Production and Trade with International Capital Movements and Payments*

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I. Introduction

International movements of productive capital and payments on international stocks of capital are important concerns in both international economics and development economics. Little has been done, however, to relate international capital movement and payments to an economy's underlying structure of production. This paper extends the specific factors model of production and trade to provide a picture of an economy involved with international capital movements and net payments on internationally diversified capital stocks.

Capital is treated as imperfectly mobile internationally, its domestic return endogenously resolved along with the pattern of production. The two sectors in the economy are assumed to share homogeneous capital input, while labor is sector specific. Imperfect international capital mobility with adjustment at the margin distinguishes the approach in this paper from the literature.

A change in the world return to capital will induce international capital movement, shifting the economy's production possibility frontier. A higher world return to capital or a domestic capital tax will squeeze capital from the economy, resulting in output declines, a higher domestic return to capital, and falling wages. The direction of change in net capital payments depends on the country's net international capital position.

A tariff would shift production toward the protected good and raise the wage in that sector, while the output and wage in the other sector necessarily fall. Increased demand for capital due to a tariff raises capital's domestic return, attracting it to the economy. Net international capital payments fall. Immigration of labor is also found to raise the domestic demand for capital, creating a capital inflow and a decline in net capital payments.

This paper is the first effort to directly integrate international capital movement and net capital payments into a model of a productive trading economy. Policy aimed at trade will affect the international capital market, and policy aimed at capital from the international market will affect the pattern of production and trade.

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II. An Approach to the International Capital Market

Net capital payments are paid on internationally diversified stocks of capital. Suppose wealth holders at home own K' of capital in the rest of the world, where the world return to capital is r^*. Capital payments into the country are then r^*K'. Foreign investors own K^* of capital in the home country, the domestic price of capital r determines capital outpayments rK^*. Net international capital payments equal the difference,

$$\pi \equiv r^*K' - rK^*. \tag{1}$$

The country's net capital position is written $c \equiv K^* - K'$. Changes in the domestic or foreign returns to capital create international capital movements:

$$dc = dK^* - dK'. \tag{2}$$

The real external balance is extended from the balance of trade (T) to include both π and dc. The real current account is $T + \pi$, and the real capital account dc. It follows that $T = -(\pi + dc)$. Trade deficits are feasible if $\pi + dc > 0$. Emphasis in this model is placed on solving for dc and changes in π, with T implicitly determined. From this perspective, T depends on international capital stocks, returns to capital, and movements of productive capital input. Trade deficits or surpluses would be the rule rather than the exception.

There are two simple ways in the literature to model an economy's capital market. The domestic endowment of capital is exogenously given in the factor proportions and specific factor models pioneered by Jones [2; 3]. Capital supply is fixed and perfectly inelastic, while the capital price r is endogenous. Effects of the international movement of capital are then traced with an exogenous change in the capital endowment. By definition, dc would be zero with the domestic capital endowment fixed, while net capital payments could be calculated.

At the other extreme, capital is viewed in perfectly elastic supply at the world price r^* by Caves, Srinivasan, and others [1; 6]. The economy becomes a price taker in the world capital market, and endogenous international capital flows occur. Since $r = r^*$ under this assumption, net capital payments depend on c. International capital movement depends entirely on endogenous changes in the demand for capital and cannot be independently modelled.

The approach in this paper builds on an idea of partial mobility. An implicit link between changes in world and domestic capital prices is introduced. This link can be summarized by the condition $dr = \alpha(K^*, K')dr^*$, with α a function of the levels of foreign investment. Capital's partial mobility can implicitly be due to restrictions on foreign investment, imperfect information, foreign exchange risk, or exchange control.

International capital movements are assumed to be random with respect to ownership. If the world price of capital r^* rises, either a unit of home owned capital goes abroad or a unit of foreign owned capital employed at home repatriates.

