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"TWO-NESS" IN TRADE THEORY: COSTS AND BENEFITS

RONALD W. JONES

INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
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International Finance Section

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I. Introduction

The number "two" is undoubtedly encountered more frequently in the theory of international trade than in any other field of economics. It is a large number: two countries provide a more complex setting for analysis than just one. The analysis of two countries trading two commodities, each produced with one or possibly two factors of production, eschews the partial-equilibrium one-thing-at-a-time approach standard in so many areas of economics in favor of general equilibrium. But two is also a small number. It is the smallest number that can be used to describe international trade when countries have genuinely different commodities to exchange with each other.

The basic defense offered in casting so much of trade theory in "twos" is ease of exposition and lack of ambiguity in conclusions. Two dimensions are ideally suited to blackboard diagrams. Koopmans (1957, p. 175) has suggested that "Only unnecessary and self-imposed tool limitations can explain why almost the entire literature on the theory of international trade has been confined to models of two countries trading in two commodities." I suggest there are other reasons. Fundamentally, there exists a belief that most of the useful and valid points in trade theory can be made in the context of two countries, two commodities, and one or two productive factors. If so, there is surely some advantage to using such a streamlined vehicle of communication. Combined with this is the fear that general-equilibrium analysis of higher-dimensional cases cannot be coaxed into yielding definite and unambiguous comparative-statics results.

But can the simple two-by-two models in trade theory be relied upon to provide answers to basic questions that have hopes of generalizing fairly accurately to a world with many commodities, countries, and factors? Listen to some of the critics: Pearce (1970, p. 320), in discussing trade and production models, states: "... many textbooks of international trade theory (even the most advanced) lay a great deal too much emphasis upon *propositions which are true only for models with two commodities and two factors of production*" (italics supplied). Hahn (1973, p. 297), in a review of a recent book by Negishi, remarks: "... it is well known that an economy with only two goods has a number of important properties which do not carry over to the general case."

Perhaps the clearest note of criticism was that sounded by Frank Graham, whose 1948 volume, *The Theory of International Values,* culminated several decades of pioneering work aimed at setting the pure theory of trade on a much firmer foundation than had been provided by Ricardo, Mill, and Marshall. Graham (1948, p. 284) states explicitly, ". . . one of the very strongest reasons for rejection of the classical doctrines is that the classicists themselves made their analysis in such simple terms (two-country, two-commodity trade) and then erroneously projected their results into complex trading situations." In reviewing Graham's book, Elliott (1950, p. 16) summarizes Graham's attitude toward received doctrine in trade theory by remarking, "In the theory of international trade, classical and neoclassical writers were led astray . . . by generalizing from the case of two countries and two commodities."

The issue I wish to address in this paper concerns the appropriateness of "two-ness" as an assumption in the theory of international trade. I shall start where Graham left off, with a brief analysis of the issue of dimensionality in the classical, or neo-Ricardian, world characterized by constant returns in production to composite units (labor). From there I shall branch more widely into several diverse areas of international trade theory in which standard work has been characterized by the "two-ness" assumption but in which it is also possible to consider the consequences of moving beyond two. To conclude, I shall appraise the post-classical (or modern) approach known as the Heckscher-Ohlin theory in the light of our quest for higher-dimensional truths. In particular, I shall argue that the sharp distinction often drawn between Ricardian "climatic" models and the Heckscher-Ohlin theory can disappear when one heeds Graham's insistence on basing the analysis of trade upon a model with many countries and many commodities.

In my discussion, I shall in large measure (but not exclusively) pick examples from my own work. For the past twenty years I have taken seriously the kind of question concerning dimensionality that was posed so forcefully by Graham. But perhaps I have been more conservative—trying to reveal how the "two-ness" assumption can often be salvaged to play a useful role in expressing basic economic truths. As I shall argue, this defense of the simple models is frequently made possible only after basic concepts are reformulated to take account of economic relations more clearly viewed in higher dimensions.

II. The Classical Trade Model and Graham's Criticism

The basic Ricardo-Mill-Marshall model that attracted so much criticism from Graham can be sketched as follows: In each of two countries, fixed labor costs (man-hours) per unit of output would be required to produce one unit each of two commodities (wine and cloth). In the absence of international exchange, each country would supply its own residents' consumption demands and wine and cloth would exchange for each other according to their relative (labor) costs of production. For countries not sharing the same technology (or climate), these costs ratios would differ between countries. Once free trade is made possible, some ratio of commodity exchange is struck between the limits set by the cost ratios in the two countries. Although Ricardo was mute concerning precisely how such terms of trade were established, both Mill and Marshall asserted that the forces of reciprocal demand—in each country for the product in which the other country possessed a comparative advantage—would determine an equilibrium trading ratio.

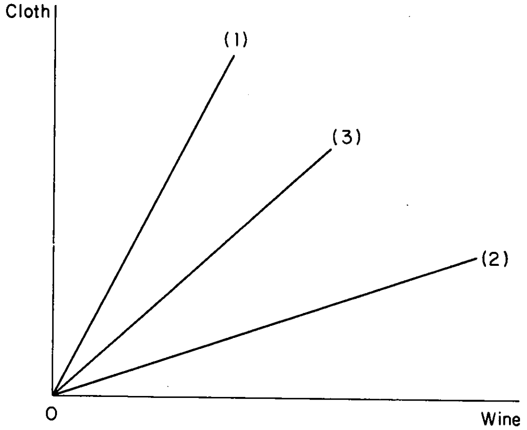
Perhaps the feature of this solution that most disturbed Graham was the assertion that the terms of trade would lie *between* the cost ratios in either country. With occasional remarks to the contrary, most classical writers illustrated, in their numerical examples, a trading ratio lying *strictly* between the cost ratios in each country. This is what Graham called a "limbo" ratio, one not anchored by costs of production, since each country specializes in a different commodity. The striking feature of such a limbo solution is that changes in tastes cause prices to change but there is absolutely no response in supply.

The alternative, which Graham viewed as "normal," involves terms of trade equilibrated to the cost ratio in one of the countries, with at least one commodity produced in common by more than one country. He provided numerical examples with either more than two countries or more than two commodities, or both, in which an "intermediate" commodity or country served as a link between the two countries' cost structures. Thus, in a three-commodity, two-country case, each country could produce the commodity in which it possessed the greatest comparative advantage as well as the intermediate commodity. Labor costs in each country would then serve to bind the price of the intermediate commodity to each of the other two commodities. In such a world, according to Graham, changes in the structure of world demand could be accommodated by reallocations of labor in each country between the two goods that country produces without any change in the terms of trade.

The role of intermediate commodity thus described could alternatively be played by a third country. To the two-country, two-commodity case now add a third country whose cost ratio is intermediate between the two other countries. Figure 1 illustrates this cost ratio by the slope of intermediate line (3). If the world terms of trade coincide with the cost ratio in the third country, a shift in tastes could serve just to alter production patterns in the intermediate country instead of changing the terms of trade.

FIGURE 1

Cost Ratios in a Ricardo-Graham Model



Since Graham's work, there has apparently emerged an agreement among writers in this area that an eclectic view is appropriate. In a world of many countries and many commodities, a disturbance to trade may be met primarily by price changes, on the one hand, or production changes, on the other. Limbo price ratios may occur and are not as "unstable" as Graham would have led us to believe. The analytical concept that supports this view is of a world production-possibilities surface which, in the Ricardian world of constant returns to single primary inputs in each country, consists of "flats," "ridges," and "corners" of various dimensions, depending upon the number of commodities and countries.[1] A simple two-commodity, three-country version is illustrated in Figure 2.

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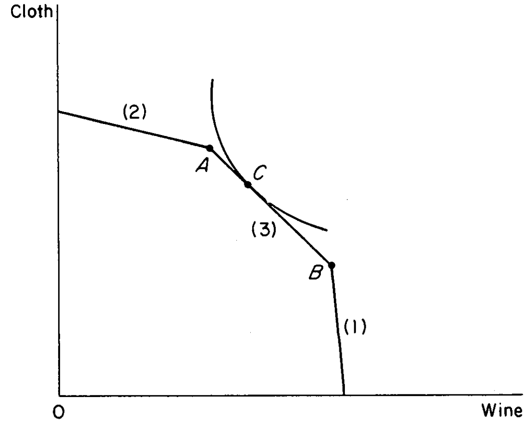
[1] This concept was used by Whitin (1953) and McKenzie (1954).

FIGURE 2
THE WORLD TRANSFORMATION LOCUS



The slope of each segment corresponds to the cost ratio in the designated country (as shown also in Figure 1).

Imagine now being able to describe world taste patterns by a set of smoothly bowed-in indifference curves. A point of "tangency" between one such curve and the transformation locus could take place anywhere along the surface. If it takes place at *C* (as illustrated), intermediate country (3) indeed fulfills its Graham role of producing both wine and cloth, leaving country (1) to produce just cloth and (2) to concentrate on wine. But a different taste pattern (not drawn) could easily result in a corner (or limbo) solution such as *A*, with prices strictly between the slopes of (2) and (3).

It is certainly the case that Graham forces us to consider the possibility that the terms of trade will be reflected in the cost ratio of some country that is incompletely specialized. But is it necessary to abandon the simple two-by-two world to illustrate this point? Not at all. Indeed, Graham argued strongly that, even in a world composed of two countries and two commodities, the terms of trade would be unlikely to lie strictly between the cost ratios in each country. More likely, in his view, would be a disparity either in country size or in the relative importance of commodities that would drive one of the countries to produce both commodities.

The appropriate criticism of the two-by-two model, then, is not that it excludes the possibility that the terms of trade may correspond to some country's cost ratio but that it suggests such a possibility is *extreme*. In such a model, there is a whole range of possible equilibrium terms of trade. All the ones "in the middle" are limbo ratios. The solution that Graham terms normal can be found only at one extreme ratio or the other, for example, the slopes of rays (1) or (2) in Figure 1 when country 3 is absent. I refer to this more generally as the phenomenon of the *excluded middle*, a trait of "two-ness" that will show up in other contexts. In general, I submit that, if a wide variety of solutions is possible, some midway solution suggests itself more naturally than an extreme solution. Certainly, Ricardo, Mill, and Marshall found this case seductive in most of their arithmetic examples. The difficulty with the structure of the two-country, two-commodity model is that there is no middle solution that is capable of expressing what to Graham was normal—terms of trade that are a reflection of opportunity costs.

