MORE GOODS THAN FACTORS IN INTERNATIONAL TRADE ONCE AGAIN

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This paper extends the H-O-S model of trade in order to incorporate more goods (n) than factors (2) and transport costs. Along the lines of Bhagwati (1972) and Deardorff (1976), it is made clearer that both the Ricardian chain of comparative advantage and the pattern of production (and trade) will be determined and that one implies the other. The set of nontraded goods is endogenously determined and it is shown that, in general, these will crisscross the chain of comparative advantage. However, sufficient conditions are derived, so that nontradeables will be spanned by all exportables on one side and all importables on the other. A general proposition on the number of tradeables is derived. This model is able to relate the size of the country and the diversification of the bundle of tradeables, as well as to explain the observed fact that exports are less diversified than imports. The technique used here is interesting in itself for its generality and for not departing from the two-dimensional framework.

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1-INTRODUCTION

The introduction of more than two goods in the Heckscher-Ohlin-Samuelson trade model brings up non-trivial problems largely discussed in international trade theory. Melvin (1968) has shown that the indeterminacy of the pattern of production (and trade) would arise in such a model. Independently, Bhagwati (1972) proved further that the above indeterminacy would imply the Ricardian chain of comparative advantage not to be valid anymore. Deardorff (1976) following Bhagwati’s assertion, proved that the validity of the chain is recovered when transport costs are taken into consideration, while leaving open the issue of indeterminacy of production pattern.1/

The purpose of this paper is not to model transport services in a trade model since this has been made elsewhere 2/, but rather to study the implications of transport costs in the case of more goods than factors. It is shown in section 2 that transport costs lead to a determinate pattern of production (and trade). In section 3 we prove that the chain of comparative advantage is revalidated as in Deardorff (though in a more general way); thus making clear that transport costs imply both the determinacy and the validation of the Ricardian chain, and that one implies the other, in the context of the model. The model goes however, beyond this notion, however, being able to determine endogenously which goods will be nontraded in equilibrium. One is, then, able to examine whether these nontraded goods will crisscross the chain or be in the middle, spanned by all exportables on one side and all importables on the other. Furthermore, a general proposition on the number of tradeables is derived. In section 4 we deal with all these issues.

In section 5 we derive other results that emerge from the model. This is able to shed some light on the observed fact that exports of a country are less diversified than its imports. It is also shown that
the trade pattern is specially sensitive to changes in tastes or taxes. Section 6 provides some concluding remarks.

The technique used here is interesting for its simplicity in dealing with more goods than factors without departing from the two dimensional framework so dear to trade theorists. In its assumptions this paper follows the standard Heckscher-Ohlin-Samuelson model of trade. Technologies are assumed to be CRS and no special assumption on demand is required. Unless otherwise stated, complete diversification or both the demand side and supply side is assumed. The (home) country A and the "rest of the world" -country B- enjoy the same technological information.

2- THE INDETERMINACY

We will first consider the case of no transport costs in the context of more goods than factors, so that factor prices are internationally equalized. As it is well known since Mundell (1957), under those assumptions there is an equivalence between trade in factors and trade in goods. This can be shown with the help of Fig. 1A. The box is drawn such that AL, AK are the world factor endowments of labor and capital respectively. Take E as the endowment point. Then, AL_A, AK_A, BL_B, BK_B are respectively, the endowments of factors L and K of countries A and B, and naturally the slopes AE and BE reflect the capital-labor endowment ratio for each economy.

Under free trade, factors prices are well determined and so is national income of each country. Therefore, the demand for each good and the total quantity of factors embodied in total demand are known. Let C be such a point. Then, \( (w/r)DC = ED \), where \( w, r \) are the factor returns of L and K. Trade in commodities will indirectly exchange factors such that
country A will "export" the quantity KE of capital and "import" LI of labor.

In Fig. 1B, we have an enlarged version of Fig. 1A, where we also have drawn four rays from the origin, k₁ through k₄ which represent the capital intensities of four commodities to be produced. It is possible to show that there are some feasible patterns of trade, all of them leading to an indirect net exchange of K for L in quantities ED and DC, respectively. For convenience we shall call this indirect trade in factors the factor trade triangle EDC. By construction, the line Eb is parallel to Ak₂ and represents the export of good 2. It is as if E has moved South-East (SE) since the export of goods is equivalent to a reduction of factor availability in the home country. Similarly, Ec, which is parallel to Ak₁, represents the export of good 1. On the other hand, bb' (parallel to Ak₁) and b'C (or aC, both parallel to Ak₃) represent imports of goods 1 and 3, respectively. Since this is a movement to the North West (NW) (ex: b to b') it shows an increase in the quantity of factors available, and it represents imports of country A. The indeterminacy on the pattern of trade (and production) is then well illustrated. For instance, country A could import C_a units of good 3 and export E_a units of good 2. Another pattern of trade could be to import bb' and b'C of commodities 1 and 3, and export Eb of good 2. If this is the pattern of trade then factors from O to b will be devoted to produce for domestic consumption.

