International Trade Models and Real World Features

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All models of international trade share the basic characteristic that with trade the pattern of a nation’s production can differ from the pattern of its consumption, and this is what allows any country to experience a gain from entering world markets. Furthermore, a great concentration in production can be achieved without limiting the choices available to consumers. This asymmetric characteristic surely mirrors real world features – variety in consumption typically exceeds variety in production for countries open to world trade. “New trade theory” has offered up the model of monopolistic competition that certainly is consistent with a setting in which production for export takes place in a more narrow range of varieties than represented by varieties available to consumers, with a degree of increasing returns in this setting providing the rationale for the postulated asymmetry. Here we focus on traditional competitive models of trade to investigate how manageable trade models can exhibit these real world asymmetries.

It is perhaps ironic that such an asymmetry is not found in the most popular form of the Heckscher-Ohlin model, in which a country produces two commodities with two factors of production, the 2x2 version. The problem with this setting is that unless the price-taking country is driven by trade to specialize completely in only one commodity, international trade causes a change from autarky in the volumes of production but not in the pattern of production. A more promising approach is contained in the many-commodity, two-factor version of Heckscher-Ohlin., (or, indeed, in the multi-commodity
version of the Ricardian model). The reason for this is that in international trade a
country need not produce more commodities than it has factors of production. With
many production patterns possible, the composition of actual production becomes
sensitive to changes in commodity prices or to changes in factor endowment proportions.

Consider, for example, the 2xn version of the Heckscher-Ohlin model for a small
country that is growing and engaged in world trade. For a country facing a given set of
world prices suppose that the country’s capital/labor ratio grows over time. Then its
production pattern will also systematically change. If initially the country produces two
commodities, growth in the capital/labor endowment ratio causes the output of its more
capital-intensive commodity to expand, and its more labor-intensive commodity to
contract, until the country becomes completely specialized in producing the capital-
intensive commodity. Further growth with capital accumulation leads to increases in the
output of this single good until the country can start producing an even more capital-
intensive commodity, with both commodities being produced. Such a pattern proceeds as
before, with periods of incomplete specialization interspersed with those of complete
specialization. Somewhat the same phenomenon of alterations in production patterns
can be observed if it is commodity prices instead of endowments that change. However, it
seems less realistic as a feature of real world trading patterns that a country produces only
one or two commodities.

Such a severe restriction of production could be avoided by considering general
Heckscher-Ohlin models with many mobile factors of production as well as many
commodities. The problem with this solution is that without further structure few results
showing how small or large shocks alter the pattern of production can be derived. An
alternative framework that allows more commodities to be produced assumes that there exists a different set of commodities that exhibit large natural or man-made barriers to international exchange so that they are non-traded. We comment on this possibility in Section 1, and then proceed to illustrate how combinations of the Heckscher-Ohlin 2xn setting with suggestions from the Specific Factors model and the Middle-Products scenario (Sanyal and Jones, 1982) can be used to illustrate how trade allows consumption patterns to be more widespread than production patterns, which nonetheless are not as concentrated as in typical two-factor models. Furthermore, the role of international trade in promoting a labor force with heterogeneous skills is emphasized.

1. Overlapping Market Domains

A further distinguishing feature of all models of international trade is that once complete autarky is left behind, some markets become global but others remain purely national, or perhaps even regional (Jones, 1995). The latter are often taken to be factor markets. For example, in simple Ricardian trade models often all commodities are assumed to be traded in world markets, whereas labor, the single factor of production in the Ricardian setting, is confined by national borders. Here we restrict ourselves to production structures with more than one factor of production (only two, say labor and capital, in this section), and consider the situation in which some commodity is non-traded while a pair of other commodities is traded, one exported and another imported. A two-commodity world (such as the standard 2x2 Heckscher-Ohlin setting) is too restrictive to illustrate a country engaged in trade as well as possessing a commodity whose market is purely national. However, in a general three-commodity setting the demand side of the model needs to cope with the possibility of complementarities between commodities. To avoid
this complication as well as to emphasize the possibilities afforded by international trade we make two extreme simplifying assumptions: (i) there is no local demand for the commodity exported in world markets, and (ii) national consumers rely completely on foreign production for the commodity that is imported.¹

Suppose that a country with this production structure is too small to have changes of its own affect its terms of trade, but is faced with such a price change deriving from disturbances in other countries. How does such a change in world prices alter the volumes of this country’s exports and imports, and, more importantly, the relative price of the non-traded commodity compared with the price of exportables (of relevance to production decisions) or compared with the price of importables (of relevance to consumption decisions)? The answer to such a question would be revealed by the shape of the country’s offer curve, but, as Edgeworth long ago observed, much is hidden behind the offer curve, such as the effect of the change in the terms of trade on the price of the non-traded commodity.

