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Intraindustry Specialization and the Gains from Trade

Paul R. Krugman

Massachusetts Institute of Technology

Several recent empirical studies of trade suggest that *interindustry* specialization and trade, which reflect the conventional forces of comparative advantage, are also accompanied by *intraindustry* specialization, which reflects scale economies and consumers' taste for a diversity of products. This paper develops a simple model which illustrates this argument. Two main results are developed. First, the nature of trade depends on how similar countries are in their factor endowments. As countries become more similar, the trade between them will increasingly become intraindustry in character. Second, the effects of opening trade depend on its type. If intraindustry trade is sufficiently dominant, the advantages of extending the market will outweigh the distributional effects, and the owners of scarce as well as of abundant factors will be better off.

Over the years, many empirical students of international trade have argued that trade among the industrial countries cannot adequately be explained by conventional theories of comparative advantage. One might summarize this empirical critique by pointing to three aspects of world trade which seem to contradict received theory. First, much of world trade is between countries with similar factor endowments. Second, a large part of trade is intraindustry in character—that is, it consists of two-way trade in similar products. Finally, much of the expansion of trade in the postwar period has taken place without

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sizable reallocation of resources or income-distribution effects. This last point is particularly noticeable in the cases of the EEC and the North American automobile pact.

The purpose of this paper is to formalize one possible explanation of these seeming paradoxes. The explanation is not a new one: It is essentially the same as that put forward by Balassa (1967), Grubel (1970), and Kravis (1971), among others. What this paper does is put the argument in terms of a formal model, a step which may be of some help in clarifying and disseminating ideas which have been "in the air" for some time.

Briefly, the argument of these empirical workers, a very clear exposition of which is given by Kravis (1971), runs as follows. The conventional forces of comparative advantage operate on *groups* of products ("industries") and thus give rise to *interindustry* specialization and trade. Economies of scale in production, however, lead each country to produce only a subset of the products within each group, so that there is also *intraindustry* specialization and trade. This provides a simple explanation of two of our empirical ostensible paradoxes. Countries with similar factor endowments will still trade because of scale economies, and their trade will be largely intraindustry in character. The third seeming paradox—the apparent painlessness of some trade liberalization—can also be resolved if we argue that income-distribution effects are outweighed by the gains from a larger market when countries are sufficiently similar.

While this is a simple and straightforward explanation, however, it is not so easy to formalize. Scale economies are crucial to the argument, and they are notoriously awkward to handle in general equilibrium models. In this paper I follow an earlier paper (Krugman 1979) and use the device of Chamberlinian monopolistic competition. As in the earlier paper, this proves to be a very convenient approach, yielding a simple and tractable model. The structure of this model and the determination of this model's equilibrium in a closed economy are set forth in Section I. Section II shows how the pattern of trade between two countries is determined in the model, developing the basic relationship between differences in factor endowments and the extent of intraindustry trade. Section III then examines the effects of trade on income distribution and shows how the extent of intraindustry trade determines whether scarce factors of production gain or lose from trade. Finally, Section IV summarizes the results and discusses some implications for theory and policy.

It must be emphasized that the model presented here is in no sense a general one. In addition to making strong assumptions about functional forms of cost and utility functions, I impose a great deal of symmetry on the model to simplify the analysis and give a natural

meaning to the concept of "similarity" in factor proportions. Thus the results of the analysis are at best suggestive. Nonetheless, they seem intuitively plausible and also seem to have something to do with actual experience.

I. The Model in a Closed Economy

Intraindustry trade depends on the existence of unexhausted economies of scale in production. The main problem in modeling this kind of trade is how to handle these scale economies, which must lead to a breakdown of perfect competition (unless they are wholly external to firms). In this paper, as in an earlier paper (Krugman 1979), I will use the device of Chamberlinian monopolistic competition, basing the model on recent work by Dixit and Stiglitz (1977). An "industry" will consist of a large number of firms, all producing somewhat differentiated products, all operating on the downward-sloping parts of their average cost curves. There will be two-way international trade within an industry because firms in different countries will produce different differentiated products. What prevents countries from producing a complete range of products domestically is the existence of fixed costs in production; thus scale economies are the basic cause of intraindustry trade.

