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THE RICARDO-VINER TRADE MODEL WITH AN INTERMEDIATE GOOD

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Abstract

This paper incorporates an intermediate good into the Ricardo-Viner trade model. One of the sector-specific factors in the Ricardo-Viner model is replaced with a sector-specific intermediate good. We are primarily concerned with comparisons between the results of our model and those of the Ricardo-Viner model. Most of the basic results of the Ricardo-Viner model are drastically changed in our model. Furthermore, this paper studies various trade patterns created by the presence of the intermediate good and the effects on an economy of a distortion-induced inflow of a factor.

Key words: Ricardo-Viner model; Specific factors model; Heckscher-Ohlin-Samuelson model; Intermediate good
JEL classification: F11, F20

I. *Introduction*

After its rigorous development by Jones (1971) and Samuelson (1971), the Ricardo-Viner (RV) model, or, the specific factors model became one of the basic frameworks in the theory of international trade.[1] In the RV model, a general factor, which is usually referred to as labor, has diminishing returns in each use due to the presence of sector-specific factors, which are usually regarded as capital and/or land. The diminishing returns make the RV model distinct from the Ricardian model, while the specificity of factors makes the model distinct from the Heckscher-Ohlin-Samuelson (HOS) model. It is well known that the RV model provides an interesting contrast to the results of both the Ricardian and HOS models.

On one hand, the RV model can be interpreted as being a short-run version of the HOS model in the sense that specific factors are not mobile between sectors only in the short-run. For example, the specific factors are different kinds of capital and hence they can gradually move between sectors in response to intersectoral differences in rentals. On the other hand, the

[1] For subsequent work, see Jones and Neary (1984).

specific factors can be thought of physically distinct factors such as capital, land and resources. In this case, these factors continue to be sector-specific even in the long-run.

This paper adopts the latter interpretation and extends the basic RV model (the 2 good and 3 factor framework) considerably by replacing one of the sector-specific factors with a sector-specific intermediate good. This is of interest because the existence of intermediate goods has been one of the most important issues in the theory of international trade. We are primarily concerned with a contrast between the results of our model and those of the RV model. By introducing the sector-specific intermediate good, most of the basic results of the RV model are drastically changed. For instance, the factor price equalization, which does not hold in the RV model, revives in our model.

The present study has two primary factors, two final goods, and one intermediate good. One of the factors is sector-specific and the other is general. The intermediate good is also specific to the sector where the specific factor is not used.[2] Specifically, the intermediate good is produced with the general factor alone. For example, we can interpret the general factor as labor, the specific factor as land, and the intermediate good as capital or producer services, in which case the model could be used to analyze production and trade of food and manufacturers.

The structure of the remainder of this paper is as follows. Section 2 provides the basic model. Section 3 considers several basic relationships before analyzing international trade: the relationships between commodity prices and factor prices, between commodity prices and outputs, between factor endowments and factor prices, between factor endowments and outputs, and between technology progress and factor prices. In section 4, using the relationships obtained in section 3, we study international trade. We first analyze trade in final goods alone and then trade in the intermediate good along with trade in the final goods. Trade in the intermediate good and one of the final goods is also examined. Section 5 studies the effect on a small open economy (SOE) of a restricted inflow of a primary factor. This is of interest because this analysis has widely been done in the RV model (see Brecher and Findlay (1983) and Srinivasan (1983)) as well as in the HOS model (see, for example, Brecher and Diaz Alejandro (1977)). Following the previous work, we allow a factor inflow with distortion, a production tax/subsidy. Section 6 concludes the paper.