For convenience in what follows let the importable serve as numeraire, with its price set at unity. What can be said about the effect of a terms-of-trade improvement (an increase in the price of exportables, $p_X$) on the price of non-tradeables ($p_N$), where the market for such a commodity reflects only national demand and supply? At the initial price of non-tradeables, a terms-of-trade improvement must, through an income effect, shift the demand curve for non-tradeables outwards, thus serving to increase its price

¹ A model with this structure is developed in Jones (1974) to analyze expressions in the literature for the effects of exchange rate changes and of income transfers between countries. See also Komiya (1967) and Ethier (1972). In this literature if a country produces as many commodities for world markets as there are factors of production, given world prices determine local factor prices and therefore as well the prices of any other commodity produced strictly for the national market. By contrast, the model in this section is one in which local taste patterns have a role to play in determining relative commodity prices facing consumers.
relative to the fixed price of importables. By how much does this price increase? Not by very much if in consumer taste patterns importables are quite a good substitute for non-tradeables. (The extreme case would occur if indifference curves at home are downward-sloping straight lines). The case illustrated in Figure 1, explained below, is that in which taste patterns exhibit unit elasticity of demand for importables and the price of non-tradeables rises in equilibrium, but only by the same relative extent as that of exportables. Even lower import demand elasticities would result in an increase in the price of non-tradeables that exceeds the relative increase in the price of exportables.

Figure 1 combines the economy’s production possibilities curve with its taste pattern. Since the former involves the non-traded commodity and the export commodity, while tastes are depicted by indifference curves in the space of the non-traded commodity and the commodity being imported, knowledge of the terms of trade would help to link the production possibilities curve to the taste pattern. The horizontal axis measures the volume of importables, and the transformation curve illustrated in Figure 1 (and passing through point $B$) is drawn assuming unity as the initial value of the terms of trade, $p_X/p_M$, in which case the horizontal axis also measures the output of exportables. For unit terms of trade the transformation schedule is also the consumption-possibilities locus (assuming balanced trade), and point $B$, where an indifference curve is tangent to the transformation schedule, would illustrate the equilibrium values of production and consumption of non-tradeables ($N$), production of exportables ($X$) as well as consumption of importables ($M$). Line $ABE$ is the original budget line. Suppose the terms of trade improve by 25%. The new consumption-possibilities locus is shown by the bowed-out curve that shifts the

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2 The relative upward shift in the supply curve is easy to detect. If the price of non-tradeables increases by the same relative amount as has the price of exportables there would be no change in the allocation of resources between exportables and non-tradeables.
transformation schedule at every point rightwards by 25%. Thus point $D$ represents a 25% increase in the quantity of the importable that could be consumed if there were no change in consumption of the non-tradeable and the slope of line $ADF$ would represent the slope of the new consumption-possibilities curve at point $D$. If the demand curve for importables exhibited unit elasticity, a new indifference curve would be tangent to the new consumption-possibilities curve at point $D$. A unit value for the elasticity of demand for importables represents an exact balance between an income effect encouraging a larger demand for non-tradeables and a substitution effect away from non-tradeables towards importables. At point $D$ non-tradeables have risen in price by the same relative amount as have exportables. By contrast, an inelastic demand for importables requires $p_N$ to increase by more than $p_X$, so that the increased real income from the terms of trade improvement can find outlet in greater production of the non-tradeable.

This variation in possible ranges for the relative price of non-tradeables compared with exports has an important consequence for the local factor-price response to a change in the terms of trade. According to the Stolper/Samuelson (1941) theorem, if the terms of trade improve, the real wage of labor will rise if exportables are produced by labor-intensive techniques compared with importables. In this model, however, factor proportions in exportables cannot be compared with those in importables because there is

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3 By contrast, a deterioration of the terms of trade would show the consumption-possibilities schedule shifted in, e.g. to point $C$ with slope of line $AC$.