We should note at the outset that the concept of an industry used in this paper is a somewhat special one. One might want to define an industry either as a group of products which are close substitutes on the supply side or as a group of products which are close substitutes on the demand side. In the model of this paper, I assume that there are two groups of products which fit both definitions. Products within each group are closer substitutes than products in different groups, while factors of production are assumed mobile among products within each group yet immobile between groups. This convenient coincidence of the two possible concepts of an industry may or may not be empirically reasonable; it is certainly not theoretically necessary and should be regarded as one among many special assumptions.

Another conceptual difficulty concerns the notion of a "product." In the formulation below, all products seem to look alike, since they enter symmetrically into cost and utility functions. This may seem to involve an illegitimate comparison of physical quantities of different goods. I show in the Appendix, however, that the formulation of many "identical" products can be interpreted as a restriction on the parameters of a model in which products really do differ.

Let us begin, then, with a two-industry model of a closed economy. Each industry consists of a large number of products, all of which enter symmetrically into demand, with the two industries—industry 1

and industry 2—themselves playing symmetric roles. All individuals will have the convenient utility function.

$$U = \ln\left(\sum_{i=1}^{N_1} c_{1,i}^{\theta}\right)^{1/\theta} + \ln\left(\sum_{j=1}^{N_2} c_{2,j}^{\theta}\right)^{1/\theta}, \qquad (1)$$
$$0 < \theta < 1,$$

where $c_{1,i}$ is consumption of the ith product of industry 1; $c_{2,j}$ is consumption of the jth product of industry 2; and N_1 and N_2 are the (large) numbers of potential products in each industry. Not all potential products will necessarily be produced, and we will in fact assume that the actual numbers of products produced—n_1 and n_2—while large, fall short of N_1 and N_2.

The utility function (1) has several useful properties. First, it ensures that half of income will always be spent on industry 1's products. Second, if the number of products in each industry is large, it implies that every producer faces a demand curve with elasticity $1/(1 - \theta)$. Finally, (1) will allow us to represent the gains and losses from trade in a particularly simple way.

On the demand side, then, an industry is assumed to consist of a number of products which are *imperfect* substitutes for one another. On the supply side, however, they will be assumed to be *perfect* substitutes. There will be only two factors of production, type 1 labor and type 2 labor, each of which is wholly specific to an industry but nonspecific among products within an industry. Thus, type 1 labor will be used only in industry 1, type 2 only in industry 2. Within each industry, the labor required to produce a particular product will consist of a fixed setup cost and a constant variable cost;

$$\begin{aligned} l_{1,i} &= \alpha + \beta x_{1,i}, \qquad i = 1, \ldots, n_1, \\ l_{2,j} &= \alpha + \beta x_{2,j}, \qquad j = 1, \ldots, n_2, \end{aligned} \qquad (2)$$

where $l_{1,i}$ is labor used in producing the ith product of industry, 1; $x_{1,i}$ is the output of that product; and so on. To go from these required labor inputs to nominal costs, we must multiply by the wage rates of the two types of labor, w_1 and w_2.

To close the model, we begin by noting that output of each product, x, is the sum of individual consumptions of the product. At the same time, total employment in each industry is the sum of employment in producing all the individual products. Assuming full employment, we have

$$\left.\begin{aligned}\sum_{i=1}^{n_1} l_{1,i} &= L_1 = 2 - z \\ \sum_{j=1}^{n_2} l_{2,j} &= L_2 = z\end{aligned}\right\} 0 < z < 1. \tag{3}$$

Thus the total labor force is set equal to 2, with the parameter z measuring factor proportions. As we will see below, z will assume crucial significance in determining the importance of intraindustry trade and the effect of trade on income distribution.

We are now prepared to examine the determination of equilibrium in this model. This involves determining how many products are actually produced in each industry, the output of each product, the prices of products, and the relative wages of the two kinds of labor. We should note at the outset that it is indeterminate *which* products are produced—but it is also unimportant.

Our first step is to determine the pricing policy of firms. We assume that producers can always costlessly differentiate their products. This means that each product will be produced by only one firm. If there are many products the elasticity of demand for each product will, as already noted, be $1/(1 - \theta)$. (This is proved in the Appendix.) Thus, each firm will face a demand curve of constant elasticity. We then have the familiar result that the profit-maximizing price will be marginal cost plus a constant percentage markup:

$$\begin{aligned} p_1 &= \theta^{-1}\beta w_1, \\ p_2 &= \theta^{-1}\beta w_2, \end{aligned} \tag{4}$$

where p_1 and p_2 are the prices of any products in industry 1 and 2, respectively, which are actually produced.

