SHORT–RUN OUTPUT CHANGES AND LONG–RUN CAPITAL MOVEMENTS IN RESOURCE–POOR COUNTRIES

HIROSHI ONO
Associate Professor
Faculty of Economics and Business Administration
Hokkaido University

Recent experiences of resource-poor countries seem to call for reconsideration of the traditional Heckscher-Ohlin approach. Uneven gloval distribution of resources, particularly raw materials, cause some countries, for instance, Japan, to heavily import raw materials from abroad. It will then be practically important to probe into how a raised price of the imported good, like a rise in the cartel price of crude oil set by the OPEC countries, will affect output levels and long-run capital movements in the country concerned. In order to answer this problem, we might employ an extreme Ricardian model where the rest of the world always possesses strong comparative advantage in producing raw materials. However, we will find this model not appropriate for giving an answer, because imported raw materials are, in most of resource-poor countries, used as intermediate inputs. Furthermore, it might not theoretically be an interesting model, because a rise in the price of the imported good would not result in any disturbances on allocation of factors due to nonexistence of the import-competing good sector. Meanwhile, if imported raw materials, combined with labor and capital, are employed as inputs, their price rise would affect, through changes in relative factor prices, allocation of factors and levels of outputs, and this question will become nontrivial.

In other context P. A. Samuelson (10) has extended the traditional Heckscher-Ohlin model by introducing the nontraded good and expounded that the interest rate, as well as the rental on capital, should be equalized among countries. He added an assumption that the nontraded good be the investment good. Then, unlike R. Komiya (7), who also brought the nontraded good into the conventional Heckscher-Ohlin model, the Samuelson model needs no consideration on the demand side of the nontraded good. Taking the same vehicle as used by Samuelson, G. H. Borts (3) further assumed that the country concerned be small. Then, he illustrated that a government policy of tariff duties may put some existing sector out of business. While we shall posit the Samuelson-Borts model in essence, there is a big difference between that model and the model we have in our mind. First, our model, dwelling on the point discussed above, does not include the import-competing good sector. Secondly, at least one of factors of production, i. e., the imported input, is free from a resource constraint, thus having an infinite price elasticity. But this idea has been framed in the field of the theory of effective protection (see W. M. Corden (4), R. Jones (6) and A. H. H. Tan (11)) and our model may be regarded as a variant of the Jones-Tan model in which either the imported input (Tan model) or capital (Jones model) is solely employed in one of two sectors; the exported good sector and the nontraded good sector. Of course, since our model does not have the import-competing good sector, we can not directly compare our results with theirs, but we may mention that in our premises any government policy, for example, export subsidy, cannot keep factor allocations and output levels unchanged, once the price of the imported input changes (see equations (9) and (13) in section 2). We will refrain from shedding light on it, but rather pay our attention to effects on domestic output levels and long-run capital movements as a result of exogenous changes.[1)]

Section 1 presents the basic features of our model, pointing out what exogenous variables are in our framework. Next, section 2 deals with the magnification effect claimed by R. Jones (5); we will prove that this effect also holds in our context. Then, section 3 proves the validity of the Rybczynski theorem in our framework and considers changes in output levels. Furthermore, section 4 describes some of results on comparative statics, showing that on domestic productions and the imported amount of raw materials a rise in the price of the imported input has exactly opposite impacts on the economy, compared to the case of a rise in the price of the exported good. Finally, section 5 briefly touches upon long-run capital movements.

1. THE MODEL

The country concerned is assumed small. She produces the nontraded good (X_0) and the exported good (X_1) with combining factors of production: Labor (L), capital (K) and the imported input (M). Perfect competition and full employment prevail over this economy. Production functions are assumed linearly homogeneous. We express these assumptions in terms of the following equations:

Equations (1) and (2) respectively show the equilibrium in the commodity markets X_0 and X_1, in which the average cost of each good should be equalized up to its market price.