Graham points out as well that the higher-dimensional cases admit a richer variety of possible outcomes than does the two-by-two model. Can a fall in world demand for a nation's export commodity improve that country's welfare? Certainly not in the two-country, two-commodity case. In suggesting the alternative possibility, Graham is stressing that today's exports may become tomorrow's imports. With sufficient commodities and countries explicitly considered, the entire trading (and production) pattern in a country can change when tastes are altered. By contrast, in the two-by-two case each country has only one commodity it can ever export (excluding technical progress).

The criterion for comparative advantage in the two-by-two case involves a double bilateral-ratio comparison: the ratio of labor costs in wine and cloth in one country compared with a similar ratio in the other country. Now enlarge the scope of the model: three countries (America, Britain, and Continental Europe—A, B, and C), each capable of producing three commodities, say corn, linen, and cloth. Some years ago, I analyzed this kind of model and provided a numerical solution in which America was assigned production of linen, Britain production of corn, and Continental Europe production of cloth. With the labor-cost figures chosen,[2] it turned out that each country had a bilateral comparative advantage in the commodity assigned to it relative to either of

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[2] See Jones (1961, p. 163). This example was suggested by a diagrammatic illustration in McKenzie (1954). For ease of reference, I reproduce the numerical example here. Each number represents man-hours per unit of output.

	America	*Britain*	*Continental Europe*
Corn	10	10	10
Linen	5	7	3
Cloth	4	3	2

the other countries compared with the commodity assigned to each of them. That is, if a_j^i represents the labor cost (man-hours) in country i per unit output of commodity j,

$$a_{linen}^A/a_{corn}^A < a_{linen}^B/a_{corn}^B\,, \quad a_{linen}^A/a_{cloth}^A < a_{linen}^C/a_{cloth}^C\,,$$

and

$$a_{corn}^B/a_{cloth}^B < a_{corn}^C/a_{cloth}^C\,.$$

These are the comparisons suggested by the two-by-two model. However, with the numbers chosen, it turns out that this set of production assignments could never be tolerated in a free-trade competitive world. The criterion that was used in the two-by-two model turned out not to be incorrect, but rather to be *insufficient* in a genuine multilateral world. An alternative assignment (America in corn, Britain in cloth, and Continental Europe in linen) turned out also to satisfy the appropriate bilateral rankings. No comparison between the efficient specialization (America in corn, etc.) and the inefficient one (America in linen, etc.) was possible using just a pair of countries and commodities at a time.

Lest these remarks serve to cast doubt on the generalization of the concept of comparative advantage, I hasten to add that the appropriate general criterion for choosing among production assignments in a Ricardo-Graham model does, of course, reduce to the standard bilateral comparison in the two-by-two case. It just appears in slightly different guise. Both specializations cited above for the three-by-three model involved the specialization of each country in a different commodity (and thus all three commodities were produced—each by a different country). How many patterns of production should be considered? There are six candidates for this "class" of assignments.[3] (There are three choices for corn. Each leaves two for linen, with the remaining country in cloth.) The optimal (or efficient) assignment in this class is the one that *minimizes* the product of labor coefficients. Thus, the second of the two specializations I cited had

$$a_{corn}^A\, a_{cloth}^B\, a_{linen}^C < a_{linen}^A\, a_{corn}^B\, a_{cloth}^C \quad (90 < 100)\,.$$

This minimum-product rule can be translated into the bilateral-ratio rule in the two-by-two case. For example, the first bilateral-ratio comparison cited previously can be written as

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[3] As I have defined the term, a "class" of assignments specifies how many countries are to be completely specialized in each commodity. Here there is one country in each commodity (see Jones, 1961, p. 164).

$$a^A_{linen}\, a^B_{corn} < a^A_{corn}\, a^B_{linen}.$$

The criterion in the two-by-two case thus rewritten serves as the appropriate guide for the multilateral case.

This phenomenon will occur again in comparing a model characterized by "two-ness" with a higher-dimensional version: alternative and equivalent criteria in two-by-two cases may not prove equivalent in more general settings. But knowledge of the general case can aid in recasting criteria in the simple model so that it can generalize.

Let me make one final remark about this Ricardo-Graham model before turning to other issues. In general, we can specify two categories of production assignments of countries to commodities. Some assignments are efficient, and, if world prices (or world demands) are appropriate, these production patterns could be observed in a free-trade world. Other assignments are inefficient, so that no conceivable pattern of demand (or prices) could coax them into existence given the competitive pressures of free trade. Indeed, the doctrine of comparative costs should, I think, be viewed as telling us not what *will* be produced (for that depends on demand as well) but what patterns *cannot* be produced in a worldwide competitive framework. Suppose we restrict ourselves to patterns of production in which each country is completely specialized in some one commodity. If there are n commodities and r countries, there are n^r possible assignments of this type. In a two-by-two model there are four.[4]

How many of these assignments are inefficient? In a two-by-two world, only one (each country assigned the commodity in which it has a comparative disadvantage). That is, in the basic two-by-two world the doctrine of comparative advantage can be used to knock out only 25 per cent of the possible production patterns based on complete specializations. In this sense, the two-by-two model does insufficient justice to the power of the doctrine. In a three-by-three world, a full 17 out of 27 (or 63 per cent) of the assignments are ruled out; in a four-by-four world, the percentage of inefficient production assignments rises to 86. Multilateral models of comparative advantage—of the kind considered by Graham—reveal more forcefully than the classical two-country, two-commodity model the ruthlessness with which a regime of free trade requires countries to abstain from inefficient production assignments.

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[4] One assignment has both countries producing, say, wine, one has both producing cloth, and two have one country in wine and the other in cloth.

III. New Possibilities in a Multicommodity, Multifactor Setting

A natural formal objection to models characterized by "two-ness" is that they are automatically precluded from displaying compositional features that can emerge in higher-dimensional cases.

To illustrate, consider the relationship between commodity outputs and prices along a smoothly bowed-out production-possibility schedule. Suppose the price of commodity 1 rises, all other commodity prices remaining constant. Output in the first sector must rise. This is a common property of general-equilibrium models that holds regardless of the number of sectors. In a two-sector economy, such output expansion in the first sector must draw resources away from the second. But in a multisector model this condition does not usually generalize to *every* other sector. Some sectors may expand when p_1 rises—those that are complementary to the first sector. Formally, if p_1 rises in an n-sector model (other prices remaining constant), $\sum_{j \neq 1} p_j \, dx_j$ must be negative. But *some* other outputs may expand.

A similar observation can be addressed to demand behavior along smoothly bowed-in indifference surfaces. With real income held constant, a rise in p_1 would induce a fall in demand for commodity 1 (D_1) and a substitution toward *some* other commodities. Indeed, $\sum_{i \neq 1} p_i \, dD_i$ would have to be positive. But not *all* other D_i's need rise. Some may be complements of good 1 in consumption, a feature precluded in the two-by-two models.

This possibility of complementarity lies at the root of a phenomenon discussed recently by Gruen and Corden (1970). In the standard two-commodity model, a country might improve its terms of trade by levying a tariff. A duty on imports, so the argument goes, could serve to depress the world price of imports by artificially creating a reduction in home demand. Symmetry compels the same conclusion to emerge in the case of an export tax: the world price of the country's exports could be bid up. The exception to this result follows in the case in which the home country is too small to be able to exercise any influence over world prices. In this event, a tariff (or export tax) would leave the terms of trade unaffected.

By adding one more commodity (and one more factor), Gruen and Corden provide an example in which a tariff serves to *worsen* the terms of trade. In addition, their example usefully points out how in a multicommodity world a country may be "small" in some markets but not in others. Their example is intended to capture some of the features of the Australian economy. Only one commodity is imported (textiles), and it utilizes capital and labor. Two commodities are exported—wool and grain—and each requires land and labor (but not capital). Of these two export items, wool employs a higher proportion of land to labor than does grain.

This description ensures that wool and textiles are complements in production. Suppose the domestic price of textiles rises because a tariff is levied on textiles and the country is too small in the world textile market to influence world prices. If the prices of grain and wool are (temporarily) held fixed, what resource shifts are induced? Clearly, textiles draw labor away from the export sectors. Wool and grain production together form a subset of the economy in which total land availability is constant (land is not used in textiles), and in which labor supply has been depleted (the departure of workers to the protected textile industry). At constant prices (for wool and grain), the standard Rybczynski (1955, pp. 336–341) result for a two-sector economy asserts that labor-intensive grain output falls but land-intensive wool output actually rises.

Gruen and Corden use the complementarity between textiles and wool in this example to establish their "paradox" by assuming further that, although the country cannot influence grain prices, it can affect the world price of wool. The tariff on textiles has caused local output of wool to rise. If this exceeds any rise in local demand, the world price of wool will be depressed. Thus, the only influence on world prices exerted by the initial tariff on textiles is a lowering of the wool price. A tariff has worsened a country's terms of trade. Complementarity, either in production or consumption (or both), is thus a new feature introduced by moving beyond the world of twos.

There are also *problems* that cannot effectively be posed without introducing more than two commodities, factors, or countries. For example, the theory of customs unions requires at least three countries in order to capture the phenomenon of two or more nations banding together to create a tariff structure that discriminates against other countries in favor of the nations in the union.[1]

At a more basic level, the presence of more than two commodities is required in order to raise the question of optimal tariff *structures*. A simple illustration involves a country too small to affect world prices that imports two commodities (2 and 3) in exchange for exports of another commodity (1). Suppose that the country has imposed a tariff at rate

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[1] For recent treatments of the customs-union issue, see Kemp (1969) and Berglas (1975).

t_2 on its imports of commodity 2, and that this rate cannot be changed. (For example, strong trade-union pressure has forced protection in the second industry.) Also, suppose there is required free trade in the market for its exportables. Should this small country levy a duty on its imports of commodity 3? If so, at what level?

The analysis of this case is straightforward. Since the country is small, there are no terms-of-trade effects. Real income is affected only if the volume of trade is altered in any market in which world price (p_j^*) differs from domestic price (p_j). By assumption, no such discrepancy exists in the nation's export market, but it does in the market for the second commodity. A small initial duty on imports of commodity 3 would, if commodities 2 and 3 were substitutes, tend to shift demand toward 2 and production away from 2. On both counts, imports of 2 would rise; this would raise real income, since the local value of the second commodity to home residents is reflected in the domestic price, p_2, which exceeds the cost of obtaining commodity 2 on world markets (p_2^*) by the amount of the fixed tariff rate, t_2. But this reasoning also suggests that further increases in the duty on commodity 3 will introduce some harmful effects on real income as a tariff wedge in the market for good 3 is established and imports of good 3 are reduced.

