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 1 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, $T$, and labor, $L = L_1 + L_2$, 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 1. 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
THOMPSON: INTERNATIONAL CAPITAL MOBILITY

...ually mobile capital.

Each and Comparat-

-Parth diagram for equants, $Q^*$ and $Q^*_s$, returns to scale pro-
world prices, $p^*$ and
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unit isocost lines,
$w_L$, for labor, $w_T$.
Unit factor mixes
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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 mar-
ginal returns, its employment falling. Margi-
nal 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 pay-
ments. These arguments are confirmed by
examination of adjustments in Figure I asso-
ciated 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 produc-
tivity, expanding output of sector two. Cap-
tal's marginal productivity declines as labor
leaves, leading to capital outflow and declin-
ing sector one output.

Immigrating labor finds no opportunity for
employment in sector two, where land end-
owment 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 dem-
and 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 tempo-
arily 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 margi-
nal 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 $Q_1$ 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 solu-
tion. Overall characteristics of general equili-
rium production models of trade are well
developed in the literature [Jones and
Scheinman, 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, \( s_{h} = \Sigma Q \partial a_{h} / \partial w_{i} \) (or \( r_{K} \) for capital), summarize how firms in both sectors switch between factors \( h \) and \( i \). These terms are symmetric: \( s_{K} = s_{L} \). A firm reacts only to changing payments to factors in its employ, so \( s_{K} = 0 \). For any factor \( i \), the own substitution term \( s_{i} \) is negative. Either sector employs a pair of substitute factors, so \( s_{KL} > 0 \) and \( s_{LT} > 0 \). It is known \( \Sigma w_{p} s_{h} = 0 \) (with \( r_{K} \) for capital). Factors are rescaled so \( \Sigma s_{h} = 0 \), which means \( s_{KL} = -s_{KL} \), \( s_{TT} = -s_{LT} \), and \( s_{LT} = -s_{KL} - s_{LT} \).

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 & \frac{dK}{dK} & \frac{dQ_{1}}{dK} \\
0 & s_{LL} & s_{LT} & a_{L1} & a_{L2} & \frac{dw_{L}}{dK} & \frac{dQ_{1}}{dL} \\
0 & s_{LT} & s_{TT} & 0 & a_{T2} & \frac{dw_{T}}{dK} & \frac{dp_{1}}{dK} \\
0 & a_{L1} & 0 & 0 & 0 & \frac{dQ_{1}}{dL} & \frac{dp_{1}}{dK} \\
0 & a_{L2} & a_{T2} & 0 & 0 & \frac{dQ_{1}}{dL} & \frac{dp_{2}}{dK}
\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: \( D = -a_{K1} a_{T2} < 0 \). Table 1 reports comparative static solutions.

### TABLE 1
Comparative Static Solutions

<table>
<thead>
<tr>
<th>( \partial K )</th>
<th>( \partial w_{L} )</th>
<th>( \partial w_{T} )</th>
<th>( \partial Q_{1} )</th>
<th>( \partial Q_{2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( -a_{T2} a_{1} s_{KL} &lt; 0 )</td>
<td>( -\partial K / \partial L &lt; 0 )</td>
<td>( -\partial K / \partial T &gt; 0 )</td>
<td>( -\partial K / \partial p_{1} &lt; 0 )</td>
<td>( -\partial K / \partial p_{2} &gt; 0 )</td>
</tr>
<tr>
<td>( a_{1} a_{T2} &gt; 0 )</td>
<td>0</td>
<td>0</td>
<td>( \partial w_{L} / \partial p_{1} )</td>
<td>0</td>
</tr>
<tr>
<td>( a_{1} a_{T2} &gt; 0 )</td>
<td>0</td>
<td>0</td>
<td>( \partial w_{T} / \partial p_{1} )</td>
<td>( \partial w_{T} / \partial p_{2} &gt; 0 )</td>
</tr>
<tr>
<td>( a_{1} a_{T2} &gt; 0 )</td>
<td>( a_{1} a_{T2} + a_{T2} &gt; 0 )</td>
<td>( -a_{L2} &lt; 0 )</td>
<td>( a_{T2} s_{KL} / a_{L1} + a_{1} a_{T2} s_{LT} / a_{L1} a_{T2} &gt; 0 )</td>
<td>( a_{T2} / \partial p_{1} &lt; 0 )</td>
</tr>
<tr>
<td>( a_{1} a_{T2} &gt; 0 )</td>
<td>( a_{1} a_{T2} &gt; 0 )</td>
<td>( a_{L2} &gt; 0 )</td>
<td>( a_{1} a_{T2} s_{LT} / a_{T2} &gt; 0 )</td>
<td>( a_{L1} s_{LT} a_{T2} &gt; 0 )</td>
</tr>
</tbody>
</table>
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.

REFERENCES


\[
\begin{align*}
\frac{\partial Q_1}{\partial p_2^*} &> 0 \\
\frac{-\partial K}{\partial p_2^*} &> 0 \\
\frac{\partial w_T}{\partial p_2^*} &> 0 \\
\frac{\partial Q_1}{\partial p_2^*} &< 0 \\
\frac{a_{LT} a_{Lt}}{a_{Tt}} &> 0
\end{align*}
\]