II. *The Basic Model*

We consider a three-sector (sectors 1, 2 and 3), two-primary-factor (factors 1 and 2) framework. Sectors 1 and 2, respectively, produce final goods, good 1 and good 2, while sector 3 produces an intermediate good, good 3. Factor 1 is specific to sector 1, while factor 2 is a general factor and freely moves across sectors. The production function of each good is given by

$$
\begin{aligned}
X_1 &= \delta_1 F^1(V_1, V_2^1) \\
X_2 &= \delta_2 F^2(X_3, V_2^2) \\
X_3 &= \delta_3 V_2^3
\end{aligned}
\tag{1}
$$

[2] If both sectors use a general factor and a sector-specific intermediate good produced using the general factor, then the model will be reduced to the Ricardian model.

where X_i, V_1, V_2^i, and δ_i ($i=1, 2, 3$) are, respectively, the output of sector i, the endowment of factor 1, the amount of factor 2 employed by sector i, and the productivity parameter in sector i. Good 1 is produced using factors 1 and 2, while good 2 is produced using factor 2 and the intermediate good. $F^i(\cdot)$ ($i=1, 2$) is increasing, strictly quasi-concave, positively linear homogeneous, and twice continuously differentiable. Good 3 servers only as an input to produce good 2. Good 3 is produced using factor 1 alone with constant returns to scale (CRS) technology.[3] Full employment and perfect competition are assumed.

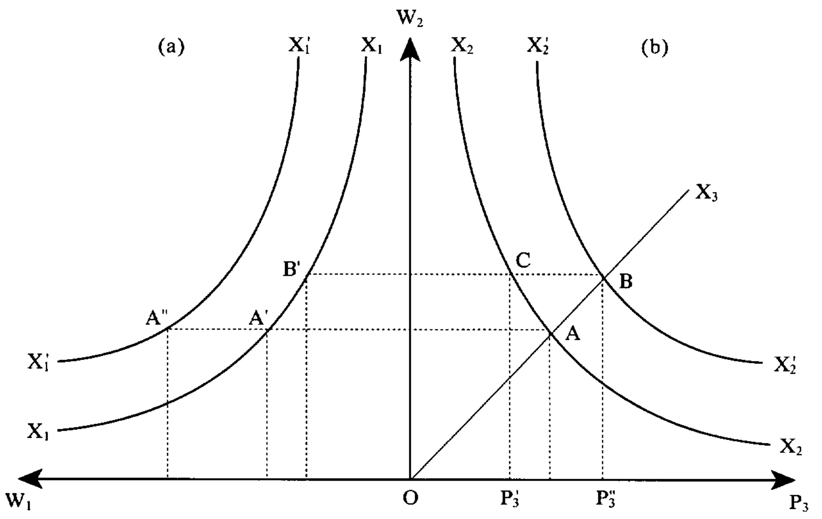
In the following analysis, however, we mainly use the dual unit cost functions. Letting good 1 be numeraire, the unit cost functions of goods 1, 2 and 3 are, respectively, given by

$$C_1=\frac{1}{\delta_1}C^1(W_1, W_2)$$
$$C_2=\frac{1}{\delta_2}C^2(P_3, W_2)$$
$$C_3=\frac{1}{\delta_3}W_2$$

where P_3 and W_j ($j=1, 2$) are the price of good 3 and the price of factor j ($j=1,2$) in terms of good 1. With perfect competition, we have

$$\frac{1}{\delta_1}C^1(W_1, W_2)=1 \tag{2}$$
$$\frac{1}{\delta_2}C^2(P_3, W_2)\geq P_2 \tag{3}$$
$$\frac{1}{\delta_3}W_2\geq P_3 \tag{4}$$

FIG. 1. FACTOR PICES AND PRICE OF GOOD 3



[3] Ishikawa (1992), for example, assumes a similar technology in production of producer services.

where P_2 is the price of good 2 and where equality holds if $X_i>0$ (i=2, 3). In figure 1, X_1X_1, X_2X_2 and OX_3, respectively, show equations (2), (3) and (4).

