ_k are alternative expressions for the long-run Marshall-Lerner condition (in the scalar case $\delta\Delta_k = \bar{S}_k\Delta$) and so both may be assumed positive.

The other result needed in the text is the long-run effect of a capital tax on home imports of manufactures. Recalling that m equals $E_p(p, u, k)$, this is found to be:

$$dm = \bar{g}_{pk}\bar{S}_k^{-1}d\rho + \bar{x}_I du. \quad (22)$$

Here $\bar{g}_{pk}$ and $\bar{x}_I$ are weighted averages of the individual country terms, where the weights are the contributions of the home and foreign countries to $\bar{S}$, the total substitution effect of a fall in p on the world demand for manufactures, allowing for the effects of induced capital flows. $\bar{S}$ itself must be positive though both its components, $\bar{S}_1$ and $\bar{S}_2$, need not be. In the scalar case, $\bar{g}_{pk}$ simplifies to $\bar{S}^{-1}(S^*g_{pk} + Sg_{pk}^*)$. This is a weighted sum of the

individual country terms, where the weights are positive.

Income effects complicate the story considerably, even when k is zero. Substituting for du in this special case, the full long-run effect of a capital tax on home imports becomes:

$$dm = [\bar{g}_{pk} + \bar{x}_p m' \bar{S}^{-1} \phi (1 + m' \bar{S}^{-1} \beta)^{-1}] \bar{S}_k^{-1} d\rho. \tag{23}$$

Thus, under our assumption that capital is specific to the import-competing sector, the substitution effect of a tax on capital imports tends to raise goods imports; but the income effect reinforces this if and only if ϕ is positive.

Symbol	Definition	Interpretation
$\bar{S}$	$S+S^* \equiv -(E_{pp}+E_{pp}^*)$	Substitution effect in world market for manufactures
$\bar{S}_k$	$S_k+S_k^* \equiv -(g_{kk}+g_{kk}^*)$	Substitution effect in world capital market
ϕ	$g_{pk}^*-g_{pk}$	Supply-side asymmetry: Effect on EDM of a transfer of k from foreign to home when $k=0$
β	$x_I-x_I^*$	Demand-side asymmetry: Effect on EDM of a transfer of numeraire from foreign to home
δ	$\bar{S}+\beta(m'+k'g_{kp})$	Short-run Marshall-Lerner condition
δ_1	$\delta-\delta_2 \equiv S^*+\beta m'$	Effect on EDM of a tariff at given p
δ_2	$\delta-\delta_1 \equiv S+\beta k'g_{kp}$	Effect on ESM of a tariff at given p^*
Φ	$\phi+\beta k'S_k$	Supply-side asymmetry: Effect on EDM of a transfer of k from foreign to home
Δ	$\delta+\Phi\bar{S}_k^{-1}\phi'$	Long-run Marshall-Lerner condition
Δ_k	$\bar{S}_k+\phi'\delta^{-1}\Phi$	Transformation of Δ
$\bar{S}$	$\bar{S}+\phi\bar{S}_k^{-1}\phi'$	Long-run substitution effect in world market for manufactures
$\bar{S}_1$	$\bar{S}-\bar{S}_2 \equiv S-g_{pk}\bar{S}_k^{-1}\phi'$	Contribution of home country to $\bar{S}$
$\bar{g}_{pk}$	$\bar{S}_1\bar{S}^{-1}g_{pk}^*+\bar{S}_2\bar{S}^{-1}g_{pk}$	Weighted average of factor-intensity terms
$\bar{x}_I$	$\bar{S}_1\bar{S}^{-1}x_I^*+\bar{S}_2\bar{S}^{-1}x_I$	Weighted average of income responses

Table 1: Glossary of Symbols Used

Abbreviations:

EDM - World excess demand for manufactures

ESM - World excess supply of manufactures

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Figure 1: Stability of Long-run Equilibrium: $\phi > 0, \Phi > 0$.

Figure 2: Stability of Long-run Equilibrium: $\phi < 0, \Phi < 0$.

Figure 3: Effects of a Transfer: $\beta > 0$, $\phi > 0$, $\Phi > 0$.

Figure 4: Effects of a Transfer: $\beta < 0$, $\phi > 0$, $\Phi < 0$.

Figure 5: Effects of a Tax on Capital Imports: $\beta > 0$, $\phi > 0$, $\Phi > 0$.

Figure 6: Effects of a Tax on Capital Imports: $\beta < 0$, $\phi > 0$, $\Phi > 0$.

Figure 7: Effects of a Tariff: $\phi > 0, \Phi > 0, \delta > \delta_1, \delta_2 > 0$.
 "Normal Outcome": No Short-Run Tariff Paradoxes; Long-Run Capital Outflow

Figure 8: Effects of a Tariff: $\phi < 0, \Phi < 0, \delta_1 < 0$.
 Short-Run Metzler Paradox ($\delta_1 < 0$) with Importables More Capital-Intensive
 at Home ($\phi < 0$) encouraging a Long-Run Capital Outflow