Suppose now that transport costs are present. Trading is thus costly and one would intuitively expect that the market would lead to an equilibrium where those costs are minimized, while still "trading" the same amount of factors. In fact, this was proved in Cunha (1985). In a
model with endogenous transport services it was shown that comparative advantage in those services would result in a free trade equilibrium such that the total cost of trade is minimized. Following that hint, it will be assumed that country A will minimize the cost of trade, i.e., the equilibrium will be such that

1. \( \min \sum_i u_i |\Delta_i| \) for \( i=1, \ldots, m \);

2. s.t. \( \sum_i a_{iK} \Delta_i \geq KE \)

3. \( -\sum_i a_{iL} \Delta_i \geq LI \)

4.1 \( \Delta_i \geq -C_i \)

4.2 \( \Delta_i^* \leq C_i^* \)

where \( \Delta_i = X_i - C_i \). If \( \Delta_i \) is positive, commodity \( i \) is exported, if negative it is imported. Equation (1) measures the cost of trade, where \( u_i \) is the cost of transporting one unit of good \( i \), independently of being exported or imported. Equation (2) states that the pattern of trade has to be such that the net outflow of factor \( K \) embodied in the traded commodities has to be equal to \( KE \) (see Fig. 1A). The constraint (3) is the equivalent of (2) for factor \( L \). Restrictions (4) imply that imports cannot exceed consumption, in other words, \( X_i \) and \( X_i^* \) are non-negative values. Since exports of country A are imports of country B, the problem (1) to (4) could be applied to country B. Therefore, both countries will, choose the same pattern of trade without doubt.

There is, however, another way of looking at problem (1)-(4). It can be assumed that transport costs are not large enough to prevent factor price equalization, but it is, nevertheless, economical for each country to save spending on transport costs. If, as above, it is assumed that transport costs depend on the volume of goods transacted, each
country will choose from the possible patterns of trade the one that minimizes those costs. 3/

Basically, the complete model is solved in two steps. First, equilibria are characterized paying no attention to transport costs. Second, from all possible patterns of trade, each country will choose the one that minimizes the costs of trade. Since problem (1) to (4) is linear, both in the constraints and in the maximand, a unique solution exists. The following proposition summarizes the first result:

Proposition 1: The indeterminacy on the pattern of trade (or production) disappears once transport costs are introduced (although infinitesimal).

3 - THE HECKSCHER-OHLIN THEOREM

The indeterminacy disappears once transport costs are introduced, but it is left to be shown what happens to the chain of comparative advantage. In the presence of more goods than factors, the Heckscher-Ohlin theorem has been stated in several different forms depending upon whether or not factor prices are equalized. When factor prices are not equalized, the theorem in the Bhagwati-Jones version states that the capital abundant country will export commodity i and import commodity j, such that

\[ k_i > k_j \]

When factor prices are internationally equalized, the theorem is stated in a weaker way, which is known as the factor content formulation. For the capital abundant country, the following relation holds

\[ k_X - k_m > 0 > l_X - l_m \]

where \( k_X, l_X \) denote the capital and labor contents of the exported goods
and \( K_m, L_m \) the quantities of capital and labor embodied in the imported goods. More recently, Brecher and Choudri (1982) have shown that when factor prices are not equalized, relation (5) also holds. However, since Bhagwati (1972) it is known that the Heckscher-Ohlin theorem as expressed in (6) does not hold when factor prices are equalized and there are more than two goods. For that, some properties of the solution to the problem (1)-(4) will be analysed in more detail. The following proposition summarizes the main conclusion:

**Proposition 2:** When transport costs are introduced, the chain of comparative advantage is recovered, i.e., for the capital abundant country, any exported good is more capital intensive than any imported good.