Total capital employed at home is $K_H \equiv K_h + K^*$, where K_h represents the amount of home owned capital employed at home. With a marginal increase in r^*, the probability that a unit of K^* will repatriate is $P^* \equiv K^*/K_H$. The probability that a unit of home capital K_h would leave the country is $K_h/K_H = 1 - P^*$. If a total of κ units of capital go abroad, $P^*\kappa$ units of foreign capital repatriate, while $(1 - P^*)\kappa$ units of home capital go abroad. Without loss of generality, suppose $\partial K^*/\partial r^* = -P^* < 0$ and $\partial K'/\partial r^* = 1 - P^* > 0$. The effects of changes in r on K^* and K' are similarly formulated.

International movements of capital can then be summarized

$$dK^* = \beta_1 dr - \beta_2 dr^*, \quad \text{and} \tag{3}$$

$$dK' = -\beta_3 dr + \beta_4 dr^*, \tag{4}$$

where $\partial K^*/\partial r = \beta_1 > 0$, $\partial K^*/\partial r^* = -\beta_2 = -P^* < 0$, $\partial K'/\partial r = -\beta_3 < 0$, and $\partial K'/\partial r^* = \beta_4 = 1 - P^* > 0$. Equations (2), (3), and (4) lead to a simple expression of net capital movements,

$$dc = dr - dr^*, \tag{5}$$

using the fact that $\beta_1 + \beta_3 = -(\beta_2 + \beta_4) = 1$.

Changes in domestic and world capital prices affect international capital payments π. Differentiate (1) to find $d\pi = r^* dK' + K' dr^* - r dK^* - K^* dr$. Substituting from (3) and (4),

$$d\pi = -\gamma_1 dr + \gamma_2 dr^*, \tag{6}$$

where $\gamma_1 \equiv K^* + \beta_1 r + \beta_3 r^*$ and $\gamma_2 \equiv K' + \beta_2 r + \beta_4 r^*$. Equation (6) describes the change in net capital payments due to changes in the domestic and foreign returns to capital. Equations (5) and (6) become the novel part of a comparative static model presented in the next section.

III. The Comparative Statics of Production and International Capital

Labor is treated as specific to its sector. This assumption can be viewed as short run, with labor not having enough time to move between sectors if wage differences arise. It might alternatively be interpreted as leading to a regional model, with labor tied to the industry in its region. A third interpretation is that labor may be trained specifically in its industry, and its intersectoral mobility is hindered.

Flexible cost minimizing labor inputs a_{ij} are functions of input prices, describing amounts of labor used to produce one unit of each good: $a_{ij} = a_{ij}(w_i, r), i, j = 1, 2$. With each type of labor used specifically in its sector, $a_{12} = a_{21} = 0$. Neoclassical production functions with constant returns to scale are assumed in both sectors. Full employment is ensured by flexible factor payments:

$$L_i = \sum_j a_{ij} x_j. \tag{7}$$

All of the capital at home is fully employed,

$$K_h + K^* = \sum_j a_{Kj} x_j, \tag{8}$$

where a_{Kj} is the cost minimizing input of capital and x_j is the output of either good.

Substitution terms $s_{ih} \equiv \sum_j x_j \partial a_{ij}/\partial w_h$ $(i, h = K, 1, 2)$ summarize the degree of substitution across the economy. From Shephard's lemma, $s_{iK} = s_{Ki}$. Since labor is sector specific, $s_{12} = s_{21} = 0$. Differentiating (7) and (8) leads to [4; 7; 8]:

$$dL_i = s_{Ki} dr + s_{ii} dw_i + \sum_j a_{ij} dx_j, \quad i = 1, 2, \quad \text{and} \tag{9}$$

$$dK_h + dK^* = s_{KK}dr + \sum_i s_{Ki}dw_i + \sum_j a_{Kj}dx_j. \tag{10}$$

Let $\overline{K}$ represent total domestically owned capital: $\overline{K} \equiv K_h + K'$. It follows that $dK' = d\overline{K} - dK_h$. Substituting this expression for dK' into (2),

$$dK_h + dK^* = d\overline{K} + dc. \tag{11}$$

Equation (11) is substituted into (10) for the first equation in the comparative static system (13). Full employment of each sector's labor leads to the second and third equations in (13). Competitive pricing of either good is stated $p_j = a_{Kj}r + a_{jj}w_j$. Prices of the two traded goods are exogenously determined at world levels for the small open economy. Differentiating and using a cost minimization envelope result,