(1) $$a_{L0}w+a_{K0}R+a_{M0}p_M=p_0$$

(2) $$a_{L1}w+a_{K1}R+a_{M1}p_M=p_1\,,$$

where a_{ij}, R, w, p_M and p_i denote the amount of factor i to produce a unit of commodity j, the rental on capital, the wage rate, the price of the imported input and the price of commodity i ($i=0, 1$). Perfect competition determines input-output coefficients as functions of respective factor prices employed.

$$(3) \qquad a_{ij}=a_{ij}\ (w, R, p_M) \qquad i=L, K, M; \qquad j=0, 1$$

Equations (4), (5), (6) and (7) describe full employment of the respective factors.

$$(4) \qquad a_{L0}X_0+a_{L1}X_1=L$$

$$(5) \qquad a_{K0}X_0+a_{K1}X_1=K$$

$$(6) \qquad a_{M0}X_0=M_0$$

$$(7) \qquad a_{M1}X_0=M_1\,.$$

It should be noted, however, that equations (6) and (7) do not state restrictions on imports of raw materials. In fact, they indicate that both sectors can, at the given world price p_M, import raw materials as much as they need to produce X_0 and X_1 respectively.

Finally equation (8) demonstrates the assumption that the investment good is nontradable. That is, the market price of the investment good must equal capitalized value of the average return of capital.

$$(8) \qquad p_0=R/r\,,$$

where r stands for the rate of interest. The small country implies that the rate of interest is given from abroad.

Now, there are thirteen equations and eighteen variables: a_{L0}, a_{Ko}, a_{M0}, a_{L1}, a_{K1}, a_{M1}, w, R, p_M, p_0, p_1, r, X_0, X_1, L, K, M_0, and M_1. However, L and K are given in the shortrun and p_M, p_1 and r are assumed constant from the assumption of the small country. Therefore, this system may be solvable.

2. THE MAGNIFICATION EFFECT

R. Jones (5) has investigated relationships between variations in commodity prices and in factor prices. Then, he has proved that the variations in factor prices yield upper and lower bounds to the variations in commodity prices. In this section we shall show that the magnification effect claimed by Jones also holds in our model.

Totally differentiating equations (1), (2) and (8), we have equations (9), which are arranged as a matrix expression:

$$(9) \qquad Aq=Bp\,,$$

where

$$A=\begin{bmatrix}\theta_{L0} & \theta_{K0} & -1\\ \theta_{L1} & \theta_{K1} & 0\\ 0 & 1 & -1\end{bmatrix},\quad B=\begin{bmatrix}-\theta_{M0} & 0 & 0\\ -\theta_{M1} & 1 & 0\\ 0 & 0 & 1\end{bmatrix},\quad q=\begin{bmatrix}\hat{w}\\ \hat{R}\\ \hat{p}_0\end{bmatrix},\ \text{and}\quad p=\begin{bmatrix}\hat{p}_M\\ \hat{p}_1\\ \hat{r}\end{bmatrix}.$$

In this matrix θ_{ij} denotes the distributive share of factor i engaged in production of commodity j ($i=L, K, M$; $j=0, 1$). The notation "$\wedge$" indicates a percentage change in variables, i. e. $\hat{x}=d\log x$. Define Δ as a determinant of the matrix A in equation (9). Then, $\Delta=-\{\theta_{L2}(1-\theta_{K0})+\theta_{K2}\theta_{L0}\}<0$. Premultiplying the inverse matrix A^{-1} by the both sides of equations (9), we can solve $\hat{w}$, $\hat{R}$, and $\hat{p}_0$ in terms of $\hat{p}_M$, $\hat{p}_1$ and $\hat{r}$, all of which are exogenous variables in our framework.
That is, $q=Cp$,
where

$$C=A^{-1}B=\frac{1}{\Delta}\begin{bmatrix}(1-\theta_{K0})(1-\theta_{L1})-\theta_{L0}\theta_{K1} & -(1-\theta_{K0}) & \theta_{K1}\\ \theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0} & -\theta_{L0} & -\theta_{L1}\\ \theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0} & -\theta_{L0} & \theta_{L0}\theta_{K1}-\theta_{L1}\theta_{K0}\end{bmatrix}.$$

In this section we only investigate the case where the price of the imported input is raised. Then, a rise in p_M displaces the equilibrium values of w, R and p_0 as follows:

$$\begin{bmatrix}\hat{w}\\ \hat{R}\\ \hat{p}_0\end{bmatrix}=\frac{1}{\Delta}\begin{bmatrix}(1-\theta_{K0})(1-\theta_{L1})-\theta_{L0}\theta_{K1}\\ \theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0}\\ \theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0}\end{bmatrix}\hat{p}_M. \tag{11}$$