Given the pricing policy of firms, actual profits depend on sales:

$$\begin{aligned} \pi_1 &= p_1 x_1 - (\alpha + \beta x_1) w_1, \\ \pi_2 &= p_2 x_2 - (\alpha + \beta x_2) w_2, \end{aligned} \tag{5}$$

where x_1 and x_2 are sales of representative firms in the two industries.

But in this model there will be free entry of firms, driving each industry to Chamberlin's "tangency solution" where profits are zero. Thus we can use the condition of zero profits in equilibrium to determine the equilibrium size and number of firms. Setting $\pi_1 = \pi_2 = 0$ and using (4) and (5), we have

$$x_1 = x_2 = \frac{\alpha}{\beta} \cdot \frac{\theta}{1 - \theta} \tag{6}$$

for the size of firms. The number of firms can then be determined from the full-employment condition:

$$n_1 = (2 - z)/(\alpha + \beta x_1),$$
$$n_2 = z/(\alpha + \beta x_2). \tag{7}$$

The final step in determining equilibrium is to determine relative wages. This can be done very simply by noting that the industries receive equal shares of expenditure and that, since profits are zero in equilibrium, these receipts go entirely to the wages of the industry-specific labor forces. So $w_1L_1 = w_2L_2$, implying

$$w_1/w_2 = z/(2 - z). \tag{8}$$

We now have a completely worked out equilibrium for a two-sector, monopolistically competitive economy. It is indeterminate which of the range of potential products within each industry are actually produced, but since all products appear symmetrically, this is of no welfare significance. The character of the economy is determined by the two parameters z and θ. The value of z determines relative wages: If z is low, type 2 labor will receive much higher wages than type 1 labor. The value of θ measures the degree of substitutability among products within an industry. The lower is θ, the more differentiated are products, and the more important are unexploited scale economies. From (4) we have $\theta = \beta w_1/p_1 = \beta w_2/p_2$. But βw_1 and βw_2 are the marginal costs of production, while in equilibrium price equals average cost. Thus θ is the ratio of marginal to average cost (which is also the elasticity of cost with respect to output).

II. Factor Proportions and the Pattern of Trade

In the last section we saw how equilibrium can be determined in a simple closed-economy model with scale economies and differentiated products. We can now examine what happens when two such economies trade. What we are principally concerned with is the proposition, advanced in the introduction, that countries with similar factor endowments will engage in intraindustry trade, while countries with very different endowments will engage in Heckscher-Ohlin trade.

As a first step we need a working measure of the extent of intraindustry trade. The empirical literature on intraindustry trade (e.g., Hufbauer and Chilas 1974; Grubel and Lloyd 1975) generally concentrates on an index of trade overlap, that is,

$$I = 1 - \left(\sum_k |X_k - M_k|\right) \Big/ \left[\sum_k (X_k + M_k)\right], \tag{9}$$

where X_k is a country's exports in industry k and M_k is imports in that industry. This index has the property that, if trade is balanced industry by industry, it equals one, while if there is complete international specialization so that every industry is either an export or import industry, it equals zero. As we will see, this index fits in quite well with the model of this paper.

The other concept we need to make operational is that of similarity in factor endowments. In general, this is not well defined. What I will do in this paper, however, is consider a special case in which the concept does have a natural meaning without trying to arrive at a general definition.

Let us suppose, then, that there are two countries, the home country and the foreign country. The home country will be just as described in Section I. The foreign country will be identical except for one thing: The relative sizes of the two industries' labor forces will be reversed. That is, the foreign country will be a mirror image of the home country. If we use a star on a variable to indicate that it refers to the foreign country, we have

$$\begin{aligned} L_1 &= 2 - z \qquad & L_2 &= z \\ L_1^* &= z \qquad & L_2^* &= 2 - z. \end{aligned} \tag{10}$$

Obviously, given this pattern of endowments, we can regard z as an index of similarity in factor proportions. If $z = 1$, the countries have identical endowments. As z gets smaller, the factor proportions become increasingly different.

The mirror-image assumption can be given a geometric interpretation. In figure 1, an Edgeworth box is used to represent the international distribution of productive resources. The origin O is used to measure home country endowments, O^* to measure foreign endowments. The two diagonals of the box can then be given economic interpretations: OO^* is a line along which factor proportions are equal in the two countries, while the other diagonal is a line along which the countries are of equal economic size. The mirror-image assumption is saying that the endowment point E lies on this diagonal. The parameter z then determines the position of E; as z goes from 0 to 1, E moves from the corner to the center of the box.