$$dp_j = a_{Kj}dr + a_{jj}dw_j, \quad j = 1, 2, \tag{12}$$

which become the fourth and fifth equations in (13). Equations (5), (6), (9), (10), (11), and (12) are combined into the comparative static system:

$$\begin{bmatrix} s_{KK} & s_{K1} & s_{K2} & a_{K1} & a_{K2} & 0 & -1 \\ s_{K1} & s_{11} & 0 & a_{11} & 0 & 0 & 0 \\ s_{K2} & 0 & s_{22} & 0 & a_{22} & 0 & 0 \\ a_{K1} & a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{K2} & 0 & a_{22} & 0 & 0 & 0 & 0 \\ \gamma_1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} dr \\ dw_1 \\ dw_2 \\ dx_1 \\ dx_2 \\ d\pi \\ dc \end{bmatrix} = \begin{bmatrix} d\overline{K} \\ dL_1 \\ dL_2 \\ dp_1 \\ dp_2 \\ \gamma_2 dr^* \\ dr^* \end{bmatrix}. \tag{13}$$

Partial derivatives of each endogenous variable (r, w_i, x_j, π, c) with respect to each exogenous variable (K, L_i, p_j, r^*) are found with Cramer's rule.

Goods are rescaled for simplicity so $a_{11} = a_{22} = 1$. Due to the homogeneity of factor mix terms, $\Sigma_i \omega_i s_{ik} = 0$, where ω_i is an index of factor prices (r, w_1, w_2). Factors are rescaled so $\omega_i = 1$, which implies $\Sigma_i s_{ik} = 0$, $s_{11} = -s_{K1}$, $s_{22} = -s_{K2}$, and $s_{KK} = -s_{K1} - s_{K2}$.

The determinant Δ of the system in (13) equals $1 - \Delta'$, where Δ' is the determinant of the model with no international capital: $\Delta' = -b_{K1}s_{K1} - b_{K2}^2 s_{K2}$, and $b_{Ki}^2 \equiv 1 + a_{Ki}$. It is known that Δ' is negative, and it follows that $\Delta > 0$.

Cofactors of the system are reported in Table I, and signs of the model's comparative static results in Table II.

IV. A Discussion of Results

An increased endowment of home owned capital $\overline{K}$ expands the production frontier, increasing labor's productivity and demand. Both outputs rise with prices of the two goods constant at exogenous world levels. The domestic return to capital falls with its higher supply, causing capital to leave the economy. This higher level of home owned capital abroad raises net international capital payments. If γ_1 is greater than 1, $d\pi > -dc$. Note that γ_1 is composed of foreign capital at home K^* plus a weighted average of r and r^*. If the foreign capital stock K^* is nontrivial, an influence toward surplus can be expected if a country's ownership of capital increases.

Table I. Comparative Static Cofactors

	$\partial\overline{K}$	∂L_1	∂p_1	∂r^*
∂r	-1	a_{K1}	$b_{K1}s_{K1}$	1
∂w_1	a_{K1}	$-a_{K1}^2$	$1 + b_{K2}^2 s_{K2} + s_{K1}$	$-a_{K1}$
∂w_2	a_{K2}	$-a_{K1}a_{K2}$	$-a_{K2}b_{K1}s_{K1}$	$-a_{K2}$
∂x_1	$b_{K1}s_{K1}$	$1 + b_{K1}s_{K1} + [1 + a_{K2}(2 + a_{K2})]s_{K2}$	$b_{K1}s_{K1} + b_{K2}^2 s_{K1}s_{K2}$	$-b_{K2}s_{K1}$
∂x_2	$b_{K2}s_{K2}$	$-b_{K2}a_{K1}s_{K2}$	$-[1 + b_{K2}a_{K1}]s_{K1}s_{K2} - s_{K2}$	$-b_{K2}s_{K2}$
$\partial\pi$	γ_1	$-\gamma_1 a_{K1}$	$-\gamma_1 b_{K1}s_{K1}$	$-\gamma_2\Delta' - (\gamma_1 - \gamma_2)$
∂c	-1	a_{K1}	$b_{K1}s_{K1}$	Δ'