Note that $(1-\theta_{K0})(1-\theta_{L1})-\theta_{L0}\theta_{K1}=\theta_{L0}\theta_{M1}+\theta_{M0}(\theta_{K1}+\theta_{M1})>0$, using $\theta_{Li}+\theta_{Ki}+\theta_{Mi}=1$ ($i=0, 1$). As $\Delta<0$ and $\hat{p}_M>0$, $\hat{w}<0$. It is evident from equation (11) that $\hat{R}=\hat{p}_0$. Moreover, we can show:

(1) $\hat{w}-\hat{p}_0=\theta_{M0}\hat{p}_M/\Delta<0$, that is $\hat{w}<\hat{p}_0$, and

(2) $\hat{p}_M-\hat{p}_0=-\theta_{L0}\{\theta_{K1}+(1-\theta_{K0})\}/\Delta>0$, that is, $\hat{p}_M>\hat{p}_0$.

While the sign of $\hat{p}_0$ or $\hat{R}$ depends upon the sign of $\theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0}$, the above manipulation clearly indicates that variations in the commodity prices, due to the rise in p_M, have the lower bound $\hat{w}$ and the upper bound $\hat{p}_M$. For example, suppose $\theta_{L0}\theta_{M1}-\theta_{L1}\theta_{M0}>0$. Then,

$$\hat{w}<\hat{p}_0=\hat{R}<\hat{p}_1=0<\hat{R}_M.$$

Repeating the similar procedure as above, we will easily show that the magnification effect holds[2].

3. VARIATION IN OUTPUTS AND THE RYBCZYNSKI THEOREM

This section attempts to analyze how domestic output levels will be displaced by exogenous disturbances. Totally differentiating equations (4), (5), (6) and (7), we may derive equations (12):

$$\text{(12)} \qquad \begin{bmatrix} \lambda_{L0} & \lambda_{L1} & 0 & 0 \\ \lambda_{K0} & \lambda_{K1} & 0 & 0 \\ 1 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 \end{bmatrix} \begin{bmatrix} \hat{X}_0 \\ \hat{X}_1 \\ \hat{M}_0 \\ \hat{M}_1 \end{bmatrix} = \begin{bmatrix} \hat{L}-(\lambda_{L0}\hat{a}_{L0}+\lambda_{L1}\hat{a}_{L1}) \\ \hat{K}-(\lambda_{K0}\hat{a}_{K0}+\lambda_{K1}\hat{a}_{K1}) \\ -\hat{a}_{M0} \\ -\hat{a}_{M1} \end{bmatrix}$$

where $\lambda_{L0}=L_0/L$, $\lambda_{K0}=K_0/K$ and so on. Define as D the matrix of the LHS of equations (12). Then the value of its determinant may be:

$$|D|=\lambda_{L0}\lambda_{K1}-\lambda_{K0}\lambda_{L1}\,.$$

In order to ask the validity of the Rybczynski theorem, fix the commodity prices. Then the factor prices are also settled. This implies from equation (3) $\hat{a}_{i0}=\hat{a}_{i1}=0$ $(i=L, K, M)$. Suppose that the endowment of labor be increased. Then, $\hat{L}>0$ and $\hat{K}=0$ in equation (12). Multiplying the inverse matrix D^{-1} from the LHS of equations (12), we may derive:

$$\text{(12')} \qquad \begin{bmatrix} \hat{X}_0 \\ \hat{X}_1 \\ \hat{M}_0 \\ \hat{M}_1 \end{bmatrix} = \frac{1}{|D|} \begin{bmatrix} \lambda_{K1} \\ -\lambda_{K0} \\ \lambda_{K1} \\ -\lambda_{K0} \end{bmatrix} \hat{L}\,.$$

Note that the sign of $|D|$ is the same as that of k_1-k_0. Assume $k_1>k_0$. Then, an increase in the labor endowment expands the production of the nontraded good sector which employs relatively labor intensive technology and reduces the production of the other sector which adopts relatively capital intensive technology. The essence of this argument does not change even for the reversed case of factor intensity ordering and for the case where the capital endowment increases. Therefore the Rybczynski theorem still holds in our framework. It should be noted that

$$\hat{X}_0/\hat{L}=\hat{M}_0/\hat{L} \qquad \text{and} \qquad \hat{X}_1/\hat{L}=\hat{M}_1/\hat{L}\,.$$

We may call them homogeneity property[3].