**Proof:** Assume there is a feasible commodity trade profile in which, among many others, good \( i \) is imported and good \( j \) is exported. Furthermore, suppose that good \( i \) is more capital intensive than good \( j \), such that, the chain of comparative advantage is violated: \( k_i > k_j \). We are going to show that this cannot be the optimal solution to the problem (1)-(4). In Fig. 2A, where EDC is the factor trade triangle, as before, Eb represents an export of good \( j \) and Cf an import of good \( i \). The resulting triangle of trade, after those transactions, will be bgf.

Two cases have to be distinguished, depending on the relative lengths of Eb and Cf. If a line starting from E, and parallel to the hypotenuse bf, crosses Cf (at h for instance) that means Eb is "small" relative to Cf. This represents the first case to be considered, which is shown in Fig. 2A. In the second case to be considered, the size of Cf is "smaller" in relation to Eb. This can be seen in Fig. 2B.

In Fig. 2A, by construction, the triangles bgf and Elh are
similar. This implies that if there was a feasible profile of trade for the triangle bfg (not drawn) as assumed, there is also one feasible profile of trade for the smaller triangle Eih. Furthermore, because of the similarity and size of the two triangles, the profile of trade of Eih is only a shrunk version of the trade triangle bgf, i.e., exporting and importing the same goods but a smaller volume of each one of them. Moreover, to move from the initial trade triangle EDC to bfg, it is necessary to import Cf of good i and export Cf of good j, but to reach Eih from the initial triangle EDC, it is only necessary to import Ch of good i; no exports of good j are necessary (by construction, Ch is smaller than Cf).

The initial trade profile, then, in which Eb was exported and Cf imported, cannot be optimal, because it is possible to find another one with less trade in each and every good, which is also feasible. In this new trade profile, good j is not exported and so, the chain of comparative advantage is not violated.

In the second case (Fig. 2B), the demonstration follows the same logic. It is possible to find a new feasible trade profile in which there is less trade for each good. But, in this case, imports of good i do not take place and exports of good j are reduced to Eh'. Once again, the chain of comparative advantage cannot be violated.

To sum up, if the capital abundant country exports good j, all its imports will be less capital intensive, and the H-O theorem re-emerges.

Proposition 2 is not new. In fact, in Deardorff (1976) the chain of comparative advantage is rehabilitated when factor prices are not equalized due to impediments to trade, but uniqueness (Proposition 1) is not proved. Furthermore, Proposition 2 is a more general result, because we need not to rely on differences in factor prices. As a counterexample take the case of complete diversification in production and consumption
In the presence of positive transport costs such that \( u_i > 0 \) for \( i = 3, ..., m \) but \( u_1 = u_2 = 0 \). In this case only goods 1 and 2 would be traded, factor price equalization would prevail and the Deardorff argument could not be used. In the present approach that would not present a problem and the determinacy, as well as, the chain of comparative advantage would reemerge.

It is also clear that in the presence of transport costs recovery of the chain implies the establishment of determinacy. Once it is known the importable and the exportable, trade volumes are determined and so is the pattern of production.

4- NONTRADEABLES AND THE CHAIN OF COMPARATIVE ADVANTAGE

In this model, it was demonstrated that the determinacy on the pattern of trade, as well as, the chain of comparative advantage are recovered. The natural questions will then be: how many goods are traded; which goods are traded (or non-traded); how to break the chain of comparative advantage between exportables, importables and non-traded goods. This section deals with these issues.

The number of goods traded can be determined by using a general property of linear programming. First consider the small country case, i.e., restrictions (4.2) are not binding. If (4.1) is also not binding, then the problem (1) to (3) has \( m \) control variables with 2 linear constraints and the optimal solution will have \( (m-2) \) zeros. In other words, if (4) is not binding only one good is exported and only one good is imported. The remaining \( (m-2) \) goods are not traded. If some constraints of (4.1) are binding, then more goods will be traded. In that case, production of those goods is not taking place in the home country, that is,
all of the consumable is imported. Therefore, of all the goods that are imported, only one is produced at home also.

Proposition 3: In a small country, the number of traded goods is equal to the number of factors (two in our case) plus the number of non-active sectors in that economy.

In the two countries case, since we have to consider the set of constraints (4.2) specific to country B, the proposition has to be changed somewhat.

Proposition 3': In the case of two countries, the number of commodities internationally traded is equal to the number of factors plus the number of non-active sectors in both countries.