Formal analysis in this case reveals that, if all goods are substitutes, the small country should impose a duty on the third commodity, but *at a lower rate* than the fixed duty on the other importable. If M_j denotes excess demand for good j, the change in home real income (measured in units of the first commodity) as tariff rate t_3 is increased is given by

$$\frac{dy}{dt_3} = \sum_j (p_j - p_j^*) \frac{dM_j}{dt_3}.$$

Real income reaches a maximum when this expression is zero, or when tariff rate t_3 is given by

$$\frac{t_3}{1 + t_3} = \left[\frac{p_2(dM_2/dt_3)}{-p_3(dM_3/dt_3)}\right] \cdot \frac{t_2}{1 + t_2}.$$

With p_3 the only variable price, and since in the neighborhood of the point of maximum utility the real-income effects of a tariff rise vanish,

$$\frac{dM_j}{dt_3} = \left(\frac{\partial D_j}{\partial p_3} - \frac{\partial x_j}{\partial p_3}\right) p_3^*,$$

where the consumption effect, $\partial D_j/\partial p_3$, reflects only a substitution term. For substitution effects in consumption, $\sum p_j(\partial D_j/\partial p_3)$ equals zero. For movements along the transformation frontier, $\sum p_j(\partial x_j/\partial p_3)$ is also zero.

Therefore,

$$\frac{t_3}{1+t_3} = \left[\frac{p_2\left(\dfrac{\partial D_2}{\partial p_3} - \dfrac{\partial x_2}{\partial p_3}\right)}{p_1\left(\dfrac{\partial D_1}{\partial p_3} - \dfrac{\partial x_1}{\partial p_3}\right) + p_2\left(\dfrac{\partial D_2}{\partial p_3} - \dfrac{\partial x_2}{\partial p_3}\right)} \right] \frac{t_2}{1+t_2}.$$

If all commodities are substitutes in consumption and production, each term in parentheses is positive, and optimal t_3 is a positive fraction of predetermined t_2. Thus the introduction of a second import commodity suggests, for the small country, a *nonuniform tariff structure*. Note that if the two imports become highly substitutable for each other, the optimal value of t_3 approaches tariff rate t_2, while if exportables and commodity 3 are highly substitutable instead, good 3 should be (almost) freely traded. These are the limits suggested by the two-commodity model.

The "second-best" flavor of this example should be stressed. Since the country is assumed not to be able to affect the world terms of trade, the optimal tariff on good 2 would be zero. If t_2 cannot be reduced, an alternative route is to impose an export tax on commodity 1 and a tariff on commodity 3, both at the same rate as t_2. It is only when a fixed *relative* tariff wedge is prescribed—between export commodity 1 and import commodity 2—that a second-best nonuniform tariff structure is revealed as more commodities are added to the model.[2]

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[2] A more complicated problem in tariff structure is provided in the literature on optimal taxes on foreign investment when an optimal tariff policy is simultaneously being pursued. The details of the relationship between capital and outputs in the production process (both at home and abroad) are involved in the question of the optimal pair of tax distortions (see Kemp, 1966, and Jones, 1967). A point to emphasize about this literature, however, is that it involves only two countries, two commodities, and two productive factors. The problem of tariff *structure* is introduced by allowing trade in capital services as well as in the two commodities.

IV. The Role of Nontraded Commodities

In traditional two-sector models, both commodities are traded. No room is left for commodities which, by virtue of high costs of transport, are neither imported nor exported. It would seem that a basic case against "two-ness" in trade theory can be launched with the assertion that the introduction of nontraded commodities can significantly alter traditional findings in models with only importables and exportables. I shall argue in a later chapter that the role of nontradeables can frequently be analyzed without sacrificing the essential "two-ness" of the model. But first let me sidestep this issue in order to suggest the nature of the new phenomena which the incorporation of nontradeables allows the model to reveal.

The distinguishing characteristic of nontradeables is that their market is national instead of international. Any local excess supply of nontradeables cannot be disposed of on world markets. Instead, the local price must fall. The "small country" case, in which the home country has no control over the prices of traded goods, points up in extreme fashion this distinction between tradeables and nontradeables. An immediate consequence of this distinction is that to determine the impact of any change abroad on local consumption and production it is necessary to incorporate the effect of this change on the market for nontradeables *and* the subsequent feedback to the markets for tradeables. It would be fallacious to argue that if models of international trade are ultimately concerned only with markets for exportables and importables, they can usefully ignore the background adjustments in the nontraded-goods markets.

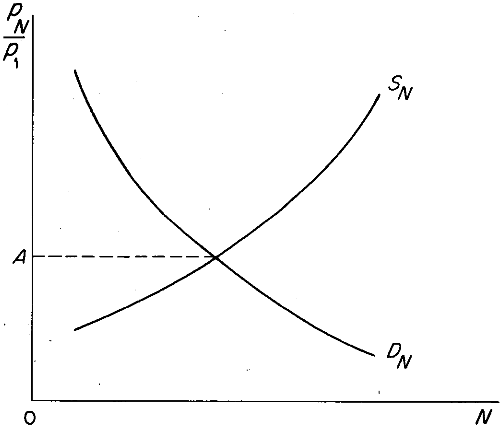
This potentially crucial role for nontraded goods can be illustrated by examining the following question: Suppose the price of a small country's exportable (say commodity 1) rises on world markets, the prices of all other *traded* goods remaining constant. Must this price rise encourage the production of exportables? We argued in the preceding section that moving to a model with many commodities did not disturb the conclusion that a rise in p_j *alone* would cause output, x_j, to rise. At issue here is the potential for overturning such results when account is taken of required changes in prices of nontradeables.

Although this example can be handled in a general three-commodity model, new results can more easily be obtained by assuming that the community consumes none of export commodity 1 and produces none of import commodity 2, although of course it must both produce and consume a nontradeable commodity (N).[1]

Start by assuming that the price of export commodity 1 is driven up in world markets. The repercussion on the market for nontradeables is discussed with reference to Figure 3. The supply curve shows the influence of a rise in p_N/p_1 in attracting resources to the nontradeable sector. With only nontradeables and exportables produced (by assumption), this supply curve is invariant as world p_1 rises. Not so the demand curve. Since the community consumes commodities 2 and N, the demand curve in Figure 3 is drawn as of given terms of trade (p_2/p_1). The price of importables, p_2, is held fixed, but when p_1 rises, initial *relative* price OA (Figure 3) indicates a higher price for nontradeables as well. That is, at initial OA there has been a rise in p_N/p_2. The substitution effect in consumption would serve to shift the D_N curve leftward.[2] But the terms of trade have improved with the rise in p_1, and the consequent real income gain serves to shift the D_N curve rightward. If the income effect dominates, the relative price and output of nontradeables rise. That is, output of exportables falls as a consequence of an increase in their price.

The criterion sufficient to ensure this paradoxical-sounding result can be put in more recognizable form. An equivalent percentage rise in export

FIGURE 3
DEMAND AND SUPPLY FOR NONTRADEABLES



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[1] These assumptions were exploited in Jones (1974a).

[2] Alternatively, the D_N curve shifts downward (for the substitution effect) by the same relative amount as p_1 has increased. With real income and p_2 constant, the absolute price of p_N would have to remain constant in order to ensure that the same quantity is demanded.

and nontraded-goods prices (keeping the ratio at OA in Figure 3) at a constant p_2 has the same impact on real quantities as a fall in p_2 at constant p_1 and p_N. In the latter event, the absolute value of income produced is also constant. The quantity of importables demanded would rise, but the aggregate value of spending on importables would fall if the ordinary elasticity of demand for importables was less than unity. Suppose it is. Then the value of spending on home goods (the only other outlet for spending) rises and, to clear the market, p_N/p_1 would have to rise. That is, a rise in the price of exportables serves actually to *reduce* the quantity of exportables produced if the demand for importables is inelastic, since in this case the price of home goods is driven up by more than the price of exportables.[3]

In a two-commodity model, the sensitivity of a nation's demand for imports to a change in the terms of trade is linked directly and unambiguously to the extent of producer and consumer response to prices. Indeed, the elasticity of import demand can be expressed as the straightforward sum of an elasticity of consumer demand for importables and an elasticity of production response for exportables (or importables) (for explicit statements, see Caves and Jones, 1973, Chap. 6). When nontradeables are added, this view must be modified. For example, in the simplified version of the model just considered—with no local consumption of exportables or production of importables—ask whether the elasticity of demand for imports (with respect to the terms of trade) is increased if the elasticity of supply of exportables (along the transformation curve) is increased. A straightforward affirmative answer cannot be given: it depends upon demand behavior.

The logic of this position is illustrated by the offer curve (reciprocal demand curve) for imports drawn in Figure 4. Import demand is elastic in the neighborhood of A and inelastic near B. Following the preceding analysis, suppose the price of exports rises and import prices are constant. If the terms of trade are initially given by ray OA, such an improvement in the terms of trade raises exports, since import demand is elastic. As already shown, behind the scenes the home-goods market is cleared with a rise in the price of nontradeables that is less than the rise in export prices. The production of exportables (and therefore the volume of exports) rises because the relevant price ratio, p_1/p_N, rises. The higher the elasticity of export production along the transformation curve, the more elastic will be the offer curve. Contrast this with the situation if the terms of trade are initially shown by ray OB. An increase in p_1 causes production of exportables to fall. This paradoxical-sounding case reflects a behind-the-scenes rise in the price of nontradeables that exceeds the rise in export prices. This, in turn, was caused by the inelasticity in demand for importables, which channeled so much of the increase in real income provided by the terms-of-trade improvement into the nontradeables market. With p_1/p_N falling, the greater the value of the elasticity of export supply, the more *inelastic* will be the offer curve in region B.

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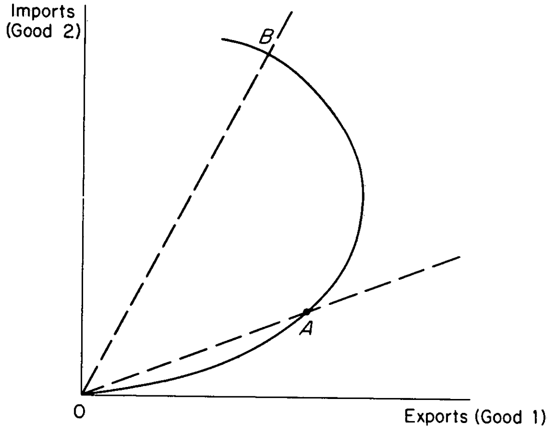
[3] Brief mention can be made of another paradoxical-sounding case in the literature that is closely related. In Kemp and Jones (1962), the following question is raised: If the price of one traded good rises relative to another, can output of the first good actually fall? Yes, if the labor-leisure choice is made explicit. Suppose as the price of exportables rises, the demand for leisure also rises. If exportables are labor intensive and labor supply is backward bending, production of exportables might actually fall. Much depends also on the possibility of complementarity between leisure and the produced commodities. The point to emphasize here is that leisure is a nontraded commodity. However, in this case the price of leisure (the wage rate) is determined *not* by local demand but rather by world prices for traded goods.