Totally differentiating equations (3) and defining the following elasticities: $E^w_{ij}=(w/a_{ij})(\partial a_{ij}/\partial w)$, $E^R_{ij}=(R/a_{ij})(\partial a_{ij}/\partial R)$ and $E^M_{ij}=(p_M/a_{ij})(\partial a_{ij}/\partial p_M)$, we may explicitly describe shortrun output responses due to factor price changes $(\hat{L}=\hat{K}=0)$:

(13) $$Dx = Ey\,,$$

where

$$x = \begin{bmatrix} \hat{X}_0 \\ \hat{X}_1 \\ \hat{M}_0 \\ \hat{M}_1 \end{bmatrix}, \quad E = -\begin{bmatrix} E_L^w & E_L^R & E_L^M \\ E_K^w & E_K^R & E_K^M \\ E_{M0}^w & E_{M0}^R & E_{M0}^M \\ E_{M1}^w & E_{M1}^R & E_{M1}^M \end{bmatrix}, \quad y = \begin{bmatrix} \hat{w} \\ \hat{R} \\ \hat{p}_M \end{bmatrix}, \quad \text{and}$$

$$E_i^j = \lambda_{i0} E_{i0}^j + \lambda_{i1} E_{i1}^j \qquad (i = L, K, M;\ j = 0, 1)\,.$$

Since a_{ij}s are of homogeneity of order zero in labor, capital and the imported input, $E_{ij}^w + E_{ij}^R + E_{ij}^M = 0$ $(i = L, K, M;\ j = 0, 1)$. Then, it is also implied that $E_L^w + E_L^R + E_L^M = 0$ and $E_K^w + E_K^R + E_K^M = 0$. Now, following Jones (6), we assume substitutability among factors, that is to say,

$$E_{L0}^w < 0\,, \quad E_{K0}^w > 0\,, \quad E_{M0}^w > 0\,, \quad \text{etc.}$$

Substituting equations (9) and (10) into (13) and using the relationships among elasticities, we may express output variations in terms of only exogenous variables;

(14) $$Dx = Fz\,,$$

where

$$F = -\begin{bmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \\ d_1 & d_2 & d_3 \end{bmatrix}, \quad z = \begin{bmatrix} \hat{p}_M \\ \hat{p}_1 \\ \hat{r} \end{bmatrix}, \quad a_1 = \left\{(1-\theta_{K0})\, E_L^w + \theta_{L0} E_L^R\right\} \Big/ \Delta\,,$$

$$a_2 = -a_1\,, \quad a_3 = (\theta_{K1} E_L^w - \theta_{L1} E_L^R)/\Delta > 0\,, \quad b_1 = \left\{(1-\theta_{K0})\, E_K^w + \theta_{L0} E_K^R\right\} \Big/ \Delta\,,$$

$$b_2 = -b_1\,, \quad b_3 = (\theta_{K1} E_K^w - \theta_{L1} E_K^R)/\Delta < 0\,, \quad c_1 = \left\{(1-\theta_{K0})\, E_{M0}^w + \theta_{L0} E_{M0}^R\right\} \Big/ \Delta < 0\,,$$

$$c_2 = -c_1\,, \quad c_3 = (\theta_{K2} E_{M0}^w - \theta_{L2} E_{M0}^R)/\Delta\,, \quad d_1 = \left\{(1-\theta_{K0})\, E_{M1}^w + \theta_{L0} E_{M1}^R\right\} \Big/ \Delta < 0\,,$$

$$d_2 = -d_1\,, \quad d_3 = (\theta_{L1} E_{M1}^w - \theta_{L1} E_{M1}^R)/\Delta\,.$$

4. SOME RESULTS OF COMPARATIVE STATISTICS

Using equations (14), we can investigate the following effects on domestic outputs and on imports of raw materials, due to (1) a rise in the price of the imported input, (2) an increase in price of the exported good, and (3) a change in the world interest rate.