4 For example, Leontief-type indifference curves would have their corners on a ray from the origin through point $B$. Consider the offer curve for importables, and assume that at high relative price of importables compared with exportables the offer curve is positively sloped (i.e. demand for importables is elastic) while for lower import prices it is backward bending. As the terms of trade improve, the quantity of imports always expands, but exports do as well only in the elastic range. Exports represent payments for imports, and will increase as the terms of trade improve only if the demand for imports is elastic. If exports fall, it must be because the price of non-tradeables has risen even more than that for exports, i.e. in the inelastic range.
no import-competing activity. The comparison must be with the non-traded sector.
Suppose exportables are labor-intensive relative to the non-traded sector and the terms of trade, \( p_X/p_M \), improve. Real wages may fall instead of rise if the country’s elasticity of demand for importables is less than unity because the price of exportables will have fallen relative to the other commodity produced, the non-tradeable good. This ensures that the nominal wage rate falls relative to the price of exportables, but may or may not fall in absolute terms (i.e. relative to the fixed price of importables). If factor proportions in exportables and non-tradeables are fairly similar, the nominal wage must fall, implying that the real wage rate unambiguously drops. However, if factor proportions are far apart, the magnification effect of the price of exportables increasing by relatively more than non-tradeables will be weaker. This could result in the nominal wage rate change falling below that of non-tradeables but still being positive, above the fixed price of importables. In such a case the direction of change of the real wage rate depends as well on taste patterns. Note that we have assumed that this is a small country, so that the famous Metzler effect (1949), made possible by small elasticities of demand in the world economy, cannot arise. Here it is a small value for the local demand elasticity for importables that causes a terms-of-trade improvement for a country to shift resources out of exportables towards non-tradeables because their price has risen by more than that of exportables. This is a phenomenon discussed in earlier literature on booming export sectors and the Dutch Disease. This model that includes a non-tradeable produced at home reveals that price changes on world markets favorable to exportables do not

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5 This is like the situation in specific-factors models in which a relative price change for commodities places the nominal wage change between that of the two produced commodities. The logic of real wage changes if exportables are capital-intensive is analogous, with an unambiguous increase in the real wage rate taking place if demand for importables is inelastic.

6 For example, see Corden and Neary (1982).
necessarily increase the real income of the factor intensively used in exportables. The spill-over effect on local prices may prove dominant.

2. A Focus on Investment

Turn, now, to a hybrid blend of the two-factor, many commodity Heckscher-Ohlin model and the specific-factors model. Assume that the country already possesses an array of types of capital that are specific to producing different commodities (with the aid of labor). These specific capitals reflect investment decisions made in the past. Furthermore, assume that in each period there is a sector of the economy that currently transforms labor inputs into production of the kinds of specific capital used to produce the commodities that prove to be most suitable for investment at that period’s commodity prices. That is, given the country’s technology and world prices, there is a convex Hicksian composite unit-value isoquant showing minimal amounts of capital and labor required to produce a dollar’s worth of output. As opposed to our earlier description of the 2xn model in which all capital is devoted to production of only one or two commodities, with trade all new investment is focused either on the best single sector or on a pair of sectors with adjoining capital/labor ratios used in production. The optimal selection, of course, depends upon the ratio of newly produced capital (to be produced in the required specific forms), on the one hand, and the labor force that is to be devoted to work with the newly created capital (this period’s investment) to produce this period’s “best” commodities, on the other. To simplify matters we assume that there is a basic process whereby new capital is produced, with a given quantity of labor. Of the labor

7 Details of this model are found in Jones (2007).
force not so used in investment, part will be used with the newly created capital to
produce the single or pair of “best” commodities. The remaining labor force is spread out
over the pre-existing specific capitals to produce a variety of consumer goods.