With the aid of figure 1, we see how the factor prices, the price of good 3, and factor allocation are determined with given prices of final goods. We examine the following two cases. First, suppose that equation (4) intersects the unit cost curve of good 2 at point A in figure 1 (b). Then W_2 and P_3 are determined at A and thus W_1 is also determined by the unit cost curve of good 1 in figure 1 (a) (point A'). That is, with given prices of final goods, equations (3) and (4) determine the prices of factor 2 and good 3. Then equation (2) gives the price of factor 1. Applying the implicit function theorem and Shephard's lemma to the unit cost functions, we have

$$\frac{dW_2}{dW_1}=-\frac{\partial C^1}{\partial W_1}\Big/\frac{\partial C^1}{\partial W_2}=-\frac{V_1}{V_2^1}$$

$$\frac{dW_2}{dP_3}=-\frac{\partial C^2}{\partial P_3}\Big/\frac{\partial C^2}{\partial W_2}=-\frac{X_3}{V_2^2}$$

That is, the slope of the isocost line tangent to the unit cost curve of good 1 at A' is equal to V_1 / V_2^1 and the slope of the isocost line tangent to the unit cost curve of good 2 at A is equal to X_3 / V_2^2. Taking account of the full employment condition for factor 2 and equation (1), the allocation of factor 2 is uniquely determined (though this is not shown in the diagram). We should note that the slope of the unit cost curve of goods i (i=1, 2) becomes steeper as the price of factor 2 rises, because the unit cost function of good i is strictly quasi-concave.

Second, suppose that the slope of the isocost line tangent to the unit cost curve of good 1 at A' is equal to the economy's factor endowment ratio, V_2 / V_1 (where V_2 is the endowment of factor 2), that is, all of factor 2 is allocated to sector 1. Then point A' gives the maximum price of factor 1 and the minimum price of factor 2. Inequality holds in (3) and (4). Thus, if equation (4) intersects the unit cost curve of good 2 at A or to the right of A, then the economy completely specializes in good 1 at point A'. In this case, the prices of factors 1 and 2 are determined by equation (2) and

$$\frac{dW_2}{dW_1}=-\frac{\partial C^1}{\partial W_1}\Big/\frac{\partial C^1}{\partial W_2}=-\frac{V_1}{V_2}$$

III. *The Basic Relationships*

On the basis of the model in the previous section, this section deals with several basic relationships that are useful for the following analysis. In this section, we assume that the economy is diversified before and after an exogenous change in a variable or a parameter.[4]

1. Commodity prices, factor prices, and outputs

It is known that in the RV model that an increase in the relative price of a final good is beneficial to the specific factor used in that sector, is harmful to the other specific factor, and

[4] A decrease in the price of good 2 or an increase in the endowment of factor 1 could lead the economy to completely specialize in good 1.

has an ambiguous effect on the general factor. In particular, the last result is known as the neoclassical ambiguity. The owner of the general factor (factor 2 in our model) may be made better off or worse off depending on his/her preferences for the final goods.

In our model, however, the above results are drastically changed. In particular, the neoclassical ambiguity disappears in our model. Suppose that the price of good 2 increases. Then the unit cost curve of good 2 shifts outward. By supposing that the unit cost curve of good 2 (X_2X_2) shifts to $X_2'X_2'$, the rate of change in the price of good 2 is given by AB/OA in figure 1. Since equation (4) must always hold under diversification, the new equilibrium is given by point B. Thus, we have

$$\hat{W}_2 = \hat{P}_3 = \hat{P}_2 > 0 = \hat{P}_1 > \hat{W}_1$$

where a "hat" represents a rate of change. The price of factor 1 falls in terms of both final goods, while the price of factor 2 does not change in terms of good 2 but rises in terms of good 1.

In the RV model, an increase in the relative price of a final good raises its output. We also have a similar result. When the relative price of good 2 increases, the factor ratio adopted in sector 1, V_1 / V_2^1, rises, while the input ratio in sector 2, X_3 / V_2^2, does not change. With fixed endowment of factor 1, this implies that the factor 2 is reallocated out of sector 1 into sectors 2 and 3. Thus, the output of good 1 decreases, while the output of good 2 increases. We thus have the following proposition:

Proposition 1. An increase in the relative price of good 2 is harmful to the specific factor (factor 1), is not harmful to the general factor (factor 2), increases the output of good 2, and decreases the output of good 1.

2. Endowments, factor prices, and outputs

With respect to the relationship between endowment changes and factor prices, it is known in the RV model that at constant commodity prices (i) any increase in the endowment of a specific factor raises the price of the general factor but lowers the prices of both specific factors and (ii) an increase in the endowment of the general factor lowers the price of the general factor but raises the price of both specific factors. These results are also drastically changed in our model.