It was previously proved that the chain of comparative advantage holds, i.e., for the home country, any exportable is more capital intensive than any importable. Now, it will be shown that, in general, it is not possible to determine which goods are exportables, importables, or non-tradeables. Afterwards, a set of sufficient assumptions will be found which will determine the goods to be traded and non-traded.

In Fig. 3, some of the possible patterns of trade where good 1 is exported and goods 2 or 3 are imported, are denoted by a or b. The one that minimizes costs of transportation cannot be chosen a priori, because it depends on whether or not the cost of transportation is specific to each good. For instance, if the cost of transportation for commodity 3 is relatively higher than the cost for commodity 2, then the pattern of trade a might be cheaper than that of b. So, in general, non-tradeables are going to be spanned along the chain.

In the 2x2x2 model the relative endowment of capital-labor
(k^0=slope of AE) will lie between the importable and the exportable. However, it can be shown, for instance, that all tradeables (importables and exportables) may lie to the right (or to the left) of the endowment ratio. Using Fig. 3, it is easy to see that trade in commodities 1 and 2 (pattern of trade a) where k_1 > k_2 > k^0 is compatible with the assumption X_1 ≥ 0 (or Δ_i ≥ -C_i). Therefore, one cannot separate candidates for exportables from candidates to be importables. To summarize:

Proposition 4: In a model with transport costs, the chain of comparative advantage holds, but, in general, it is not possible to separate tradeables from non-tradeables nor exportables from importables.

It is possible, nevertheless, to find some more restrictive conditions to break the chain in a very clear cut way. As above, the unit of X_i is chosen such that transport costs are equal for each commodity. Then, the following proposition can be proved:

Proposition 5: Under the assumptions of the model, if for any two commodities (k_i > k_j), it happens to be true that a_{Li} ≤ a_{Lj} and a_{Ki} ≥ a_{Kj}, then the pattern of trade is such that the capital abundant country will export the most capital intensive commodities and import the most labor intensive ones, while the non-traded goods will lie in-between.

Intuitively, this result can be explained in the following way. Under the assumptions of Proposition 5, the cheapest way to "export" capital is by exporting the commodity which has the largest content of capital and the
smallest content of labor per unit traded. This commodity is good 1. Similarly, to "import" labor the most economical way is to import the commodity with the larger content of labor and with a "small" content of capital per unit traded. In our example, this is commodity 4. In the case of Fig. 3, the pattern of trade b is then the optimal one.

**Proof:** More formally, the above result can be obtained in the case of \( m \) goods and 2 factors, using the formulation of the problem as in (1) to (4). For simplicity and, as shown later without loss of generality, it is assumed that \( X_i > 0 \), or, equivalently, (4) is not an active constraint.

The proof will proceed as follows: first a solution is hypothesized and the value of the objective function for that solution is obtained. Then, it is shown that any small variation will increase the value of that function. Since, the hypothesized solution is thus proved to be minimum, it is the optimal solution.

Assumptions: (ass. 1) \( a_{L1} \leq \cdots \leq a_{Lj} \leq \cdots \leq a_{Lm} \)
\[ \geq \]
\( a_{K1} \geq \cdots \geq a_{Kj} \geq \cdots \geq a_{Km} \)

(ass. 2) \( u_i = u^o \) (choice of units)

(ass. 3) \( m \) goods and 2 factors

(ass. 4) \( X_i > 0, i=1, \ldots, m \)

Hypothesis: \( \Delta_1 > 0; \Delta_m < 0; \Delta_i = 0, i=2,\ldots,m-1. \)

If we can prove that under assumptions 1-4 any positive level of trade in commodity \( i \) (\( i=2, \ldots, m-1 \)) is not optimal, then the hypothesis is the optimal solution. Therefore, we can conclude that assumptions (1)-(4) guarantee the result intuitively claimed in Proposition 5.
From (2)-(3) the following system can be obtained

(7.1) \[-a_{L1}\Delta_i - a_{Lm}\Delta_m = \Omega_1 + \Sigma_2^{m-1} a_{Li}\Delta_i\]

(7.2) \[+a_{K1}\Delta_i + a_{Km}\Delta_m = \Omega_2 - \Sigma_2^{m-1} a_{Ki}\Delta_i\]

Using Cramer’s rule we can solve for

(8) \[\Delta_i = [a_{km}(\Omega_1 + \Sigma_2^{m-1} a_{Li}\Delta_i) + a_{km}(\Omega_2 - \Sigma_2^{m-1} a_{Ki}\Delta_i)] / D\]