Suppose, now, that these countries are able to trade at zero transportation cost. As before, we can determine pricing behavior, the size and number of firms, and relative wages. In addition, we can determine the volume and pattern of trade.

The first point to note is that the elasticity of demand for any particular product is still $1/(1 - \theta)$. This gives us price equations

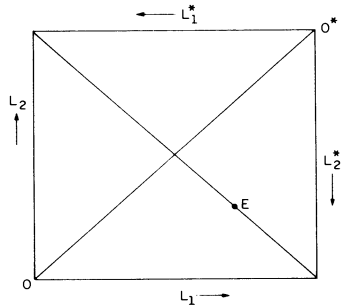

FIG. 1

exactly the same as before:

$$\begin{aligned} p_1 &= \theta^{-1}\beta w_1, \\ p_2 &= \theta^{-1}\beta w_2, \\ p_1^* &= \theta^{-1}\beta w_1^*, \\ p_2^* &= \theta^{-1}\beta w_2^*. \end{aligned} \tag{11}$$

Now, however, the symmetry of the setup insures that all wages will be equal, both across industries and internationally:

$$w_1 = w_1^* = w_2 = w_2^*. \tag{12}$$

The zero-profit condition will determine the equilibrium size of firm, x, which will be the same for both industries in both countries:

$$x = \alpha\theta/\beta(1 - \theta). \tag{13}$$

Finally, full employment determines the number of firms in each industry in each country:

$$\begin{aligned} n_1 &= n_2^* = (2 - z)/(\alpha + \beta x), \\ n_2 &= n_1^* = z/(\alpha + \beta x). \end{aligned} \tag{14}$$

What these results show is that trade will lead to factor price equalization while leaving the pattern of production unchanged. Our remaining task is to determine the volume and pattern of trade. We can do this by noting two points. First, everyone will devote equal shares of expenditure to the two industries. Second, everyone will spend an equal amount on each of the products within an industry. This means that the share of all individuals' income falling on, say, industry 1 products produced in the foreign country is $\frac{1}{2} \cdot [n_1^*/(n_1 + n_1^*)]$—that is, the industry share in expenditure times that country's share of the industry. But the number of products is proportional to the labor force. Thus, if we let Y be the home country's income

(equal to the foreign country's), X_1 be exports of industry 1 products, X_2 be exports of industry 2 products, M_1 be imports of industry 1 products, and M_2 be imports of industry 2 products, we have

$$\begin{aligned} X_1 &= \tfrac{1}{2}Y \cdot [(2 - z)/2], \\ X_2 &= \tfrac{1}{2}Y \cdot (z/2), \\ M_1 &= \tfrac{1}{2}Y \cdot (z/2), \\ M_2 &= \tfrac{1}{2}Y \cdot [(2 - z)/2]. \end{aligned} \tag{15}$$

Now, the relations (15) have two important implications. First, consider the volume of trade. Total home country exports are $X_1 + X_2 = \tfrac{1}{2}Y$. Thus the ratio of trade to income is independent of z, the index of similarity in factor proportions. This can be regarded as an answer to the first ostensible empirical paradox mentioned in the introduction—the large volume of trade among similar countries. In this model, similar countries will trade just as much as dissimilar countries.

The second seeming empirical paradox was the prevalence, in trade among similar countries, of two-way trade in similar products. If we substitute (15) into our expression for intraindustry trade (9), we get a simple, striking result:

$$I = z. \tag{16}$$

The index of intraindustry trade equals the index of similarity in factor proportions.

These results may appear to depend crucially on the assumptions of this model, but in qualitative terms they can survive a good deal of generalization. The persistence of trade between countries with similar factor endowments will occur in almost any model with economies of scale. The relationship between similarity of countries and the extent of intraindustry trade can be shown to hold, for an appropriate definition of similarity, in a much more general model and has also been noted in a quite different context by Ethier (1979). Insofar as these insights are concerned, the virtue of this model is not in the difference of its conclusions but in the clarity with which they emerge.

Where the special assumptions of this model become particularly useful, however, is in attempting to deal with the welfare consequences of trade. These consequences are considered in the next section.