We should note that the unit cost functions are not affected at all by any change in factor endowments. Thus, as long as the economy is diversified and the prices of final goods do not alter with a change in factor endowments, factor prices are still determined at A and A'. Thus, we have the following proposition:

Proposition 2. At constant prices of final goods, any increase in factor endowments does not alter factor prices at all.

With respect to the relationship between endowment changes and outputs, it is known in the RV model that at constant commodity prices (i) an increase in the endowment of one specific factor increases the output of the good which uses that factor and decreases the output of the other sector and (ii) an increase in the endowment of the general factor increases both outputs. Our model obtains a similar result with respect to changes in the supply of the specific factor, while a different result is obtained with respect to changes in the supply of the general factor.

First, suppose that we increase the endowment of the specific factor, factor 1. Since factor prices are not affected, the factor ratio adopted in sector 1 is also not affected. Thus in order to keep the same factor ratio in sector 1, factor 2 must be reallocated out of the sectors 2 and 3 into sector 1. Thus, the output of good 1 increases, while the output of good 2 decreases. Noting that the factor ratio in sector 1 and the input ratio in sector 2 do not alter and that all production is subject to CRS, we can obtain the following relationship:

$$\hat{X}_1 = \hat{V}_1 > 0 > \hat{X}_2 = \hat{X}_3$$

Second, suppose that we increase the endowment of the general factor, factor 2. Again noting that the factor ratio adopted in sector 1 and the input ratio in sector 2 do not change, it is obvious that all of the increased factor 2 is absorbed by sectors 2 and 3. Thus, the output of good 1 does not change, while the output of good 2 rises. Since all production is subject to CRS, we can obtain the following relationship:

$$\hat{X}_2 = \hat{X}_3 > \hat{V}_2 > 0 = \hat{X}_1$$

No changes in the factor ratio of sector 1 and in the input ratio of sector 2 and CRS in production also imply that if the endowments of both factors increase in the same proportion, the outputs of both final goods also increase in the same proportion. That is,

$$\hat{X}_1 = \hat{X}_2 = \hat{X}_3 = \hat{V}_1 = \hat{V}_2$$

We thus have the following proposition:

Proposition 3. An increase in the endowment of the specific factor (factor 1) increases the output of good 1 and decrease the output of good 2, while an increase in the endowment of the general factor (factor 2) increases the output of good 2 without any change in the output of good 1. If the endowments of both factors increase in the same proportion, the outputs of both final goods also increase in the same proportion.

3. Technology progress and factor prices

In this subsection, we consider the relationship between technology progress of each sector and factor prices with given prices of final goods. For simplicity, we focus on the Hicks neutral technology progress that increases δ_i in the production function of sector i. The Hicks neutral technology progress in sector i (i=1, 2) shifts the unit cost curve of sector i outward. In the RV model, the Hicks neutral technology progress in sector i (i=1, 2) increases the prices of the specific factor used in that sector and of the general factor and decreases the price of the other specific factor.

With respect to the Hicks neutral technology progress in sector 2, we obtain a similar result, while the Hicks neutral technology progress in sector 1 leads to a different result. Suppose that the unit cost curve of sector 2 (X_2X_2) shifts to $X_2'X_2'$ in figure 1 by the technology progress. Then the new factor prices are determined at B and B'. Thus, the price of the general factor rises, while the price of the specific factor falls. Next suppose that the unit cost curve of sector 1 (X_1X_1) shifts to $X_1'X_1'$ in figure 1 by the technology progress in sector

1. In this case, factor prices are determined at A and A". Thus, the price of the general factor is not affected, while the price of the specific factor increases. The technology progress in sector 3 makes the slope of OX_3 in figure 1 steeper. With the technology progress in sector 3, thus, the price of the general factor rises, while the price of the specific factor falls. We thus have the following proposition.