(1) a rise in the price of the imported input

Setting $\hat{p}_1 = \hat{r} = 0$ in equation (14), we shall compute the following:

(15) $\hat{X}_0/\hat{p}_M = D_1/|D| = (b_1\lambda_{L1} - a_1\lambda_{K1})/|D|$

(16) $\hat{X}_1/\hat{p}_M = D_2/|D| = (a_1\lambda_{KO} - b_1\lambda_{L0})/|D|$

(17) $\hat{M}_0/\hat{p}_M = c_1 + \hat{X}_0/\hat{p}_M$

(18) $\hat{M}_1/\hat{p}_M = d_1 + \hat{X}_1/\hat{p}_M\,.$

Generally speaking, we do not a priori know the signs of $\hat{X}_0/\hat{p}_M$ and $\hat{x}_1/\hat{p}_M$. However, suppose that production functions are of Cobb-Douglas type. Then, $0 = E^M_{K0} < E^M_{L0}$ and $E^M_{K1} < E^M_{L1}$[4]. Now using the relation $E^w_L + E^R_L + E^M_L = 0$, we can arrange D_1 as follows:

$$D_1 = \left\{\theta_{M0}(\lambda_{L1}E^w_K - \lambda_{K1}E^w_L) + \theta_{L0}(\lambda_{K1}E^M_L - \lambda_{L1}E^M_K)\right\}\Big/\Delta\,.$$

Note that $\lambda_{L1}E^w_K - \lambda_{K1}E^w_L > 0$. The second argument in the bracketed term can be written as follows:

$$\lambda_{K1}E^M_L - \lambda_{L1}E^M_K = \lambda_{K1}\lambda_{L0}E^M_{L0} + \lambda_{K1}\lambda_{L1}(E^M_{L1} - E^M_{K1}) > 0\,.$$

The sign of D_1 unambiguously is positive. Therefore, regardless of technological combinations between the imported input and the other factors, it is the capital-labor ratios that determine the effect of the rise in p_M on the production of the nontraded good. For example, if $k_1 > k_0$, a rise in the price of the imported good always increases the production of the nontraded good and vice versa.

As for the effect on the production of the exported good, D_2 can be arranged as follows:

$$D_2 = \left\{\theta_{M0}(\lambda_{K0}E^w_L - \lambda_{K1}\lambda E^w_K) + \theta_{L0}(\lambda_{L0}E^M_K - \lambda_{K0}E^M_L)\right\}\Big/\Delta\,.$$

A substitutability requirement among factors implies that $\lambda_{K0}E^w_L - \lambda_{L0}E^w_K < 0$. If the production functions are of the Cobb-Douglas type, then the similar argument as above will show:

$$\begin{aligned} D'_2 &= \lambda_{L0}E^M_K - \lambda_{K0}E^M_L = \lambda_{L0}\lambda_{K0}(E^M_{K0} - E^M_{L0}) + (\lambda_{L0}\lambda_{K1}E^M_{K1} - \lambda_{K0}\lambda_{L1}E^M_{L1}) \\ &= -\lambda_{L0}\hat{R}/\hat{p}_M + \lambda_{K0}\hat{w}/\hat{p}_M\,. \end{aligned}$$

When $\theta_{L0}\theta_{M1} < \theta_{L1}\theta_{M0}$, then $\hat{R}/\hat{p}_M > 0 > \hat{w}/\hat{p}_M$. In this case D_2 can take dicisively a positive sign. However, if $\theta_{L0}\theta_{M1} > \theta_{L1}\theta_{M0}$, that is to say, $0 > \hat{R}/\hat{p}_M > \hat{w}/\hat{p}_M$, then D'_2 has an ambiguous sign. D'_2 may take a negative sign for $k_0 > k_1$[5]. So $|D| < 0$. That is, in this particular case, $\hat{X}_1/\hat{p}_M > 0$.

The above argument has illustrated that the rise in the price of the imported input asymmetrically affects productions of domestic sectors. With regard to the nontraded good sector, the relative sizes of the capital-labor ratios are of importance in deciding that influence. On the other hand, generally speaking, the effect on the production of the exported good sector, due to the rise in p_M, crucially rests on technological combinations among the three factors.