(9) \[\Delta_m = -[a_{L1}(\Omega_2 - \Sigma_2^{m-1} a_{Ki}\Delta_i) + a_{K1}(\Omega_1 + \Sigma_2^{m-1} a_{Li}\Delta_i)] / D\]

where \[D = (a_{ki} a_{Lm} - a_{km} a_{L1}) = a_{L1} a_{Lm}(k_1 - k_m)\]

After rearranging (8) and (9), we obtain

(8') \[\Delta_i = [\Omega_1 + \Sigma_2^{m-1} a_{Li}\Delta_i] + (\Omega_2 - \Sigma_2^{m-1} a_{Ki}\Delta_i)] / a_{L1}(k_1 - k_m)\]

(9') \[\Delta_m = -[\Omega_1 + \Sigma_2^{m-1} a_{Li}\Delta_i] + (\Omega_2 - \Sigma_2^{m-1} a_{Ki}\Delta_i)] / a_{Lm}(k_1 - k_m)\]

Using the hypothesis, the objective function to minimize becomes

(10) \[f = \Delta_i + \Sigma_2^{m-1} |\Delta_i| - \Delta_m\]

(i) If \[\Delta_i \geq 0\], for \(i = 2, \ldots, m-1\).

Using (8')-(9') and differentiating (10) with respect to \(\Delta_i\), one obtains

(11) \[\frac{df}{d\Delta_i} = (k_m a_{Li} - a_{ki})[a_{L1}(k_1 - k_m)]^{-1}

\[-(a_{ki} - k_1 a_{Li})[a_{Lm}(k_1 - k_m)]^{-1} + 1\]

After rearranging

(12) \[\frac{df}{d\Delta_i} = (a_{km} a_{Li} - a_{ki} a_{Lm} - a_{Ki} a_{L1} + a_{K1} a_{Li} + a_{K1} a_{Lm} - a_{km} a_{L1}) / D\]

where \[D = a_{L1} a_{Lm}(k_1 - k_m)\]

the denominator is positive due to (assumption 1). The numerator after rearranging, turns out to be equal to:
\[ a_{Km}(a_{Li}-a_{L1})^*a_{Lm}(a_{K1}-a_{Ki})^*a_{Li}(k_1-k_i) \]

which is also positive because of (ass. 1). Therefore, \(df/d\Delta_i\) is positive and the optimal value for \(\Delta_i\) is zero.

(ii) If \(\Delta_i \leq 0\), for \(i=2, \ldots, m-1\),

Then using (8')-(9') and (10), differentiate \(f\) and get

\[ df/d\Delta_i = (k_m a_{Li}-a_{Ki})(a_{L1}(k_1-k_m))^{-1} \]
\[ -(a_{Ki}-k_i a_{Li})(a_{Lm}(k_1-k_m))^{-1} -1 \]

after rearranging

\[ df/d\Delta_i = (a_{K1}(a_{Li}-a_{Lm})^*a_{L1}(a_{Km}-a_{Ki})^*a_{Lm}a_{Li}(k_m-k_1))/D \]

where \(D=a_{Li}a_{Lm}(k_1-k_m)\)

Taking into consideration (ass.1) \(df/d\Delta_i\) is negative. Therefore, the optimal value for \(\Delta_i\) is zero (note that good i is now imported, i.e., \(\Delta_i<0\)).

To sum up, under assumptions 1-4, it was proved the optimal solution is \(\Delta_1>0, \Delta_m<0, \Delta_i=0, i=2, \ldots, m-1\). \(\text{Q.E.D.}\)

Up to now, we have been assuming that there is complete diversification in production, \(X_i>0\), which leads to no loss of generality as will now be shown. Once this assumption is dropped, the pattern of trade \(i\) may not be feasible (Fig. 3). In other words, when one country imports \(C_h\) units of good 3, it might happen that the country ends up with an excess supply of this good, even with \(X_3=0\). So, country A will import less than \(C_h\) units of commodity 3.

Under the above assumptions on transport costs, it is known
that the next candidate to be imported is commodity 2. Then, the optimal solution could be given by point $a^*$ in Fig. 3. The home country would export commodity 1 ($Ea^*$) and import commodity 2 ($a'a^*$) and commodity 3 ($Ca^*$). Again, $Ca^*$ coincides with the total consumption of good 3 in the home country. Therefore, assumption 4 is not relevant for the proof.