Table II. Comparative Static Sign Pattern

	$\partial\overline{K}$	∂L_1	∂L_2	∂p_1	∂p_2	∂r^*
∂r	$-$	$+$	$+$	$+$	$+$	$+$
∂w_1	$+$	$-$	$-$	$+$	$-$	$-$
∂w_2	$+$	$-$	$-$	$-$	$+$	$-$
∂x_1	$+$	$+$	$-$	$+$	$-$	$-$
∂x_2	$+$	$-$	$+$	$-$	$+$	$-$
$\partial\pi$	$+$	$-$	$-$	$-$	$-$	?
∂c	$-$	$+$	$+$	$+$	$+$	$-$

An increased endowment or supply of either sector's labor would raise that sector's output and lower that labor's wage. Demand for capital increases, resulting in a higher domestic price of capital. The wage in the other sector declines as capital departs for the expanding sector. The higher domestic capital price attracts foreign investment, while leading to a higher level of capital outpayment. With $\gamma_1 > 1$, there is an influence toward deficit. Countries experiencing immigration can generally anticipate incoming foreign investment and falling net international capital payments.

A tariff on good 1 would raise the price of good 1 inside the economy and create a shift toward producing the protected good. Marginal revenue products increase in sector 1, attracting both factors of production. Excess demands for capital and sector 1 labor arise with the tariff, along with excess supply of sector 2 labor. Capital enters the economy due to the higher r, expanding the production frontier and strengthening the output effects. The induced international movement of capital, in other words, complements the change in relative price with the tariff. Net international capital payments decline. A similar analysis holds for an exogenous change in the price of good 2.

A higher r^* leads to an outflow of capital from the country. A domestic capital tax creates such an exogenous increase in the price of international capital. Outputs and wages fall in both sectors. The domestic price of capital increases with its decreased supply.

Note from Table I that the elasticity of r with respect to r^* is $r^*/r\Delta$, which is positive and less than 1 if r and r^* are nearly equal and $\Delta > 1$. The domestic price of capital would then lag behind the world price. If this elasticity is greater than 1, the domestic capital payment would "overshoot" any exogenous change in the world capital payment.

With a negative net capital position, $K' > K^*$, $\gamma_2 > \gamma_1$, and international interest payment

would rise with capital tax. With a positive net capital position, $\gamma_1 > \gamma_2$ and net interest payments could fall with a capital tax. Even though r rises less than r^*, rK^* may be larger than r^*K'. A more positive net capital position means that a tax on international capital would have less of a positive influence on international capital payments.

V. Conclusion

It is possible to integrate this approach to the international capital market with other trade models: various numbers of factors and goods, non-traded goods, intermediate goods, and so on. Investment by foreigners in the home export sector and influences of technological innovation can also be examined. General equilibrium models of imperfect competition can incorporate this structure for their international capital market. A topic for further research is the dynamic adjustment mechanism of such a model from a trade deficit.

Ruffin [5] summarizes the literature on changes in home and foreign welfare when there is internationally mobile capital. Introducing a social welfare function in the present model would allow examination of the overall effects when various factor prices move in opposite directions. While the aggregate effect may be of interest, this paper focuses on the fate of labor which is tied to its sector. Income distribution is the fundamental issue for the sector specific input.

Allowing labor to be mobile between sectors in the present model would create an underlying Heckscher-Ohlin production structure with two primary factors of production and two finished goods. The factor price equalization result would then imply that changing factor endowments would not affect factor prices, π, or dc. A change in r^* would leave r unchanged in these circumstances, so $\partial\pi/\partial r^* = \gamma_2$ and $dc = 1$. The international capital market would have less influence on the economy than in the model with sector specific labor.

This paper has examined the effects of growth, migration, domestic commercial policy, changes in the world return to capital, and a capital tax on wages, outputs, the domestic return to capital, and international capital movements and payments. The major lessons are that international capital movement and payments can be related to the structure of production and that patterns of production and trade are affected by the international capital market. This approach uncovers the essential influences which should be considered when a small open economy wants to focus on its external capital position and the distribution of income among sector specific factors of production.

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