III. Gains and Losses from Trade

In this section we must again begin by delineating a concept which I have been using loosely. This is the idea of the "seriousness" of

distribution problems. What we need is a clear way of formulating the notion that distribution problems from opening trade will not be serious, if countries are sufficiently similar in factor proportions that the trade which results is primarily intraindustry trade.

The criterion I will use to define nonserious distribution problems is the following: Distribution problems arising from trade will be held not to be serious if *both factors gain from trade.* This, of course, begs some questions, since there may be difficulties in getting groups to accept a relative decline in income even if they are absolutely better off. But this criterion is fairly reasonable and turns out to give suggestive results.

To find out whether factors gain from trade, we need to know how utility depends on the variables of the model. Suppose an individual receives a wage w and has the utility function (1). He will then spend $w/2$ on the products of each industry and divide his expenditure equally among the products within an industry. Thus his utility will depend on his wage, the prices of representative products in each industry, and the number of products available:

$$\begin{aligned} U &= \ln [n_1(w/2n_1p_1)^\theta]^{1/\theta} + \ln [n_2(w/2n_2p_2)^\theta]^{1/\theta} \\ &= -2 \ln 2 + \ln w/p_1 + \ln w/p_2 + \frac{1-\theta}{\theta} \ln n_1 + \frac{1-\theta}{\theta} \ln n_2. \end{aligned} \tag{17}$$

The function (17) has the convenient property that all the effects enter additively. Utility depends on real wages in terms of representative products and on diversity.

To analyze the effects of trade on welfare, it is useful to introduce some more notation:

U_1, U_2 = utility of workers in industries 1 and 2;

w_{11}, w_{12} = real wage of industry 1 workers in terms of products of industries 1 and 2;

w_{21}, w_{22} = real wage of industry 2 workers in terms of products of industries 1 and 2.

Then we can substitute into (17) to get (suppressing the constant term):

$$\begin{aligned} U_1 &= \ln w_{11} + \ln w_{12} + \frac{1-\theta}{\theta} \ln n_1 + \frac{1-\theta}{\theta} \ln n_2, \\ U_2 &= \ln w_{21} + \ln w_{22} + \frac{1-\theta}{\theta} \ln n_1 + \frac{1-\theta}{\theta} \ln n_2. \end{aligned} \tag{18}$$

We are now in a position to measure the welfare effects of trade. Suppose we start from a position of autarky, as in Section I, then move to free trade, as in Section II. There will then be two kinds of

effects. First, there will be a distribution effect as factor prices are equalized. As one can easily verify, labor's real wage remains the same in terms of the products of its own industry while rising or falling in terms of the other industry's products, depending on whether the factor is abundant or scarce. Thus, in the home country this effect benefits labor in industry 1 and hurts labor in industry 2.

The second effect comes from the increase in the size of the market, which makes a greater variety of products available. This works to everyone's benefit.

Since both effects work in its favor, the abundant factor must be made better off. This leaves us with the problem of determining the change in utility of the scarce factor—industry 2 labor in the home country and the symmetrically placed industry 1 labor in the foreign country.

Let a prime on a variable indicate its free-trade value while unmarked variables refer to autarky. Then, as we move from the autarky solution in Section I to the free-trade solution in Section II, the change in U_2 is

$$\begin{aligned} U_2' - U_2 &= \ln w_{21}'/w_{21} + \frac{1-\theta}{\theta} \ln n_1'/n_1 + \frac{1-\theta}{\theta} \ln n_2'/n_2 \\ &= \ln z/(2-z) + \frac{1-\theta}{\theta} \ln 2/(2-z) + \frac{1-\theta}{\theta} \ln 2/z, \end{aligned} \tag{19}$$

where the first term is negative and represents the distribution loss; the remaining terms are positive and represent the gains from being part of a larger market. The question is under what conditions these terms will outweigh the first terms.