The allocation of labor (over and above that required to produce the new capital)
between that part used with pre-existing capital and that part devoted to the commodities
deemed best by this period’s prices depends upon the equilibrium wage rate that clears
the labor market. As in Jones (2007) this equilibrium can be shown in the “back-to-back”
diagram, Figure 2. Measured rightwards from the $O_H$ – origin (“H” for Hicks, with
reference to the “Hicksian composite unit-value isoquant”) is the demand for labor to
produce this period’s optimal commodity (-ies). The horizontal stretches reflect
investment at wage rates for which a pair of commodities is produced with new capital.
Measured leftwards from the $O_S$ - origin is the sum of labor demands in the array of
industries for which previous periods have left still-usable quantities of specific factors.
The equilibrium wage rate is $w^*$. This hybrid model has the advantage of emphasizing
that international trade allows for a concentration of new investment in capital to produce
a small number (one or two) of tradeable commodities, while allowing specific capitals
from previous periods also to be used in current period production of other commodities.

Exports need not be limited to the sector, or sectors, that receive new investment.
Indeed, if past investments have contributed little to the capital stock in that sector, the
newly rising output may help to replace imports. As well, the newly created specific
capital might be of higher quality than the pre-existing stock, as is a common feature of
the “vintage capital models” developed earlier by Johansen(1959) and Solow (1962).
3. The Middle Products Model: A Re-interpretation

An alternative modeling strategy that allows both for a concentration of productive activity for exports as well as a wider range of commodities actually produced was developed by Sanyal and Jones (1982). In that model all productive activity belongs in one of two Tiers of the economy. One set of activities involves using natural resources and various kinds of capital combined with labor to produce commodities for the world market. This is referred to as the Input Tier. International trade allows some or all of these items to be exchanged in world markets for another set of commodities, of equal value if there is balanced trade. The economy’s labor market is once again tapped for labor inputs, this time to convert the items available from the world market into commodities that can be purchased for consumption. Such activity takes place in the Output Tier of the economy. The basic idea of the model is that international trade takes place in the “middle” of the production spectrum in which the local economy must use its own resources to produce items that can enter international trade as well as using its own resources (labor) combined with the items available from international trade to produce items that are in a form useful for consumption. For example, a shipment of cars might come from Japan and appear at the docks in Seattle, but local transport activities and the activities of retail services are required before individual consumers can avail themselves of the automobiles they desire at retail prices.

A diagrammatic sketch of production possibilities in a middle products framework is depicted in Figure 3. The economy’s labor force is allocated to two Tiers. In the Input Tier of the economy part of the labor force ($L_I$) is combined with a pair of sector-specific
resources or capital to produce a pair of commodities ready to enter world markets.

Instead, the country might have produced only a single item in the Input Tier (e.g. oil or copper), or perhaps several items. International trade allows these outputs to be exchanged for any number of commodities, whose total value is the same as the value of output in the Input Tier assuming trade is balanced. For illustrative purposes we suppose that the two items produced in the Input Tier are exchanged for middle products 1 through 8. These items require further inputs of local factors ($L_O$) before they can enter the consumption stream. In the middle products scenario all commodities consumed are non-tradeable, although the value of local labor applied to middle product $j$ to produce $X_j$ for consumption could be relatively small. In Figure 3 each final consumable commodity is produced using labor and a specific middle product. However, since middle products are exchangeable for each other in world markets, their total value, $T_O$, can be thought of as a single type of input which is combined with $L_O$ to produce (in Figure 3) eight different consumption items. In the classic Neary (1978) paper, specific factors can be converted to a single mobile factor with the passage of time. By contrast, in the Sanyal and Jones (1982) model of middle products, such conversion can be done within a single period by exchanges via international trade. Thus a specific-factor setting becomes a Heckscher-Ohlin one.

A re-interpretation of activity in the Output Tier proves useful in suggesting that international trade opens up the possibility of labor developing a variety of skills that allows labor to take on some of the attributes of specific factors. In the original Sanyal and Jones model, the ability of an economy to alter the variety of specific inputs available in the Output Tier by international trade allowed for an aggregation of these specific
inputs into a single mobile input, $T_0$. Instead of assuming that the labor force used in the Output Tier, $L_0$, is homogeneous, leading to a 2x2 Heckscher-Ohlin structure, now suppose Output Tier activity leads to a heterogeneous labor force that has acquired skills appropriate to the production of each consumer good. That is, international trade allows not only the conversion of specific capitals (or non-labor inputs in the Output Tier) into a flexible aggregate, but also allows a conversion of homogeneous labor into labor with specific skills. *Trade allows a transformation of a specific-factors production structure in which capitals (or material inputs) are sector-specific and labor is mobile into a specific-factors structure with capital mobile and labor sector-specific.*

So far the emphasis has been on the joint changes brought about by international trade – the concentration of production for items exported (or produced for the world market) while allowing for a greater variety of commodities consumed. The middle products model reveals as well that international trade, with its additional need for the labor force to be used in many of the occupations required to transform middle products obtained from world markets into the set of commodities found in final consumption, does not condemn labor only to be used in a few concentrated export sectors. International trade enhances the range of skills that can be obtained by the nation’s labor force.