Proposition 4. *The Hicks neutral technology progress in sector 1 raises the price of the specific factor without any change in the price of the general factor. The Hicks neutral technology progress in sector 2 or the technology progress in sector 3 raises the price of the general factor and lowers the price of the specific factor.*

IV. *International Trade*

In this section, assuming that economies have the identical technology and the identical homothetic tastes, we study international trade. We start with trade in final goods. If the economies are diversified, factor price equalization is immediate from Proposition 2. If one of the economies completely specializes in good 1, we can conclude from the analysis in the last paragraph of section 2 that this economy has a lower price of factor 1 and a higher price of factor 2 than the other diversified economies.

Proposition 5. *With free trade in final goods, the equalization of prices in final goods equalizes factor prices among diversified economies. The economies that completely specialize in good 1 have lower prices of factor 1 and higher prices of factor 2 than the other diversified economies.*

In the RV model, trade patterns cannot be predicted from a knowledge of factor endowments alone. In our model, however, we can infer trade patterns between two economies from a knowledge of factor endowments. With free trade in final goods, the relative price of a final good is equalized and hence with a homothetic utility function, the demand ratio of final goods is also equalized. From Proposition 3, the output ratio of final goods, X_2 / X_1, is less in the economy that is endowed with relatively more factor 1 than in the other economy. Noting that with free trade in final goods, the size of the demand ratio, D_2 / D_1, (where D_i is the demand for good i) must be between the sizes of two-economy's output ratios of final goods, X_2 / X_1, we can conclude that the economy, in which D_2 / D_1 is greater than X_2 / X_1, exports good 1 and imports good 2. Also recalling that the proportional increases in the endowments of both factors result in the proportional increases in the outputs of both final goods, we can conclude that there is no trade between economies with the same factor endowment ratios. We thus have the following proposition:

Proposition 6. *The economy which is relatively more endowed with factor 1 than factor 2 exports good 1 and imports good 2 with free trade in final goods. There is no trade between the economies that have the same factor endowment ratios.*

Thanks to the presence of the intermediate good, we can think of not only trade in final goods but also other trade patterns. It is interesting to examine trade in a final good and the intermediate good. With free trade in goods 1 and 3, the economy, whose autarky price of good 3 is lower, exports good 3 and imports good 1 and in equilibrium the prices of goods 1 and 3 are equalized between the economies. Proposition 6 implies that the autarky price of good 2 (in terms of good 1) and hence the autarky price of good 3 (in terms of good 1) are lower in the economy that is relatively more endowed with factor 2 than in the other economy. Thus, the economy which is relatively more endowed with factor 2 has a comparative advantage in good 3 relative to good 1. We should note that once the price of good 3 is determined, the price of factor 2 is determined from equation (4) and hence the price of good 2 and factor prices are also equalized under free trade in goods 1 and 3.

It should be pointed out that free trade in goods 1 and 3 produces the same equilibrium that free trade in final goods does. The identical and homothetic preferences, the identical CRS technology, and factor price equalization imply that the two economies which engage in free trade in goods 1 and 3 can be regarded as an integrated world economy. Since factor price equalization holds with free trade in final goods as well, the two economies which engage in free trade in final goods can also be regarded as an integrated world economy. Those integrated world economies must be identical. The demand ratio of final goods, D_2 / D_1, is a decreasing function of the price of good 2 (in terms of good 1) and does not depend on income. The output ratio of final goods in the integrated world economy, X_2 / X_1, is an increasing function of the price of good 2 (recall Proposition 1). Thus, only one price of good 2 clears the integrated world market. Thus, the prices of goods and factors with free trade in goods 1 and 3 are equal to those with free trade in goods 1 and 2.

Proposition 7. With free trade in good 1 and the intermediate good, good 3, the economy that is relatively more endowed with factor 1 than factor 2 has a comparative advantage in good 1 relative to good 3. Free trade in goods 1 and 3 and free trade in final goods, goods 1 and 2, are substitutes.

It is noteworthy that even if the prices of good 2 in terms of good 1 are different between diversified economies, the prices of good 2 in terms of good 3 are always equalized. Thus, no trade in goods 2 and 3 takes place.