FIGURE 4
THE OFFER CURVE FOR IMPORTS



Discussions during the 1940s and 1950s of stability conditions in trade or conditions required for successful devaluation[4] noted this peculiar relation between supply elasticities for exportables and demand elasticities for imports. Even if "stability" was threatened by low values of demand elasticities, low (rather than high) values for supply elasticities might save the day [see Metzler's (1949, p. 227) discussion]. This is a peculiarity of the model totally absent in the two-sector version and reflects the background adjustments in the home-goods market.

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[4] I do not mean to imply that the issue of market stability is equivalent to the effect of currency devaluation on the trade balance. But these issues were confused with each other during this period (see, for example, Ellsworth, 1950, or Metzler, 1949).

Not surprisingly, almost all results in two-sector trade theory are modified to some extent if a nontraded sector is added. For example, the criterion in a two-sector model stating in which direction the terms of trade will move when one country makes a transfer to another is extremely simple: it involves only a comparison of marginal propensities to import. More generally, it becomes necessary to ask how a transfer affects markets for traded goods at initial terms of trade when the markets for home goods have cleared. The criterion for a terms-of-trade deterioration for the transferor thus becomes complicated by demand and supply elasticities that capture responses to the required adjustment in the price of nontradeables even at the initial terms of trade.[5]

It is interesting to note that the importance of nontraded goods for the transfer issue was clearly discussed at an early stage by Frank Graham. This is perhaps not surprising, given Graham's insistence that trade theory be made more realistic by incorporating many commodities—even those not entering international trade (see Graham, 1948, pp. 184–200 and 277).

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[5] Full discussions of the transfer problem when nontraded goods are present can be found in Chipman (1974) and Jones (1975b). The tariff literature can also be reassessed when nontraded goods are present. As I show in Jones (1974c), a country may expand its demand for imports when the terms of trade deteriorate if its exportables use the import as an intermediate good and if it also produces a nontradeable. The concept of effective protection is relevant here. In this discussion I have avoided mention of the theory of effective protection and its collection of paradoxes. For example, see the Ramaswami-Srinivasan (1971) result: output in a sector granted effective protection may fall. See also my analysis of this problem in Jones (1971a). These "paradoxes" are as much a consequence of the concept of a "value-added product" as of moving beyond the two-commodity or two-factor case. For a general discussion, see Corden (1971).

V. Functional "Two-ness"

I have thus far taken a view of "two-ness" that is, I would argue, too narrow. The number "two" has been used to count the number of commodities, countries, and factors of production. For example, in the last chapter I showed how introducing a third, nontraded commodity could alter some of the conclusions derived in a two-commodity world. And yet, in a sense, a model with *three* commodities—exportables, importables, and nontradeables—is a model characterized by "two-ness" if you focus on the number of *markets*. What makes life so simple (and restricted) in a two-commodity general-equilibrium trading model is that there is only *one* market—in which exportables exchange for importables.

Even this argument still restricts the number "two" to identifying the quantity of similar items: commodities, countries, factors of production, or (with the above extension) markets. I would stress the possibility of a more functional view. Simple models can be constructed that stress two *types* of commodities, factors, or countries.

The analysis of trade models with nontraded commodities provides a key illustration. Suppose a small country produces many commodities that are exchanged at constant world prices as well as some commodity that is not traded. The Hicksian composite commodity theorem allows all the traded commodities to be lumped together, since their prices are fixed relative to one another. The model then usefully reduces to a two-commodity model: tradeables and nontradeables. Indeed, it was the belief that in some circumstances the relative price ratio of nontradeables to tradeables was more important than the terms of trade that motivated extensions of the standard two-commodity model (see, for example, Pearce, 1961). When a small country devalues its currency, how can resources be reallocated if it cannot change world prices? If the price of nontradeables can be suppressed relative to higher prices for both exportables and importables, a resource transfer toward tradeable goods can signal a successful devaluation. As Salter (1959) and others have shown, the techniques of analysis long familiar in standard two-commodity trade theory—transformation curves, indifference curves, and the like—are directly applicable to the tradeables-nontradeables distinction in small-country models (see also the discussion in Caves and Jones, 1973, Chap. 19).

The procedure of lumping all traded goods together would break down if the terms of trade changed. In the preceding chapter, I analyzed a problem of this type: the price of importables was fixed, the prices of exportables rose, and the price of nontradeables had to adjust to clear markets. However, the simplifications chosen in that discussion allowed many of the features of "two-ness" to be preserved: the country only consumed a pair of commodities (nontradeables and importables) and only produced a pair of commodities (a different pair—nontradeables and exportables).

More generally, I would argue that the two-sided nature of the distinction between tradeables and nontradeables can be exploited even in "large"-country cases in which the terms of trade are endogenous. The transfer-problem literature bears this out. To ask about the impact of transfer on the terms of trade, it is useful first to ask about the realignment of world demands and supplies at *given* terms of trade. This permits one to examine in each country the flow of resources into or out of tradeables as a group. With the price of nontradeables in each country adjusting to clear home-goods markets, the state of excess demands for the *two* tradeables can then be examined for the ultimate direction of change in the terms of trade—much as in the easier two-good model.[1]

Implicit in these remarks is another useful type of two-sided distinction between sizes of countries. There is no doubt that the concept of a "small" country has been extremely productive in trade theory. For many issues, it is unimportant to examine the compositional pattern of changes in the "rest of the world" if the disturbance introduced by a small country cannot materially affect world prices.

Just as the degree of "tradedness" can characterize two classes of commodities, so can the degree of intersectoral mobility characterize two classes of productive factors. One of the oldest production models portrays each of two sectors producing a unique output with the use of two productive factors. One of these is specific to that sector while the other is used in both industries and is sufficiently mobile to earn the same return in each. Although this is a three-factor model, the sense of "two-ness" is maintained in that only two inputs are required for each output. More important, there are only two *types* of productive factors: specific and mobile. Indeed, most features of this three-by-two model faithfully project themselves to the n-sector, $(n + 1)$-factor extension. One factor (say labor) is freely mobile between sectors, while in each sector some other specific factor is used only in that sector.[2]

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[1] All this assumes the markets are stable. For details, see Jones (1975b).

[2] The three-factor version of the specific-factors model is analyzed in Jones (1971b, pp. 3–21) and Samuelson (1971). Applications to the distinction between short-run and long-run models are found in Mayer (1974) and Mussa (1974). The $(n + 1)$–factor, n-commodity version is presented in Jones (1975a). An analogous distinction can be made between factors tied to a particular country and factors internationally mobile. Indeed, some factors

Two-sector models naturally invite bilateral comparisons. These comparisons can still be made in a multisector model, but the number of possible pairings rapidly multiplies. Often a sense of "two-ness" can be preserved in a multisector setting by contrasting any sector in which one is particularly interested with the *average* over all sectors. These averages, in turn, often possess properties quite stable relative to the structural detail in each individual sector. Examples are provided in Chapter VIII below, "Generalizations in Heckscher-Ohlin Theory."

(say, capital) may be relatively mobile between countries but not between occupations, while others (labor) may be immobile internationally but competitive as between sectors internally. An exposition of the case of internationally mobile capital is provided in Jones and Ruffin (1975).

VI. The Identification Problem

In criticizing classical doctrine, Graham (1948, Chap. 9) devoted an entire chapter to spelling out the difficulties in the concept of "reciprocal national demand." The problem, according to Graham, involved the incorrect identification of demand *for* commodities with demand *by* countries:

> When, instead of discussing the *total* reciprocal demand (supply) for the various products in an integrated trading system, the classicists split demand (supply) into irrelevant national parts, with assumed reciprocal national demands for fixed sets of commodities of mutually exclusive composition (supposed, qualitatively, to represent the unalterable output of each of the several trading countries), they were indulging in pure fantasy [pp. 158–159].

This is a pitfall made all the easier to step into if the dimensionality of the analysis is limited to two countries and two commodities. With each country committed to a particular export commodity, its demand for the other commodity is easier to identify with its demand for imports. In a general multilateral setting, by contrast, it would seem more natural to focus in turn upon all nations' demands and supplies of particular commodities.

The point Graham is making can be illustrated by considering the classic market-stability condition in the two-country, two-commodity case that is associated with the names of Marshall and Lerner.[1] Suppose ε_i denotes the (positive) elasticity of demand for imports in country i—defined as (minus) the relative change in quantity of imports demanded along that country's reciprocal demand curve divided by the relative change in that import price. The market is stable if

$$\sum_{i=1}^{2} \varepsilon_i > 1 .$$

Suppose a third country is added to this two-commodity world. Is stability more likely? Does the stability criterion, the sum of import demand elasticities exceeding unity, generalize by adding more countries?

To ask the question this way is to betray the negative answer. But suppose the two-commodity, two-country stability criterion had been rewritten to emphasize the behavior of *world* excess demand for one of the two commodities, say commodity 2. Let me simplify in an inessential way by posing the problem in an exchange model in which each country's production of the second commodity is invariant to prices. If p denotes the relative price of commodity 2, and D_2^i country i's demand for 2, stability requires that

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[1] The references are to Marshall (1923, Appendix J) and Lerner (1944).

$$\sum_{i=1}^{2} \frac{dD_2^i}{dp} < 0.$$

To put this into elasticity notation, let

$$\omega_2^i \equiv -\frac{p}{D_2^i} \cdot \frac{dD_2^i}{dp}.$$

Then the condition can be rewritten as

$$\sum_{i=1}^{2} \frac{D_2^i}{D_2} \cdot \omega_2^i > 0,$$

where D_2 is total world demand for commodity 2, $\sum D_2^i$. This statement, equivalent to the Marshall-Lerner condition, more readily generalizes to many countries because it states that a weighted average of the various countries' elasticities of demand for commodity 2 is positive.[2] Adding a third country reduces the weight that any individual country receives.

