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International Capital Mobility in a Specific Factor Model

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I. Introduction

Recent research [Srinivasan, 1983] has developed the specific factors model where one specific factor, capital, is internationally mobile. Capital's payment r_K is given to a small, price taking economy by the world capital market. This is a good description of many countries, dependent on the rest of the world for acquiring capital goods. The economy is also a price taker in world markets for two types of goods. Endowments of sector specific land and shared labor are exogenously given. Endogenously determined are output levels, payments to land and labor, and capital employment.

Land and capital become intersectorally mobile in the long run, a situation studied by Thompson [1983]. Labor and land can be renamed (labor and capital specific to sector two, skilled and unskilled labor, etc.) for different applications of the model.

Complete comparative static analysis of this short run model is performed in the present article. Srinivisan considers optimal trade and borrowing, repatriated earnings of foreign investment, and distortions, but does not develop some straightforward results.

Symmetric Stolper-Samuelson-Rybczynski relationships between goods and immobile factors are found, with labor and the sector using land completely independent of each other. A higher (lower) relative price of the good using capital creates an inflow (outflow) of capital. Labor immigration (emigration) and a falling (rising) endowment of land have the same effect.

Comparative statics are done algebraically, while straightforward reasoning and a Lerner-Pearce type diagram provide an alternative approach. Factors can be renamed for wider application of the model. This is perhaps the simplest general equilibrium model incorporating internationally mobile capital.

II. Diagrammatic Approach and Comparative Statics

Figure I is the Lerner-Pearce diagram for this model. Unit value isoquants, Q_1^* and Q_2^*, are based on constant returns to scale production and exogenous world prices, p_1^* and p_2^*. Competitive pricing insures these isoquants are supported by unit isocost lines, indicating factor payments: w_L for labor, w_T for land, and r_K for capital. Unit factor mixes are uniquely determined with r_K given by the world market.

Endowments of land, $\bar{T}$, and labor, $\bar{L} = L_1 + L_2$, are fixed. Constant returns to scale insure the ratio of labor to land equals the ratio of unit inputs. Sector two output (Q_2) and employment of labor in sector two (L_2) are determined. A linear expansion path in sector one indicates the ratio of labor to capital. Sector one employs remaining labor (L_1), determining both Q_1 and endogenous capital employment.

Equilibrium in the labor market is insured by effects of capital flows on labor's marginal productivity. Labor mobility insures equality of wages between sectors. Capital flows cause adjustment in demand for labor in sector one until full employment is reached. Labor's wage and employment in sector two is implied by demand for labor and the ratio of labor to land. With exogenous capital endowments, wages adjust freely until full employment is reached.

Following arguments are confirmed by considering necessary comparative static adjustments around exogenous parameters in Figure I. Consider an increase in cost of internationally produced capital goods, a rising r_K. Isocost lines become steeper around fixed isoquants, with w_L falling and w_T rising. A similar theorem in the literature [Ruffin, 1982] states extreme factors in the factor

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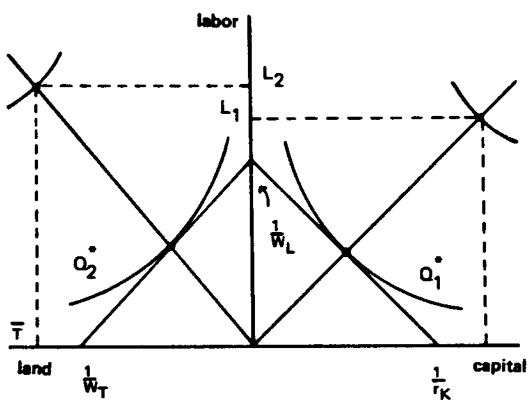
intensity ranking of three factor, two good models are enemies, the middle factor a friend with each extreme factor.

A rising r_K causes a higher ratio of labor to capital. Firms also shift to a higher ratio of labor to land, as output in sector two rises. Capital is characterized by diminishing marginal returns, its employment falling. Marginal productivity of labor in sector one falls, so labor migrates to sector two. Wages seek an equilibrium level below the original, as in a Jevons diagram. Sector one output falls. Labor inflow causes an increase in land's marginal productivity, and higher land payments. These arguments are confirmed by examination of adjustments in Figure I associated with increased r_K.

FIGURE I



Changing endowments of labor or land have no effect on factor payments, as Srinivasan notes. Unit factor mixes and input ratios are unchanged. Increased land attracts labor by increasing labor's marginal productivity, expanding output of sector two. Capital's marginal productivity declines as labor departs, resulting in capital outflow and declining sector one output.

Immigrating labor finds no opportunity for employment in sector two, where land endownment and ratio of labor to land are unchanged. Additional labor raises marginal productivity of capital, calling forth an inflow. Wages fall temporarily in sector one with immigration, but this is exactly offset by labor's increasing marginal productivity due to capital inflow. Factor prices would be equalized between similar, freely trading economies.

A rising price for good one increases demand for capital and labor in sector one. Capital flows into the economy. Labor is attracted to sector one, with wages seeking a higher equilibrium level. Firms lower the ratio of labor to capital, as sector one output increases. Land's marginal productivity falls with less labor available, so w_T falls. A fall in the ratio of labor to land occurs, as sector two output declines.

Labor's nominal wage is independent of changes in the price of good two, even though labor is employed in its production. A higher price for good two results in rising ratio of labor to land, as labor is attracted by temporarily higher wages in sector two. Labor's marginal productivity diminishes as it moves into sector two, offsetting effect of higher p^*_2. Real wages fall with higher price of good two, given that labor consumes some of each good.