**4. International Fragmentation of Production**

A further alteration in the simplifying features of the Middle Products production structure takes account of the increasing degree of international fragmentation found in global production (Jones and Kierzkowski, 1990). Production processes that originally are vertically integrated, with production taking place in a single locale, are increasingly
fragmented so that final products may contain parts produced in a number of different countries. With reference to Figure 3, a more realistic view of the trading process is that it allows middle products to be traded or exchanged from country to country so that the country’s labor force is involved not only in the Input Tier and the Output Tier but also in what we might term the Middle Tier, in which labor is adding value to middle product parts or components received from the world market, and then sending off the enhanced value middle products to the world market place. The learning-by-doing phenomenon that converts a homogeneous labor force into a heterogeneous force as in a specific-factors model holds as well for labor used in the Middle Tier both to produce parts and components used elsewhere in the global market place and to provide some of the necessary “service link” activities required to allow international fragmentation of production (e.g. as described in Golub, Jones and Kierzkowski, 2007).

In Section 2’s focus on investment some labor resources were set aside to produce the kind of specific capital required to produce the commodities that are deemed best in the light of current commodity prices. In a re-interpreted Middle Products model, resources could be used both in the Middle Tier and the Output Tier to aid in the process of education and skill-acquisition for labor used to produce the new parts or final new goods from those available on world markets. Such a strategy allows fairly simple variations in the Middle Products model to highlight the role of international trade in encouraging a severe concentration of local resources and labor to produce materials for the world market as well as to provide labor with a variety of occupational activities and skills useful in trade and necessary to produce a wide variety of consumer goods.
5. Concluding Remarks

There is no denying that the simple 2x2 version of the Heckscher-Ohlin model used to such good effect by Stolper and Samuelson (1941) has proved extremely useful in illustrating how the movement from autarky to international trade alters the quantities produced locally and the distribution of income. However, the desire to increase the dimensionality of this version is driven not only by a theoretical concern for more generality\(^8\), but also to reveal that the number of commodities that a country need produce in world markets can be much smaller than the number of commodities available to local consumers, and that the choice of commodities selected for production can change over time with growth and/or changes in world prices. In the present paper we have emphasized that relatively simple competitive trade models, especially those combining properties of Heckscher-Ohlin and Specific Factors models, can illustrate features found frequently in real world settings, including the usefulness of world markets in enhancing the range of skills that can be obtained by a country’s labor force.

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\(^8\) See, for example, the pair of articles in 1969 by Murray Kemp and Leon Wegge, on the one hand, and John Chipman, on the other, in which extra conditions were sought that would provide Stolper/Samuelson types of conclusions on income distribution in higher dimensions. In each case success in this effort was obtained for a three-factor, three-commodity setting but counter-examples were illustrated for the 4x4 case. Subsequent tighter sets of sufficient conditions were obtained by Jones, Marjit and Mitra (1993) and Mitra and Jones (1999).
References


Golub, Stephen, Ronald W. Jones and Henryk Kierzkowski (2007): “Globalization and
Country-Specific Service Link Activities,” forthcoming in The Journal of Economic
Policy Reform.

Ethier, Wilfred (1972): “Nontraded Goods and the Heckscher-Ohlin Model,”


Inter-connected Markets,” Economica, 41:121-38.

____________(1995): “The Discipline of International Trade,” The Swiss Journal of

____________(2007): “Specific Factors and Heckscher-Ohlin: An Inter-temporal

Jones, Ronald W. and Henryk Kierzkowski (1990): “The Role of Services in Production
and International Trade: A Theoretical Framework,” ch. 3 in R. Jones and A. Krueger,


Figure 1: A Change in the Terms of Trade
Figure 2: Equilibrium Wage Rate
Figure 3. Trade in Middle Products