Along this same theme, consider a model characterized throughout by "two-ness": two countries, two commodities, and two currencies.[3] The fact that the same number of countries (or currencies) as commodities is specified makes it more tempting to identify the commodity-price ratio (the terms of trade) with the currency-price ratio (the exchange rate). As Graham (1948, p. 280) observed, "There is even some tendency to confuse rates of exchange of currencies with the ratio of exchange of goods." As Graham went on to state, this confusion would be more supportable if each country were specialized in a different commodity and the price in each country for the single commodity produced by that country were pegged in terms of the domestic currency. The terms of trade do, indeed, then change in proportion to the exchange rate. However, a difficulty with this story is that it suggests that exchange authorities charged with setting exchange rates must really be in the buffer-stock business of supporting commodity prices in each country in terms of that country's currency.

In any case, the point I wish to stress is that an identification of the exchange rate with a commodity-price ratio would be much less likely if the number of commodities greatly exceeded two.

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[2] More insight into the nature of the condition could be obtained by decomposing each ω_2^i into a substitution term and an income term. The latter would normally be negative for exporters and positive for importers. For details, see Caves and Jones (1973, pp. 56–57).

[3] The number of productive factors behind the scenes could exceed two.

As a final remark on this theme, return to the case discussed by Gruen and Corden (1970) in which a country produces one import-competing commodity (textiles), and two exportables (grain and wool). It levies an import duty on textiles, and this opens the possibility that its terms of trade may deteriorate. In a two-commodity model, the Lerner (1936) symmetry theorem establishes that an import duty is equivalent to an export tax in its real effect on the terms of trade. In the Gruen-Corden three-commodity case, suppose the country had levied an export tax on wool instead of an import duty on textiles. The possibility of the paradoxical worsening of the terms of trade would disappear: the world price of wool would be driven upward. The symmetry theorem in this case states that an import duty on textiles is equivalent to an export tax on *both* exportables. It would be incorrect to equate a tariff on textile imports with a tax just on wool exports.

VII. The Aggregation Problem

Two-sector models are often defended on the grounds that each sector represents an aggregate of a number of individual commodities. Thus a nation might import 53 different types of commodities and yet speak of the effect of a rise in the import price level on the aggregate quantity of imports demanded. If these 53 commodities differ from each other significantly in the extent to which the demand for (or production of) each is sensitive to price, it would be unreasonable to expect any individual elasticity of import demand to be accurately mirrored by the aggregate elasticity of import demand. But suppose symmetry is the order of the day: a 10 per cent increase in the price of any individual import item always reduces the quantity demanded of that import by the same relative amount (say 15 per cent). Will this figure be reflected in the aggregate elasticity of demand for imports?

This type of question could also be asked of an aggregate export sector. Any aggregate elasticity of export supply would of course tend to mask radical differences in the response of any individual export commodity to price changes. But suppose a rise in p_j of 10 per cent—other prices remaining constant—serves to raise exports in the jth sector by 5 per cent, regardless of which export commodity j is chosen. In such a case, if the price of each and every exportable rises by 10 per cent—all other prices (importables) remaining constant—will there be a 5 per cent increase in the *aggregate* volume of exports? No. In fact, the quantity of each and every export supplied may *fall!* Quite aside from the possible diversity among individual commodities, the mere act of aggregation serves systematically to reduce the aggregate elasticity of export supply below the mean of the individual values.[1]

The key to understanding this aggregation problem is that the effect on demands and production of a rise in the price of a single commodity is different from that of an equi-proportionate rise in the prices of all commodities belonging to that aggregate sector (either importables or exportables). The latter change invokes cross-substitution effects in production and consumption that are absent in the case of a single price change, as well as an income effect of a different order of magnitude.

Consider how this works out for a single importable, say the twelfth commodity in the class of imports. If only p_{12} rises, the quantity of imports, M_{12}, falls both because of an "own" substitution effect in demand and an increase in production and because real income is reduced proportionally to the volume of imports of commodity 12. What further effects on M_{12} can be expected if the prices of all other importables rise by the same relative amount as p_{12}? Suppose, on balance, that commodity 12 is a substitute both in consumption and production for other importables. As their prices rise, demand is deflected back toward commodity 12 (substitution effect) and production drawn away from commodity 12. These cross effects work partially to counter the initial effect of the rise in p_{12}: M_{12} will not be reduced by as much.[2] But an income effect must also be taken into account. The rise in all the other import prices serves to lower real income by a much greater extent than would be the case if just p_{12} rose. This greater income effect serves to cause M_{12} to be reduced even more. When all import prices rise (instead of just p_{12}), two kinds of corrections are required in estimating the further impact on M_{12}: the cross effects of price changes would tend to lower the value of the elasticity of import demand, but the heightened income effects would tend to raise it. There is no reason to suppose these effects precisely cancel.

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[1] This phenomenon is explored more carefully in Jones and Berglas (1977).

On the export side, two types of corrections are also involved in considering how the exports of, say, the twenty-first export item is affected when the prices of *all* exportables rise by 10 per cent as opposed just to a rise in p_{21}. But, instead of tending to counteract each other, they reinforce one another. Suppose a 10 per cent rise in p_{21} by itself raises exports in the twenty-first sector, X_{21}, by 5 per cent. When all other export prices rise as well, the cross-substitution effects cause an increase in local demand for the twenty-first commodity and a fall in production (as resources are lost to the other export sectors). On this account, X_{21} is reduced. But the favorable extra income effect of a rise in the prices of all other exportables tends to raise local demand for the twenty-first commodity and thus *further* to reduce X_{21}. Indeed, the net effect may be a fall in exports of this commodity as all export prices rise.

In two-sector models of international trade, it is not at all unusual to find diagrams illustrating a decline in exports as the relative price of exports rises. All that is required is inelasticity in the demand for imports. Figure 4 above shows import demand inelastic at a point such as *B* where the reciprocal demand curve bends backward. And yet, how easy is it to find a real-world example in which a nation will supply less of some item for export in response to a rise in export price? This can, of course, be the response in a two-commodity world—the labor-leisure choice with a possible backward-bending supply curve of labor provides the classic textbook example. But the real world is not a two-sector world, and it seems much harder to find examples of single commodities exhibiting such a backward-bending response to a rise in own price.

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[2] Note that p_{12} has still risen relative to all exportables, so that M_{12} can be expected to fall on this account.

The importance of the preceding aggregation result lies in its demonstration that exports in the aggregate can respond precisely as shown in textbook diagrams of the Figure 4 type even if no single commodity would mirror this behavior. If the world is made up of many sectors, the two-commodity illustrations in trade theory are appropriate indicators of aggregate behavior but should not be identified with the "representative export."

VIII. Generalizations in Heckscher-Ohlin Theory

In the literature on the theory of international trade in the past quarter century, the Ricardian trade model has yielded pride of place to the Heckscher-Ohlin model, particularly the two-factor version. Indeed, much of the criticism levied against the use of "two-ness" in trade theory is aimed most specifically at the two-factor, two-commodity production model that has served as the basis for such propositions as the Stolper-Samuelson tariff theorem, the Rybczynski theorem, the factor-price-equalization theorem, and the Heckscher-Ohlin theorem itself.

Attempts to break down the dimensionality limitations of the simple two-by-two model have generally followed two paths. On the one hand, economists have endeavored to discover conditions sufficient to have an *n*-factor, *n*-commodity model replicate in detail the results of a two-sector model. For example, the Stolper-Samuelson result posits that in the two-sector model a price increase will unambiguously raise the return to the factor used intensively in that sector and reduce the return to the other factor. In the *n*-by-*n* case, can each factor of production be associated with a particular industry so that, if the price of that industry rises, the designated factor's *real* return rises and *all other* factors lose? Only in highly special cases could such a strong version of the Stolper-Samuelson result be expected.[1] The other path of inquiry asks what generalizations can be established without making highly restrictive assumptions—even if these results do not conform precisely to the two-by-two parable.[2] Since I have recently written on this topic in detail, I limit myself here to a few summary remarks.

The concept of relative factor intensity used in the two-sector, two-factor trade model is typically not stated in a way that usefully generalizes. The second output is said to be relatively capital intensive if and only if it employs a higher capital-labor input ratio than the first. Of course, regardless of the number of factors and commodities, it is always possible to make a bilateral comparison of capital to labor ratios between any pair of commodities. But consider the usefulness of this ranking in the following example:

Let both industries 1 and 2 employ three factors of production: labor (*L*), capital (*K*), and land (*T*). Suppose that the first sector employs a higher labor-capital ratio than the second and that the wage rate (w_L) rises by 10 per cent, the return to capital (w_K) falls by 10 per cent, and the rental on land (w_T) remains constant. Does this change in factor prices raise or lower the relative cost of producing the first commodity? If labor and capital were the only factors used, the relative cost of producing commodity 1 would have to rise. But suppose the distributive shares of factor i in industry j in this three-factor model are shown by θ_{ij}:

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[1] See Chipman (1969) and Uekawa (1971). Many other sources are cited in the bibliographies of the articles mentioned in the next footnote.

[2] Two recent papers pursuing this route are Ethier (1974) and Jones and Scheinkman (undated).

$$\theta_{L1} = 0.2 \qquad \theta_{L2} = 0.5$$
$$\theta_{K1} = 0.1 \qquad \theta_{K2} = 0.3$$
$$\theta_{T1} = 0.7 \qquad \theta_{T2} = 0.2$$

Since θ_{L1}/θ_{K1} exceeds θ_{L2}/θ_{K2}, the first industry does indeed employ a higher labor-capital ratio than the second. What happens to unit costs? The presumed rise in wage rate and fall in return to capital serve to raise costs (or price, p_1) in the first industry by 1 per cent. (Let a "^" over a variable denote relative changes):

$$\begin{aligned}\hat{p}_1 &= \theta_{L1}\hat{w}_L + \theta_{K1}\hat{w}_K + \theta_{T1}\hat{w}_T \\ &= 0.2(10\%) + 0.1(-10\%) = 1\%.\end{aligned}$$

In the second industry, costs (or price) have risen by 2 per cent:

$$\begin{aligned}\hat{p}_2 &= \theta_{L2}\hat{w}_L + \theta_{K2}\hat{w}_K + \theta_{T2}\hat{w}_T \\ &= 0.5(10\%) + 0.3(-10\%) = 2\%.\end{aligned}$$

This increase in the wage-rent ratio has lowered relative cost in the industry employing the higher labor-capital ratio.[3]

This example is cited not to establish a paradox but rather to point out that a particular form of expressing factor-intensity rankings that succeeds in indicating relative cost changes in a two-by-two world need not continue to do so in a model with many productive factors. There is, however, an alternative specification of factor intensities that is equivalent to the physical ratio comparison in the two-by-two model but accurately captures the link between intensities and costs in the multifactor case. Industry k is said to be labor intensive compared with industry j if labor's distributive share in the kth industry, θ_{Lk}, exceeds labor's share in the jth sector, θ_{Lj}. By this criterion, industry 2 was labor intensive in the preceding example ($\theta_{L2} - \theta_{L1} = 0.3$). It was also the case that industry 2 was capital intensive ($\theta_{K2} - \theta_{K1} = 0.2$), but the degree of capital intensity fell short of the degree of labor intensity, and this is crucial for a cost comparison when wages rise 10 per cent and the return to capital falls 10 per cent.[4]

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[3] Notice that the return to land was kept constant throughout. If a two-factor (capital and labor) ranking is relied upon to provide comparisons when other factors are available in differing amounts (and prices), obvious errors can be made. For example, it proved inappropriate to examine American trade patterns solely on the basis of capital and labor endowments and requirements when other factors, such as natural resources, were present but unaccounted for. See the statement of the Leontief paradox in Leontief (1953) and criticisms by Vanek (1959) and Kenen (1965).