Land's marginal productivity and payment increase with this shift of labor to sector two. As labor leaves sector one, capital does the same due to falling demand. Labor's marginal productivity rises as it leaves sector one, but this is offset by capital outflow. There is a zero net effect on labor wages due to increased price of good two. Srinivasan notes output changes involved, a higher Q_2 and a lower Q_1.

III. Algebraic Solution

While the qualitative nature of comparative static results has been found, further properties are uncovered by algebraic solution. Overall characteristics of general equilibrium production models of trade are well developed in the literature [Jones and Scheinkman, 1977; Chang, 1979; Takayama, 1982]. Cost minimizing unit factor mixes are denoted a_{ij}, with i representing a factor and j a good.

Aggregate substitution terms, $s_{hi} \equiv \Sigma_j Q_j \partial a_{hj} / \partial w_i$ (or r_K for capital), summarize how firms in both sectors switch between factors h and i. These terms are symmetric: $s_{hi} = s_{ih}$. A firm reacts only to changing payments to factors in its employ, so $s_{KT} = 0$. For any factor i, the own substitution term s_{ii} is negative. Either sector employs a pair of substitute factors, so $s_{KL} > 0$ and $s_{LT} > 0$. It is known $\Sigma_i w_i s_{hi} = 0$ (with r_K for capital). Factors are rescaled so $\Sigma_i s_{hi} = 0$, which means $s_{KK} = -s_{KL}$, $s_{TT} = -s_{LT}$, and $s_{LL} = -s_{KL} - s_{LT}$.

Full employment of resources results in the first three equations below, competitive pricing the last two. Collecting exogenous variables, the system appears

$$\begin{bmatrix} -1 & s_{KL} & 0 & a_{K1} & 0 \\ 0 & s_{LL} & s_{LT} & a_{L1} & a_{L2} \\ 0 & s_{LT} & s_{TT} & 0 & a_{T2} \\ 0 & a_{L1} & 0 & 0 & 0 \\ 0 & a_{L2} & a_{T2} & 0 & 0 \end{bmatrix} \begin{bmatrix} dK \\ dw_L \\ dw_T \\ dQ_1 \\ dQ_2 \end{bmatrix} = \begin{bmatrix} -s_{KK}\, dr_K \\ d\bar{L} - s_{KL}\, dr_K \\ d\bar{T} \\ dp_1^* - a_{K1}\, dr_K \\ dp_2^* \end{bmatrix}$$

Let some exogenous variable change, and find the partial derivative of each endogenous variable with Cramer's rule. There is a negative system determinant: $D = -a_{LI}\, a_{T2} < 0$. Table 1 reports comparative static solutions. Own substitution terms (s_{KK}, s_{LL}, and s_{TT}) are eliminated for simplicity. Also $a_1 \equiv a_{K1} + a_{L1}$ and $a_2 \equiv a_{L2} + a_{T2}$.

Negative reciprocity is noticed between capital employment and endowments on one hand, and factor payments and the capital payment on the other. Capital employment, for instance, is positively related to labor endowment; negative relation between labor's wage and capital payment has the same magnitude. Another type of negative reciprocity exists between capital employment and prices versus outputs and capital payment. Reciprocal Stolper-Samuelson-Rybczynski results between immobile factors and goods are also indicated.

A number of these results are independent of substitution between factors. Changing land or labor endowments have no effect on factor payments. Firms do not alter factor mixes, so substitution does not affect outcomes. Effects on labor and land payments are also independent of substitution due to offsetting influences. Higher degrees of substitution strengthen all effects where substitution plays a role.

Consider effects involving good two, either changes in p_2^* or endogenous adjustments of Q_2. Substitution between capital and labor,

TABLE 1

Comparative Static Solutions

	∂K	∂w_L	∂w_T	∂Q_1	∂Q_2
∂r_K	$-a_{T2} a_1 s_{KL} < 0$	$-\partial K/\partial \bar{L} < 0$	$-\partial K/\partial \bar{T} > 0$	$-\partial K/\partial p_1^* < 0$	$-\partial K/\partial p_2^* > 0$
$\partial \bar{L}$	$a_{K1} a_{T2} > 0$	0	0	$\partial w_L/\partial p_1^*$	0
$\partial \bar{T}$	$-a_{K1}/a_{T2} > 0$	0	0	$\partial w_T/\partial p_1^*$	$\partial w_T/\partial p_2^* > 0$
∂p_1^*	$a_{T2} a_1 s_{KL}/a_{L1} + a_{K1} a_2^2 s_{LT}/a_{L1} a_{T2} > 0$	$a_{T2} > 0$	$-a_{L2} < 0$	$a_{T2} s_{KL}/a_{L1} + a_2^2 s_{LT}/a_{L1} a_{T2} > 0$	$\partial Q_1/\partial p_2^* < 0$
∂p_2^*	$-a_{K1} a_2 s_{LT}/a_{T2} < 0$	0	$a_{L1} > 0$	$-a_2 s_{LT}/a_{T2} < 0$	$a_{L1} s_{LT}/a_{T2} > 0$

factors employed in the other sector, play no role. Adjustment of sector one output to changing price of good two is independent of substitution between capital and labor, even though those factors are employed in that sector. Capital flows resulting from a changing world capital payment are independent of substitution between labor and land.

IV. Conclusion

This model provides a useful starting point for the study of international capital mobility in the context of a small, open economy. All causes of capital flows are readily uncovered. Factor substitution plays a limited role, leading to straightforward properties. Factor price equalization and reciprocity relations are found. Future research could investigate positive, but less than infinite, capital supply elasticity, due perhaps to a risk premium.

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