Next, assuming that the economy is a SOE, we consider the effects on the economy of commencement of trade in the intermediate good along with trade in final goods. A SOE implies that the prices of traded goods are exogenously given to the economy. It should be noted that with free trade in final goods, the price of the intermediate good is equalized as well. Thus, there is no incentive to trade the intermediate good with free trade in final goods. However, once we introduce some distortion such as a tax/subsidy or some differences in technology into the framework, the domestic price of the intermediate good could be different from the world one. Suppose that with trade in final goods, the domestic price of the intermediate good is higher than the world one. In figure 1, we suppose that the economy is located at A (A') with trade in final goods and that the world price of good 3 is given by P_3^1. Then commencement of trade in good 3 leads economy to shift from A (A') to C (C') in figure 1 and to import good 3. The price of factor 1 decreases, while the price of factor 2 increases. At C, inequality holds in (4) and hence there is no production of good 3. All of good 3 used in the economy is imported and thus there is no allocation of factor 2 to sector 3. The amount of import of good 3 can be determined by the slope of the isocost line tangent to the unit cost curve of good 2 at C. The production of good 1 decreases because the allocation of factor 2 at B' is less than that at A'.

Second, suppose that the domestic price of the intermediate good is lower than the world one. In figure 1, we suppose that the economy is located at A (A') with trade in final goods and that the world price of good 3 is given by P_3''. We should note that the equilibrium price of good 3 must satisfy equation (4) as long as good 3 is produced. Since the domestic price of good 3 becomes equal to the world one, commencement of trade in good 3 leads the economy from A (A') to B (B'). At B, inequality holds in (3). The economy exports good 3 and does not produce good 2 at all. The price of factor 1 decreases, while the price of factor 2 increases. It is worthwhile noting that in both cases, the price of factor 2 rises, the price of factor 1 falls and the output of good 1 falls.

It can be shown that an increase in the price of factor 2 at constant prices of final goods improves economic welfare. At constant prices of final goods, we can measure economic welfare by GNP. GNP in terms of good 1, G, is given by

$$G(W_2)=W_1(W_2)V_1+W_2V_2$$

Noting equation (2), G can be written as a function of the price of factor 2. Differentiating this equation with respect to W_2, we have

$$\frac{dG}{dW_2}=-V_2^1+V_2\geq 0$$

which implies that with diversification, GNP increases as the price of factor 2 rises. We thus have the following propositions:

Proposition 8. If a SOE commences free trade in the intermediate good along with trade in final goods, the price of the general factor (factor 2) rises, the price of the specific factor (factor 1) falls, and economy's welfare improves.

Proposition 9. If the domestic price of the intermediate good is higher than the world one with trade in final goods, the opening of free trade in the intermediate good leads a SOE not to produce the intermediate good. If the domestic price of the intermediate good is lower than the world one, the opening of free trade in the intermediate good leads a SOE not to produce good 2. In both cases, the output of good 1 decreases.

The following point should be remarked. If a domestic distortion results in a difference between the domestic price of the intermediate good and the world one, then that distortion may be eliminated by the opening of free trade in the intermediate good. For example, suppose that the domestic price of the intermediate good is higher than the world one because of a production tax on sector 3. In this case, commencement of free trade in the intermediate good leads the economy not to produce the intermediate good. Thus, the distortion disappears and the economic welfare improves to the level of free trade without any distortion. Similarly, if a distortion in sector 2 such as a production tax on sector 2 makes the domestic price of the intermediate good lower than the world one, commencement of free trade in the intermediate good results in no production of good 2 and hence eliminates the distortion.

V. *Factor Inflows*

In this section, we analyze the effects on a diversified SOE of a restricted factor inflow with trade in final goods. Again, recall that the factor prices are equalized with free trade in final goods. In this section, thus, we specifically introduce a production tax or subsidy in sector 2 to make a difference between the domestic factor price and the world one.[5] We assume that the foreign factor receives the same return as the domestic factor and that all return to the foreign factor is repatriated.