The basic relationship linking factor and commodity prices is the competitive profit relationship already cited in this example. If factors are combined in each industry to produce a unique output, and if production levels are positive in a competitive equilibrium,

$$\hat{p}_j = \sum_i \theta_{ij}\hat{w}_i .$$

That is, each commodity-price change is a positive weighted average of all the factor-price changes.[5] From this it follows that if all price changes are ranked, so that

$$\hat{p}_1 > \hat{p}_2 > \cdots > \hat{p}_n ,$$

there must exist *some* factors i and h such that

$$\hat{w}_i > \hat{p}_1 > \cdots > \hat{p}_n > \hat{w}_h .$$

This magnification effect of commodity-price changes on the factoral distribution of income is the basis for the appropriate generalization of the Stolper-Samuelson theorem, and it rests not upon the dimensionality of the model but upon the assumption of no joint production.

Closely related to the Stolper-Samuelson theorem is the Rybczynski (1955) theorem, whereby the increase in just one factor endowment, all other factor endowments and commodity prices remaining constant, must cause a reduction in at least one commodity output. In the n-by-n model this is especially easy to establish, since the factor-price-equalization theorem asserts that factor prices remain constant if commodity prices are assumed constant. Therefore, techniques of production are also given and full employment of each factor requires that if that factor supply, V_i, changes, either all outputs rise at the same relative rate or some rise relatively more than the endowment and others relatively less.

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[4] Of course, the first industry is land intensive ($\theta_{T1} - \theta_{T2} = 0.5$). The use of distributive shares to indicate factor-intensity rankings in the two-by-two case was made in Jones (1965).

[5] If a_{ij} denotes the input of factor i per unit output of j, then p_j equals unit costs, $\sum_i w_i a_{ij}$. Cost minimization requires $\sum w_i da_{ij}$ to equal zero, from which the relationship $\hat{p}_j = \sum_i \theta_{ij}\hat{w}_i$ follows. For further details, see Caves and Jones (1973, Chaps. 8 and 9).

Formally stated, if λ_{ij} indicates the fraction of factor i employed in the jth industry, and $\hat{x}_j$ the relative change in output in the jth sector, full employment and constant prices require that

$$\sum_{j=1}^{n} \lambda_{ij}\hat{x}_j = \hat{V}_i \qquad \text{for all } i = 1, \ldots, n.$$

Therefore, if some factors grow but some others do not, at least one output must fall. The key assumption once again is the lack of joint production rather than the size of n (equal to the number of factors and goods).

If the number of factors exceeds the number of commodities, the Rybczynski result does not generalize as well as the Stolper-Samuelson result, because keeping commodity prices constant (a condition of the Rybczynski theorem) does not suffice to keep factor prices and techniques constant. Nonetheless, some results can be obtained by using what Samuelson (1953) has called the "reciprocity theorem." This remarkable result states that in any general-equilibrium model, regardless of the number of factors or commodities, and even including the possibility of joint production,

$$\frac{\partial x_j}{\partial V_i} = \frac{\partial w_i}{\partial p_j}.$$

In words, the increase of the ith factor endowment on the jth output (with all other endowments and commodity prices held constant) equals the impact that a rise in the jth commodity price would have on the ith factor return (if no other commodity prices change and endowments are kept constant).

This result, combined with the earlier statement of the competitive profit conditions and the full-employment equations of change, can be used to establish the following generalizations of the two-by-two model if the number of factors equals the number of commodities:[6]

1. A rise in any single commodity price, p_j, will cause at least one factor to gain in real terms ($\hat{\omega}_i > \hat{p}_j$) and at least one other factor to lose.

2. A rise in any single factor endowment, V_i, will cause at least one commodity output to rise by a greater proportional amount and at least one other output to fall, assuming commodity prices are kept constant.

3. Every factor, i, has at least one "natural enemy" in the sense that there is at least one industry, j, such that if p_j alone rises, w_i must fall.

4. Every factor, i, need *not* have at least one "natural friend." That is, for factor i it may be impossible to find any single industry j (and therefore

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[6] Proofs are supplied in Jones and Scheinkman (undated).

any group of industries) such that if p_j rises (other prices kept constant) w_i will rise by a greater relative amount. This has an important implication for tariff theory: Is it possible to impose a tariff structure that would unambiguously raise the real return to a preselected factor, i? Yes, in a two-by-two world; not necessarily, in an n-by-n world.[7]

5. For each industry, j, it is possible to find some factor, i, such that if endowment growth is concentrated solely in factor i, the output of j must fall at constant commodity prices.
6. It may not be possible to find any factor, i, such that, if the endowment of i alone rises, a preselected jth industry would rise by a greater relative amount at constant prices.

If the number of factors of production exceeds the number of outputs, proposition 1 remains valid, as does the general Rybczynski result (5). But propositions 2 and 3 do not generalize to this "uneven" case.

One particular feature of the two-by-two model deserves special emphasis, because it singles out the peculiar quality of the restriction to two factors in a world with no joint production. Suppose relative commodity prices change. Then each factor of production either unambiguously gains or unambiguously loses. I term this the phenomenon of the "excluded middle." With no joint production, every commodity-price change must be bounded by factor-price changes. If there are only two factors in the model, a change in relative commodity prices must serve to raise one w_i by more than any commodity price and to lower the other relative to any commodity price. This feature makes the two-factor model somewhat inappropriate in tariff analysis, for it leaves out of account any factor that genuinely "doesn't care." That is, there is no factor "in the middle" such that a change in tariff structure has ambiguous effects on real returns. The two-factor model would thus not capture the general apathy that characterizes perhaps a large section of the population when tariff changes are considered.[8]

Any model with more than two factors opens up the possibility that some factor return may not be "extreme" compared with commodity-price changes. In particular, let me consider briefly the "specific factors" model mentioned earlier. In the small-scale (three-by-two) version, let land be used only in one sector (food) and capital in the other (machines), with labor used in both and earning the same return because it is mobile between sectors. If relative commodity prices change, labor is always a middle factor in the sense that the wage will fall in terms of the commodity that has risen in price and rise in terms of the other commodity.[9] This is also the case in the large-scale $[(n + 1) \times n]$ version in which each industry uses a single factor specifically tied to that industry as well as sharing in a common labor force. If commodity prices change, the change in the wage rate is a positive weighted average of the commodity-price changes:

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[7] As demonstrated in Jones and Scheinkman (undated), factor i must indeed have at least one natural friend if i is "unimportant enough" in the sense that $\sum_j \theta_{ij}$ is less than unity.

[8] This is discussed in more detail in Ruffin and Jones (forthcoming).

$$\hat{w}_L = \sum_j \beta_{Lj}\hat{p}_j,$$

where $\beta_{Lj} > 0$ and $\sum \beta_{Lj} = 1$.

This expression can help to illustrate a remark I made earlier about the usefulness of a bilateral comparison of one sector with an average trait for the economy as a whole, even in multisector models. Suppose only the jth commodity price rises. By how much will this increase the wage rate? More particularly, would the wage rate rise (relatively) by more or less than the average change for all factor prices? The average of all the relative factor-price changes is simple to find. Letting α_j denote the output share of industry j in the national income and α^i be factor i's distributive share throughout the economy,

$$\sum \alpha^i \hat{w}_i = \sum \alpha_h \hat{p}_h.$$

The average over all factor-price changes, shown on the left, would equal industry j's output share, α_j, times $\hat{p}_j$ if the price of j is the only commodity price that rises. The change in the wage rate, $\hat{w}_L$, is given by $\beta_{Lj} \cdot \hat{p}_j$, and it is easy to show (see Ruffin and Jones, forthcoming) that

$$\beta_{Lj} = \lambda_{Lj} \cdot \frac{\gamma_{Lj}}{\sum_i \lambda_{Li}\gamma_{Li}},$$

where the new term, γ_{Lj}, represents the elasticity of labor's marginal-physical-product schedule in the jth sector.

The point I wish to stress is that in asking how labor fares (compared with the average of all factors) as a result of the rise in the price in sector j, it is necessary to know something about sector j and about the average over all sectors, but *not* the detailed composition in each and every other sector. More precisely, the larger is γ_{Lj} compared with the economywide average, $\sum_i \lambda_{Li}\gamma_{Li}$, the greater will be labor's gain. Suppose the elasticity of labor's marginal-physical-product schedule in sector j is given precisely by the average elasticity for the economy as a whole. Then the comparison of the wage-rate change with the average over all factors depends on the intensity with which the jth sector employs labor, λ_{Lj}, relative to the importance in the economy of the jth sector, α_j. Indeed, the ratio λ_{Lj}/α_j provides a bilateral ranking of industry j's labor intensity *not* with some other particular sector but with the economy as a whole. If λ_{Lj}/α_j exceeds unity, call the jth sector labor intensive and conclude that the wage rate would rise by more than the average over all factors.[10]

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[9] This model was used in Jones (1971b) in discussing the problem in economic history posed in Temin (1966). Suppose that the real wage (deflated by the price of food) *and* the interest rate (the return to capital deflated by the price of machines) in mid-nineteenth-century America can be shown to be higher than in the United Kingdom. Is it possible to conclude that America possessed a superior technology? In a two-factor model, the factor-price frontier must be negatively sloped for a given technology. But not so in a three-factor world. If food is relatively cheap in America, the same technology as is available in Britain could support a higher real wage and interest rate.

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[10] It is easy to show that λ_{ij}/α_j equals θ_{ij}/α^i. Note that the double bilateral comparison of one factor use relative to another in one industry compared with another for the two-by-two model is replaced generally by the assertion that "industry j is i intensive if θ_{ij}/α^i exceeds unity."