Proposition 5 suggests a set of sufficient conditions under which it is possible to find all exportables at the extremes of the chain and the non-tradeables goods in between, separating exportables from importables.

5. MORE GOODS THAN FACTORS: OTHER RESULTS

The foreign country or the "rest of the world" being an aggregate of many countries can be assumed to be always larger than the home country. Then, it can be shown that any country tends to have a diversified bundle of imported goods and that its exports tend to be concentrated in one commodity. The home country, being smaller, will "exhaust" (home) consumption very "easily" and, as a consequence, it tends to import several commodities while exchanging the same amount of factors. On the other hand, the (foreign) consumption of a larger economy is seldom "exhausted" by the exports of the smaller country. To sum up, in general one expects constraints (4.1) to be binding more often than constraints (4.2). In the limit, if the home country is a small economy it will export only one good. The following proposition can be stated:

**Proposition 6:** Under the assumptions of the model, any country, in general, will have a more diversified bundle of importables than that of exportables, which in the limit —the small country case— will be just one commodity.
Taking into consideration this proposition and Proposition 3' it follows that

**Proposition 7:** The smaller the economy the more specialized tend to be the pattern of production and of exports.

These conclusions are very appealing since, in the real world countries are specialized in very few exports and import a relatively larger spectrum of goods. Likewise, the smaller the economies are, the more dependent is their consumption on foreign production.

Under the assumptions of the model, a small change in preferences might lead to sharp changes in the profile of trade and production. For the sake of the argument, suppose the home country is exporting the (m-1)th good and importing good m, and all other (m-2) goods are not traded. Suppose that demand for the mth good falls, and home production falls to zero, so that imports of good m have to fall. To satisfy the factor trade triangle, the home country has to start importing another good. Since we saw that the chain of comparative advantage has to hold, the (m-1)th good can no longer be exported. The pattern of trade changes; the home country will continue to import the mth good plus the (m-1)th good, and some other good up in the chain will start being exported.\(^4\) The same type of argument can be used if some "small" tariff is levied on imports of good m, but for instance, not on others. As long as that tariff is large enough to compensate for the difference in transport costs, vis-a-vis the next good, the pattern of trade can change in the same line.

**Proposition 8:** Under the assumptions of the model, the bundle of exported
or imported goods is very sensitive to changes in preferences and to changes in the structure of non-uniform tariffs.

6-CONCLUDING REMARKS

The conclusions and results obtained so far give us a hint about volumes of trade. In H-O model, with m goods and 2 factors, the volumes of trade are indeterminate. Once the chain of comparative advantage is rehabilitated and the factor trade triangle known, trade volume will be determined. But the indeterminacy is deeper than that mentioned so far. Due to the Mundellian equivalence, if the countries allow for factor mobility the indeterminacy will reemerge even in the two goods case. Trade in goods, capital mobility and/or labor mobility are perfectly equivalent and the indeterminacy of equilibrium reappears once again. This equivalence, as well as the indeterminacy, obviously disappears in the context of this model with transport costs.

Transport costs in this CRS model lead firms to be located near the factor market regardless of the market for final good. In particular, under the assumptions of Proposition 5, it was shown that the most capital intensive good was produced by the home country and no mention was made about the location of consumers of that good. In the Krugman model of increasing returns, as shown by Helpman and P. Krugman (1985), the introduction of transport costs result in the location of firms near the larger market for the final good. The difference lies in the determinants of trade in each model which is stressed by the introduction of transportation costs. In the H-O model, trade exists due to differences at the factor market level, while market size is the determinant of trade in the Krugman model.
NOTES

1/ Also in a model of many goods but with \( n \) factors Samuelson (1954) had already referred the possibility of indeterminacy. Hong (1970) shown for the Samuelson case, how infinitesimal transport costs can lead to an unique solution. Later on we shall refer to this paper again.


3/ A somewhat similar approach was taken by Hong (1970). There, he assumes that countries tend to minimize the value of trade for which there is theoretical justification. As said before, to minimize the volume of trade is the correct procedure (see Cunha 1985). Furthermore, Hong, while working with \( m \) goods and \( n \) factors shown that a solution exists and is unique, but that prevented him from exploring other more relevant conclusions that in our opinion, can be derived in the two factor case.

4/ If the \((m-1)\)th good was suitable to be imported, despite its high capital intensity, then it is due to the fact that it was very cheap to transact. I.e., it will now be a better candidate to be exported since the associated parameter \( u_{m-1} \) is low.
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