(2) an increase in the price of the exported good.

Referring to equations (14), we can obtain expected, but rather strong results. A rise in the price of the exported good exerts an effect on domestic productions in the opposite way as in the case where the price of the imported input is raised. Attention should be paid to the fact that they have exactly opposite influences on domestic activities. That is to say,

$$\hat{X}_i/\hat{p}_1 = -\hat{X}_i/\hat{p}_M \quad \text{and} \quad \hat{M}_i/\hat{p}_1 = -\hat{M}_i/\hat{p}_M \qquad (i=0, 1) .$$

The importance of these results is that they are derived without imposing any restrictions on the state of technology of production. The reason on these strong results seems to rest on the fact that impacts of a rise in p_1 on the wage-rental ratio, the real wages and real rental on capital in terms of the nontraded good are just opposite to those of a rise in p_M. Recall the relationships in equations (9) and (10). Then, we can easily derive:

$$(\widehat{w/R})/\hat{p}_1 = -(\widehat{w/R})/\hat{p}_M , \quad (\widehat{w/p_0})/\hat{p}_1 = -(\widehat{w/p_0})/\hat{p}_M \qquad \text{and}$$
$$(\widehat{R/p_0})/\hat{p}_1 = -(\widehat{R/p_0})/\hat{p}_M .$$

Therefore, the pattern of allocation of factors would not be much influenced by either change in p_1 or p_M.

(3) a change in the world interest rate

Setting $\hat{p}_M = \hat{p}_1 = 0$ in equation (14), we may obtain:

$$\hat{X}_0/\hat{r} = E_1/|D| , \quad \hat{X}_1/\hat{r} = E_2/|D| , \quad \hat{M}_0/\hat{r} = E_3/|D| , \quad \hat{M}_1/\hat{r} = E_4/|D| ,$$

where

$$E_1 = b_3\lambda_{L1} - a_3\lambda_{K1} < 0 , \quad E_2 = a_3\lambda_{K0} - b_3\lambda_{L0} > 0 ,$$
$$E_3 = E_1 + (\lambda_{K1}\lambda_{L0} - \lambda_{L1}\lambda_{K0})\, c_3 \quad \text{and} \quad E_4 = E_2 + (\lambda_{L0}\lambda_{K1} - \lambda_{L1}\lambda_{K0})\, d_3 .$$

A rise in r decreases (increases) the production of the nontraded good for $k_1 > k_0$ ($k_1 < k_0$)[6]. It should be noted that even though there is no restriction on imports of raw materials the production of both sectors cannot simultaneously be increased or decreased. The small country seems to behave as if she moves along on the convex production frontier.

If we assume that the production functions are of the Cobb-Douglas type, it will easily be seen that $E^w_{M0} = \theta_{L0}$, $E^R_{M0} = \theta_{K0}$, $E^w_{M1} = \theta_{L1}$ and $E^R_{M1} = \theta_{K1}$. Therefore, in these case $E_3 < 0$ and $E_4 = E_2 > 0$. It should be noted that the import of raw materials in the nontraded good sector due to the rise in r, decreases more than the declining rate in the production of the investment good. The reason for this may be due to the assumption of the investment good being nontraded. The rise in r has a tendency to decrease the price of the nontraded good ($\hat{p}_0=\hat{R}-\hat{r}$) and the imported input becomes relatively expensive there even if its price remains the same.

5. ON LONG-RUN CAPITAL MOVEMENTS

We have enough information on the supply of securities, which amounts to the production of the investment good. In order to shed light on the demand side of securities issued by the small country, we could separate it into (1) domestic demand and (2) foreign demand[7]. Then it is well-known that the difference between the domestic supply of securities and the domestic demand for securities may represent the surplus or deficit in the current account and the amount of securities owned by foreigners is equivalent to the capital account[8]. Therefore, assuming that the balance of payments be in balance, long-run capital movements can be described solely by the foreign demand for securities, whose amount can be calculated by the difference between the amount of the nontraded good produced and the amount of securities demanded domestically. However, as G. H. Borts (3, footnote 3) assumed, we shall only concentrate on how an exogenous variation would affect the production of the investment good and cause long-run capital movements. Suppose, for convenience, that $k_1>k_0$. Then, a rise in the price of the imported input always reduces the production of the investment good and so does international borrowing. On the other hand, a rise in the price of the exported good always stimulates the production of the investment good and international borrowing. Finally, an increase in the world interest rate contracts the production of the investment good and reduces international borrowing as well.