IX. Ricardo and Heckscher-Ohlin: Reconciliation in a Multicommodity World

Two striking differences distinguish the Ricardian model from the standard Heckscher-Ohlin model, regardless of the number of commodities and countries we wish to consider. The Ricardian model completely ignores differences in factor intensity and mobility between sectors. Homogeneous productive resources are converted into outputs at constant costs, so that it is just as useful to say that in the Ricardian model only one factor of production (labor) is employed. The Heckscher-Ohlin model assumes there are two inputs, freely mobile between sectors but used in different proportions in each.[1] Also, the Ricardian model assumes that countries differ in "climate" or in the productivity of labor in the same occupation. By contrast, the Heckscher-Ohlin model is based on an assumption that knowledge of the best productive techniques is available to all countries.

In each model, there is a standard or typical solution in the two-country, two-commodity case. For the Ricardian model, it is a solution with each country completely specialized and limbo terms of trade established between the cost ratios in each country. Commodity prices are equalized by trade but factor prices (wage rates) are not. For the Heckscher-Ohlin model, the typical solution shows each country *in*completely specialized, producing both goods with the same techniques as are used in the other country, and with factor prices equalized between countries. Of course, if factor endowments are sufficiently dissimilar, one (or both) countries may be driven to specialize completely, but this case is often made to appear extreme. The country's factor endowments would have to lie on one side or the other of the "cone of diversification."[2]

The question of what appears "standard" and what does not is significantly affected by the dimensionality of the model. For this reason, I turn to the many-commodity, two-factor Heckscher-Ohlin case. In particular, I concentrate on the role of factor endowments in determining production and trade patterns by considering two small countries sharing access to the same technology but differing in their endowments of capital and labor. Some trade may take place between these countries, but they each rely mainly on an outside world market in which commodity prices are determined. World prices reflect technology and climate in various parts of the world, and I assume these bear no necessary resemblance to the technology shared by the two small countries.

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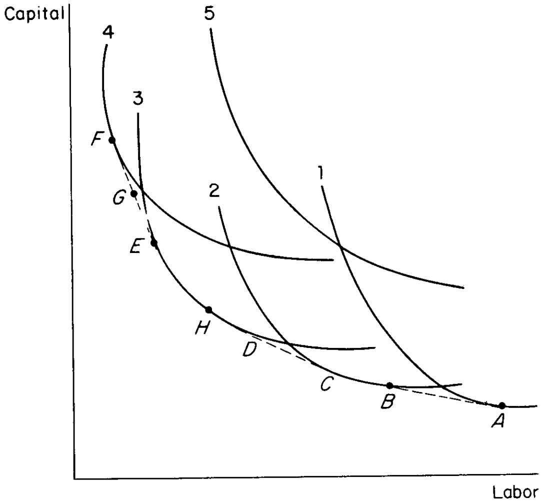
[1] In this section, I restrict the discussion to the two-factor version of the Heckscher-Ohlin model.

[2] This phrase is used by Chipman (1966).

For each of these small countries, technology plus world prices combine to yield a locus showing minimal combinations of capital and labor that can produce those quantities of one or more commodities worth exactly $1 at world prices. This locus is constructed from the separate unit-value isoquants shown in Figure 5.[3] Five commodities are illustrated. For each is shown a bowed-in locus of the minimal combinations of capital and labor which would produce a dollar's worth of that commodity. A doubling of that commodity's price would radially shift the unit-value isoquant halfway toward the origin. Some commodities, like commodity 5, could not be competitively produced in either of the small countries at prevailing world prices. The dashed tangent chords, *AB*, *CD*, and *EF*, form part of the inner frontier, since it is possible to employ capital and labor to produce a pair of commodities instead of just one. For example, point *G* is halfway between *F* and *E* on chord *FE*. The input bundle shown by *G* can be split into two parts. One part would consist of half the labor and capital combination shown by *E* and could be used to produce 50 cents' worth of the third commodity. The other part would be the bundle halfway

FIGURE 5

THE COMPOSITE UNIT-VALUE ISOQUANT



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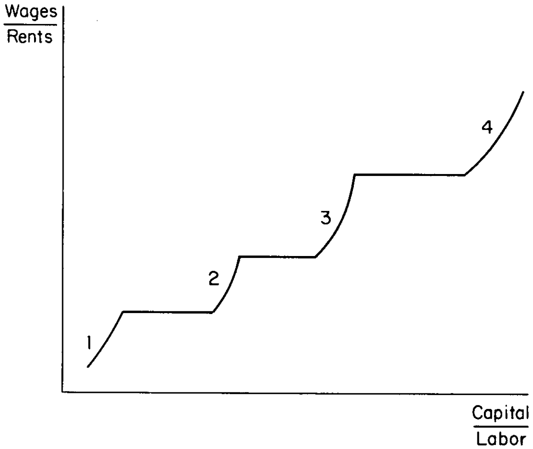
[3] This construction, and much of the succeeding argument, is based on Jones (1974b) and on Chap. 7 of Caves and Jones (1977).

between *F* and the origin. It can produce 50 cents' worth of commodity 4. Thus bundle *G* can produce a dollar's worth of output.

The individual country's capital-labor endowment ratio would dictate the location of production along this composite unit-value isoquant and the country's wage-rent ratio. For example, suppose the endowment ray from the origin cuts the composite unit-value isoquant at point *H*. The country would specialize in producing commodity 3 and the wage-rent ratio would be reflected by the slope at *H*. The resulting connection between factor endowments and factor prices is illustrated in Figure 6. The upward-sloping portions correspond to complete specialization in one of the commodities forming part of the composite unit-value isoquant. The flat portions illustrate the factor-price-equalization result for a two-by-two world. For example, if the country's factor endowments are in the ratio shown by *G* in Figure 5, it can produce commodities 3 and 4 along the highest horizontal section shown in Figure 6. In that range, any small rise in the capital-labor ratio would not increase relative wages. Instead, it would change the composition of production—increasing production of capital-intensive commodity 4 at the expense of more labor-intensive commodity 3.

Figure 6 is particularly useful in illustrating how a many-commodity model can suggest "natural" results which would appear "extreme" in a two-sector model. For example, does trade lead to incomplete specialization? This depends on the endowment proportions. As the capital-

FIGURE 6
THE FACTOR-PRICE, FACTOR-ENDOWMENT LOCUS



labor-endowment ratio rises from low to high values, the country becomes alternatively completely specialized and incompletely specialized. It would be incorrect to characterize incomplete specialization as associated only with middle values of the endowment proportions and complete specialization only with extreme values.

In the standard two-by-two model, factor-price equalization between countries is associated with incomplete specialization. But the degree of specialization does not provide the key to this issue. As Figure 6 makes clear, two countries sharing the same technology could each be incompletely specialized in two commodities without having factor prices brought to equality—one country could be producing commodities 2 and 3 and the other commodities 3 and 4. Countries that are quite similar in their endowment proportions are more likely to have their factor prices equalized by free trade. But this tendency toward factor-price equalization would be incomplete if one (or both) of the countries were completely specialized.

I emphasized earlier that the Ricardian and Heckscher-Ohlin models are distinguished from each other by the assumption concerning a commonly shared technology. Moving to a multicommodity setting allows this strict distinction to be blunted. Suppose one of the two countries produces commodities 2 and 3 and the other country produces 3 and 4. Although production functions are identical, the techniques actually adopted to produce commodity 3 will differ between countries *because* the wage-rent ratio is higher in the more capital-abundant country. The difference between countries in labor productivities that is asserted by assumption in the Ricardian model can be deduced from differences in factor endowments in a Heckscher-Ohlin model.

International trade allows countries to concentrate their resources on one or a few commodities in which they possess a comparative advantage. Multicommodity models are better suited than two-commodity models to bring home this point precisely because multidimensional models have more scope for distinguishing between the *number* of commodities that will be produced with trade and the number that will be consumed. In the typical version of the two-by-two Heckscher-Ohlin model, a country produces and consumes the same number of goods. Graham (1948, Chap. 6) provided two numerical examples of multicountry, multicommodity trade with ten countries and ten commodities. On average, with trade, each country consumed ten commodities and produced only two.[4]

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[4] With trade, two countries each produced four goods, one country produced three, another produced two, and the remaining six were completely specialized. A recent discussion of Graham's techniques in finding numerical solutions is contained in McKenzie (1976).

In the five-commodity Heckscher-Ohlin example discussed here, a small country would produce one or two commodities while consuming all five.[5] Of course, the objection to the two-commodity version is not that it is incapable of showing this asymmetry between numbers of goods produced and consumed. It is that the restricted dimensions of the model make it more difficult to highlight the extent to which trade weeds out inefficient production.

Just as in Graham's strictures on the two-by-two classical model, the many-commodity Heckscher-Ohlin model exhibits a richer variety of trade patterns than does the two-sector version. Changes in world tastes that rearrange world prices can cause a country to shift completely out of commodities it previously produced into others it previously imported. Furthermore, multicommodity models allow a *pattern* of trade that a two-sector model is too limited to display. A country can import commodities which, if produced at home, would require a higher capital-labor ratio than that embodied in its exports and simultaneously import commodities that are more labor intensive than are exportables.[6] A truly multicommodity model can show how a country's factor-endowment proportions determine which commodity or commodities it can appropriately produce in the spectrum of all commodities. The country will rely on trade with other countries to provide commodities that are both more labor intensive and more capital intensive than its own production choice.

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[5] The tendency of trade to force concentration in the number of commodities produced is also emphasized by Krueger (1977).

[6] With reference to Figures 5 and 6, the country might produce goods 2 and 3 while importing commodities 1 (more labor intensive), 4 (more capital intensive), 5 (whose factor endowments are somewhat similar to 2 or 3, but for which home technology is inferior to that of other countries), and (perhaps) some of 2 or 3, which it also produces. It exports either 2 or 3 or both.

X. Conclusion

The design of theoretical models frequently reflects a conflict between generality and simplicity. Most questions in the pure theory of international trade involve issues of composition—distinguishing between gainers and losers among countries, expanding and contracting sectors in the economy, or factors of production intensively used in one sector of an economy but not the other. The number "two" provides the lower bound in dimensionality for most of these issues. There is no doubt that trade models characterized by two countries, two commodities, and one or two productive factors have borne most of the burden in developing the present corpus of trade theory.