First, we consider an inflow of factor 1. Suppose that the SOE imposes a production tax on sector 2, which shifts the unit cost curve of good 2 inwards. Then the domestic price of factor 1 becomes higher than the world one. We allow a small amount of inflow of factor 1 from the rest of the world. We let $E[\cdot]$ and $R[\cdot]$ be the expenditure function and the GDP function, respectively. Then the following relationship holds with an inflow of factor 1:

$$E[P_2, U]=R[(1-t)P_2, V_1+V_1^*, V_2]-W_1V_1^*+tP_2X_2$$

where U, t, and V_1^* are, respectively, the social utility, a tax rate, and the amount of an inflow of factor 1. Differentiating this equation totally and using Shephard's lemma, we obtain

$$E_U\frac{dU}{dV_1^*}=-V_1^*\frac{dW_1}{dV_1^*}+tP_2\frac{dX_2}{dV_1^*} \tag{5}$$

where E_U is the partial derivative of $E[\cdot]$ with respect to U. We should note that $E_U>0$ and $dX_2/dV_1^*<0$. Moreover, evaluating equation (5) at $V_1^*=0$, the first term of the RHS is zero. We can conclude that with $t>0$, the inflow of factor 1 is harmful to the economy.

Second, we consider an inflow of factor 2. Suppose that the SOE provides a production subsidy to sector 2, which shifts the unit cost curve of good 2 outwards. Then the domestic price of factor 2 becomes higher than the world one. We allow a small amount of inflow of factor 2 from the rest of the world. Then the following relationship holds with an inflow of factor 2:

$$E[P_2, U]=R[(1+s)P_2, V_1, V_2+V_2^*]-W_2V_2^*-sP_2X_2$$

where s and V_2^* are, respectively, a subsidy rate and the amount of an inflow of factor 2. Then we can obtain

$$E_U\frac{dU}{dV_2^*}=-V_2^*\frac{dW_2}{dV_2^*}-sP_2\frac{dX_2}{dV_2^*}$$

Thus, noting that the first term of the RHS is zero at $V_2^*=0$ and that $dX_2/dV_2^*>0$, we can conclude that with $s>0$, the inflow of factor 2 is also harmful to the economy. It should be pointed out that with $t=0$ or $s=0$, the factor inflow does not affect economic welfare at all (though there is no incentive for foreign factor owners to shift their factor to the SOE).[6] We thus have the following proposition which is also valid in the HOS model:

Proposition 10. For a SOE that follows free trade in final goods, a factor inflow does not affect economy's welfare. A tax/subsidy-induced inflow of a factor is immiserizing.

[5] A tariff-induced inflow of a factor does not change the result (Proposition 10) at all.

[6] In the RV model, dW_j/dV_j^* $(j=1, 2)$ is negative. Thus, an additional inflow is welfare-improving with free trade. See also Srinivasan (1983).

VI. *Conclusion*

Incorporating an intermediate good into the RV model, we have analyzed how the results of the RV model change. Specifically, we have replaced one of the sector-specific factors with a sector-specific intermediate good. We have seen most of the basic results of the RV model are changed in our model. In particular, some HOS results that are lost in the RV model have revived. Factor prices are equalized with free trade. Trade patterns can be predicted from a knowledge of factor endowments. Changes in real factor prices due to changes in the prices of final goods can be determined and hence the neoclassical ambiguity is eliminated. We have also analyzed the relationships between factor endowments and outputs and between technology progress and factor prices.

The presence of the intermediate good has brought in two more kinds of trade: trade in a final good and the intermediate good and trade in the intermediate good along with trade in both final goods. It has been shown that free trade in the final good, which does not use the intermediate good in its production, and the intermediate good substitutes for trade in free trade in final goods. If trade in the intermediate good occurs (due to a price-difference) along with trade in final goods, then regardless of trade patterns, the price of the general factor rises, the output of good 1 falls, and economic welfare improves.

The effects on a SOE of a restricted factor inflow have been examined as well. A tax/subsidy-induced inflow is welfare-reducing, while an inflow without any distortion does not affect economic welfare at all. This result is also similar to that of the HOS model.

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