NOTES

1) It is well-established in the case of two tradable goods that the effective rate of protection is not a proper index for speculating on the way of allocation of factors. See R. Jones (6), A. H. H. Tan (11) and V. K. Ramaswami and T. N. Srinivasan (9).

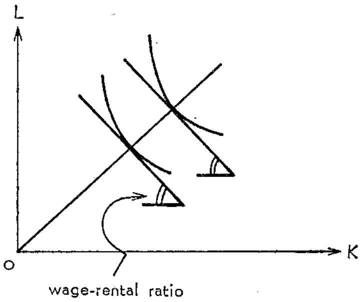
2) Interested readers should refer to Jones (5, pp. pp. 561–562) for the validity of the magnification effect. In this footnote, let us touch upon other cases. Suppose that the price of the exported good rises. Then, using equations (9) and (10) with setting $\hat{p}_M=\hat{r}=0$, we shall have the following ordering: $\hat{w}>\hat{p}_1>\hat{p}_0>\hat{R}>\hat{p}_M=0$. On the other hand, consider a rise in the world interest rate. Then,

$$\hat{R}>\hat{p}_0>\hat{p}_1=\hat{p}_M=0>\hat{w} \quad \text{for} \quad \theta_{L0}\theta_{K1}-\theta_{L1}\theta_{K0}<0, \text{ and}$$

$$\hat{R}>\hat{p}_1=\hat{p}_M=0>\hat{p}_0>\hat{w} \quad \text{for} \quad \theta_{L0}\theta_{K1}-\theta_{L1}\theta_{K0}>0.$$

Essentially our results generalized the Jones' magnification effect in the sense that changes in two of the three factor prices limit both the ceiling and the floor to changes in commodity prices.

3) In the two-factor case, the production expansion path without altering the wage-rental ratio should be the path through the origin. This implies that an increase in production of a certain good due to a change in factor endowment, for instance, is induced by proportional increases in factors of production. Our result shows that the above argument in the two-factor case will be extended to the three-factor case, too.



4) Note that in the Cobb-Douglas type production function distributive shares $\theta_{ij}s$ $=$constant. Then, $E^M_{L0}-E^M_{K0}=\hat{a}_{L0}/\hat{p}_M-\hat{a}_{K0}/\hat{p}_M$. Now, since $a_{L0}=\theta_{L0}p_0/w$ and $a_{K0}=\theta_{K0}p_0/R$, $\hat{a}_{L0}=\hat{p}_0-\hat{w}$ and $\hat{a}_{K0}=\hat{p}_0-\hat{R}=0$. Referring to the discussions developed in section 2, $E^M_{L0}-E^M_{K0}=(\widehat{p_0/w})/\hat{p}_M>0$. On the other hand, $\theta_{L1}=\theta_{L1}p_1/w$ and $a_{K1}=\theta_{K1}p_1/R$. Then $\hat{a}_{L1}=-\hat{w}$ and $\hat{a}_{K1}=-\hat{R}$. Therefore,

$$E^M_{L1}-E^M_{K1}=(\widehat{R/w})/\hat{p}_M>0\,.$$

5) As seen later, for $k_0>k_1$ a rise in the interest rate increases the production of the investment good. This suggests that, when we take into account the stability conditions of the system, we should impose the factor intensity ordering of $k_1>k_0$. Refer to Borts (3).

6) If we explicitly take into account the demand side for securities consisting of native residents and foreigners, the order of factor intensity $k_1>k_0$ would be, as usual in the closed economic growth model, one of sufficient conditions for stability in the securities market. However, this paper does not look into the demand side of securities in detail.

7) In order to avoid any complexity, we implicitly assume that both securities issued domestically and abroad are identical. Then, we may also consider the case where residents in the small country possess foreign securities, but we omit analyzing this case.

8) See B. B. Aghevli and G. H. Borts (1).

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