What have been the costs of this heavy reliance on such simple models? Frank Graham argued that these costs were considerable in the classical trade model. The primary thrust of his argument was to discredit the notion propagated in the classical literature that the network of comparative costs had so little to do with determining the precise values of equilibrium world prices. His concern for the supply side of the model provided a healthy antidote to the typical classical illustrations. I would argue, and he would have agreed, that the classical models were capable of exhibiting some of the characteristics he wished to see in the solution—prices reflecting actual cost ratios in some country. But it remains the case that trade models with more than two countries and more than two commodities offer a richer variety of solutions, in many of which the existence of countries producing commodities in common would seem less extreme than in the two-by-two setting.

Moving beyond Ricardian-type models, I have argued that the addition of more commodities, countries, and factors often requires that conclusions based on simple models be qualified to allow for feedback effects from other markets. Even so, these qualifications often remain just that—a catalogue of possible exceptions to, or modifications of, a result from models characterized by "two-ness" that retains its general validity in higher-dimensional cases.

One exception to this remark is provided by what I called the "aggregation problem." Even when all the sectors being aggregated are fairly similar, cross effects of price changes and the scale of income effects argue in favor of distinguishing between "aggregate" response to price changes and "typical" response to price changes in any one sector. The real world consists of many sectors, and it may be difficult to find individual ones that seem actually to portray the characteristics imputed by small-scale models even though real-world aggregates may do so.

The two-sector Heckscher-Ohlin model presents a series of propositions which, although challenged because of the two-dimensionality assumption upon which they seem to rest, in large part reflect the widely held assumption that productive techniques involve an array of inputs combined to produce a unique output in each sector. That is, the assumption of no joint production injects an asymmetry into the input-output constellation, and this asymmetry gets reflected in magnified relationships between output prices and factor prices, on the one hand, and factor endowments and industry output (at constant prices) on the other. This is an area of theory where, I would argue, the two-by-two results are fairly robust. Nonetheless, it is clear that assuming a greater number of productive factors creates new possibilities, perhaps the most important of which is that relative price changes leave certain factor returns fairly constant in real terms. The excluded middle can be filled in when there are more than two productive factors.

The force of Graham's contribution is most keenly felt when considering trade in many commodities between many countries. The sharp distinction between Ricardian and Heckscher-Ohlin trade models is blurred because an assumption of commonly shared technologies need not be translated into identically used techniques and equality of factor prices. Furthermore, in both models the extension to many commodities allows more adequate expression of the impact of free trade in forcing a concentration in production but not in consumption. The question of concentration is ultimately a "numbers" game, and it should come as no surprise that a limit to the number of commodities the model can encompass serves to inhibit this point's being forcefully made.

I should conclude by pointing out that I have no special plea to make for the number "two" per se. Instead, I would argue the advantages of stripping any theoretical argument down to its essential core, and if an excess number of commodities, countries, or factors is present, this core may prove unnecessarily stubborn in revealing itself. However, arguments based on higher dimensions may be required both to explore problems that essentially involve a move beyond "two-ness" and to examine how criteria applicable in the general case should be formulated in more simple models. Two-dimensional building blocks not only provide the firm foundations upon which trade theory is constructed but present a standard of comparison against which truly multidimensional results can be appreciated.

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The following is a list of the recent publications of the International Finance Section. Most of the earlier issues and those marked by asterisks are no longer available from the Section.[1] They may be obtained in microfilm and xerographic soft or library-bound copies from University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48107, United States, and 18 Bedford Row, London WC1R 4EJ, England. Microfilm editions are usually $6 and xerographic editions usually $10.

ESSAYS IN INTERNATIONAL FINANCE

91. Fritz Machlup, *The Book Value of Monetary Gold.* (Dec. 1971)
*92. Samuel I. Katz, *The Case for the Par-Value System, 1972.* (March 1972)
93. W. M. Corden, *Monetary Integration.* (April 1972)
94. Alexandre Kafka, *The IMF: The Second Coming?* (July 1972)
*95. Tom de Vries, *An Agenda for Monetary Reform.* (Sept. 1972)
96. Michael V. Posner, *The World Monetary System: A Minimal Reform Program.* (Oct. 1972)
97. Robert M. Dunn, Jr., *Exchange-Rate Rigidity, Investment Distortions, and the Failure of Bretton Woods.* (Feb. 1973)
*98. James C. Ingram, *The Case for European Monetary Integration.* (April 1973)
99. Fred Hirsch, *An SDR Standard: Impetus, Elements, and Impediments.* (June 1973)
100. Y. S. Park, *The Link between Special Drawing Rights and Development Finance.* (Sept. 1973)
101. Robert Z. Aliber, *National Preferences and the Scope for International Monetary Reform.* (Nov. 1973)
102. Constantine Michalopoulos, *Payments Arrangements for Less Developed Countries: The Role of Foreign Assistance.* (Nov. 1973)
103. John H. Makin, *Capital Flows and Exchange-Rate Flexibility in the Post-Bretton Woods Era.* (Feb. 1974)
104. Helmut W. Mayer, *The Anatomy of Official Exchange-Rate Intervention Systems.* (May 1974)
105. F. Boyer de la Giroday, *Myths and Reality in the Development of International Monetary Affairs.* (June 1974)
106. Ronald I. McKinnon, *A New Tripartite Monetary Agreement or a Limping Dollar Standard?* (Oct. 1974)
107. J. Marcus Fleming, *Reflections on the International Monetary Reform.* (Dec. 1974)
108. Carlos Díaz-Alejandro, *Less Developed Countries and the Post-1971 International Financial System.* (April 1975)
109. Raymond F. Mikesell and Henry N. Goldstein, *Rules for a Floating-Rate Regime.* (April 1975)
110. Constantine Michalopoulos, *Financing Needs of Developing Countries: Proposals for International Action.* (June 1975)
111. Gerald A. Pollack, *Are the Oil-Payments Deficits Manageable?* (June 1975)

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[1] Essays 62, 67, 71, 73, 75, 88, and 90; Studies 12, 14 through 18, 20, 21, 23, and 24; Special Paper 1; and Reprints 4 and 6 through 12 are still available from the Section. For a complete list of publications issued by the Section, write to the Section or consult the publications list in Essay 91 or earlier.

112. Wilfred Ethier and Arthur I. Bloomfield, *Managing the Managed Float*. (Oct. 1975)
113. Thomas D. Willett, *The Oil-Transfer Problem and International Economic Stability*. (Dec. 1975)
114. Joseph Aschheim and Y. S. Park, *Artificial Currency Units: The Formation of Functional Currency Areas*. (April 1976)
115. Edward M. Bernstein *et al.*, *Reflections on Jamaica*. (April 1976)
116. Weir M. Brown, *World Afloat: National Policies Ruling the Waves*. (May 1976)
117. Herbert G. Grubel, *Domestic Origins of the Monetary Approach to the Balance of Payments*. (June 1976)
118. Alexandre Kafka, *The International Monetary Fund: Reform without Reconstruction?* (Oct. 1976)
119. Stanley W. Black, *Exchange Policies for Less Developed Countries in a World of Floating Rates*. (Nov. 1976)
120. George N. Halm, *Jamaica and the Par-Value System*. (March 1977)

PRINCETON STUDIES IN INTERNATIONAL FINANCE

26. Klaus Friedrich, *A Quantitative Framework for the Euro-Dollar System*. (Oct. 1970)
27. M. June Flanders, *The Demand for International Reserves*. (April 1971)
28. Arnold Collery, *International Adjustment, Open Economies, and the Quantity Theory of Money*. (June 1971)
29. Robert W. Oliver, *Early Plans for a World Bank*. (Sept. 1971)
30. Thomas L. Hutcheson and Richard C. Porter, *The Cost of Tying Aid: A Method and Some Colombian Estimates*. (March 1972)
31. The German Council of Economic Experts, *Towards a New Basis for International Monetary Policy*. (Oct. 1972)
32. Stanley W. Black, *International Money Markets and Flexible Exchange Rates*. (March 1973)
33. Stephen V. O. Clarke, *The Reconstruction of the International Monetary System: The Attempts of 1922 and 1933*. (Nov. 1973)
*34. Richard D. Marston, *American Monetary Policy and the Structure of the Eurodollar Market*. (March 1974)
35. F. Steb Hipple, *The Disturbances Approach to the Demand for International Reserves*. (May 1974)
36. Charles P. Kindleberger, *The Formation of Financial Centers: A Study in Comparative Economic History*. (Nov. 1974)
37. Margaret L. Greene, *Waiting Time: A Factor in Export Demand for Manufactures*. (April 1975)
38. Polly Reynolds Allen, *Organization and Administration of a Monetary Union*. (June 1976)
39. Peter B. Kenen, *Capital Mobility and Financial Integration: A Survey*. (Dec. 1976)
40. Anne O. Krueger, *Growth, Distortions, and Patterns of Trade among Many Countries*. (Feb. 1977)

SPECIAL PAPERS IN INTERNATIONAL ECONOMICS

8. Jagdish Bhagwati, *The Theory and Practice of Commercial Policy: Departures from Unified Exchange Rates*. (Jan. 1968)
9. Marina von Neumann Whitman, *Policies for Internal and External Balance*. (Dec. 1970)
10. Richard E. Caves, *International Trade, International Investment, and Imperfect Markets*. (Nov. 1974)
11. Edward Tower and Thomas D. Willett, *The Theory of Optimum Currency Areas and Exchange-Rate Flexibility*. (May 1976)
12. Ronald W. Jones, *"Two-ness" in Trade Theory: Costs and Benefits*. (April 1977)

REPRINTS IN INTERNATIONAL FINANCE

13. Benjamin J. Cohen, *Sterling and the City*. [Reprinted from *The Banker*, Vol. 120 (Feb. 1970)]
14. Fritz Machlup, *On Terms, Concepts, Theories and Strategies in the Discussions of Greater Flexibility of Exchange Rates*. [Reprinted from *Banca Nazionale del Lavoro Quarterly Review*, No. 92 (March 1970)]
15. Benjamin J. Cohen, *The Benefits and Costs of Sterling*. [Reprinted from *Euro-money*, Vol. 1, Nos. 4 and 11 (Sept. 1969 and April 1970)]

*16. Fritz Machlup, *Euro-Dollar Creation: A Mystery Story*. [Reprinted from *Banca Nazionale del Lavoro Quarterly Review*, No. 94 (Sept. 1970)]

*17. Stanley W. Black, *An Econometric Study of Euro-Dollar Borrowing by New York Banks and the Rate of Interest on Euro-Dollars*. [Reprinted from *Journal of Finance*, Vol. 26 (March 1971)]

18. Peter B. Kenen, *Floats, Glides and Indicators: A Comparison of Methods for Changing Exchange Rates*. [Reprinted from *Journal of International Economics*, Vol. 5 (May 1975)]

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