By collecting terms, we can rewrite (19) as

$$U_2' - U_2 = \frac{2\theta - 1}{\theta} \ln z - \frac{1}{\theta} \ln 2 - z + \frac{2 - 2\theta}{\theta} \ln 2. \tag{20}$$

This gives us one immediate result: If $\theta < 0.5$, the scarce factor necessarily gains from trade, since the first term will be positive and the third term will outweigh the second. Recall that θ is a measure of the substitutability of products within an industry. What this result then says is that *if products are sufficiently differentiated, both factors gain from trade.*

If $\theta > 0.5$, whether both factors gain depends on the extent to which trade is intraindustry in character, which in turn depends on how similar the countries are in factor proportions. When $\theta > 0.5$, the function (20) has three properties: (i) as z approaches 1, $U_2' - U_2$ goes to $[(2 - 2\theta)/\theta] \ln 2 > 0$; (ii) as z goes to zero, $U_2' - U_2$ goes to minus infinity; and (iii) $U_2' - U_2$ is strictly increasing in z_1. Thus, if we were to graph (20), it would look like figure 2. There is a critical value of z, $\bar{z}$,

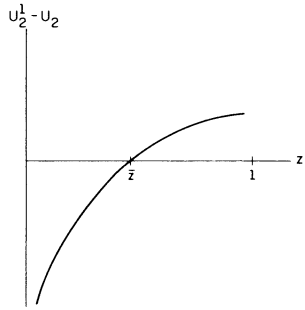

FIG. 2

for which $U_2' - U_2 = 0$. If $z > \bar{z}$, both factors gain; if $z < \bar{z}$, the scarce factor loses. But z is our measure of similarity in factor proportions. Thus what we have shown is that *if countries have sufficiently similar factor endowments, both factors gain from trade.*

What is particularly nice about this result is that we have already seen that there is a one-for-one relationship between similarity of factor endowments and intraindustry trade. So this result can be taken as a vindication of the arguments of such authors as Kravis (1971) and Hufbauer and Chilas (1974) that intraindustry trade poses fewer adjustment problems than interindustry trade.

We should note, however, that the critical value of interindustry trade depends on the substitutability of products. The function (20) is decreasing in θ: $\partial(U_2' - U_2)/\partial\theta = \theta^{-2} \ln z(2 - z) < 0$. So an increase in θ will shift the function down. This will increase $\bar{z}$. *The less differentiated are products, the more similar countries must be if both factors are to gain from trade.* In the limit, as θ goes to 1, so does $\bar{z}$.

The results of this section are summarized in figure 3. On the axes are the two parameters θ and z, both capable of taking on values

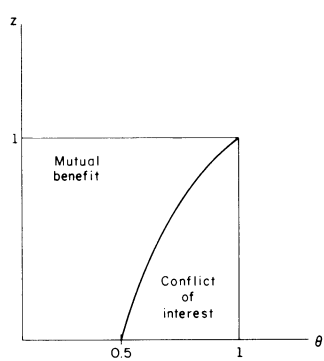

FIG. 3

between zero and one. What we have shown is that the qualitative effects of trade depend on where we are in the unit square. In the southeastern part of the square—labeled "conflict of interest"—either scale economies are unimportant or countries are very different in factor endowments, and scarce factors lose from trade. In the other region—"mutual benefit"—the gains from intraindustry specialization outweigh the conventional distributional effects, and everyone gains from trade.

IV. Summary and Conclusions

This paper began with three "paradoxes" about international trade. Since they do not seem paradoxical in the light of this model, perhaps we should state them as "stylized facts": (i) Much of world trade is between countries with similar factor endowments. (ii) The trade between similar countries is largely intraindustry in character; that is, it consists of two-way trade in similar products. (iii) The growth of intraindustry trade has not posed serious income-distribution problems.

This paper offers a simple model which formalizes one possible explanation of these stylized facts. According to this view, the variety of products produced in any one country is limited by the existence of scale economies in production. Thus similar countries have an incentive to trade; their trade will typically be in products produced with similar factor proportions; and this trade will not involve the income-distribution effects characteristic of more conventional trade.

In addition to helping make sense of some puzzling empirical results, this paper is, I hope, of some interest from the standpoint of pure theory. The model dispenses with the two most fundamental assumptions of standard trade theory: perfect competition and constant returns to scale. Instead, I have dealt in this paper with a world in which economies of scale are pervasive, and all firms have monopoly power. While the model depends on extremely restrictive assumptions, it does show that it is possible for trade theory to make at least some progress into this virtually unexplored territory.

Appendix

I. *The Concept of a Product*

In the formulation in Section I, an industry was assumed to consist of many products with the "same" cost function and entering in the "same" way into utility. This may seem to involve a comparison of apples and oranges. However, it can be justified as a restriction on the parameters of a more general model.

Consider the utility and cost functions for a one-industry model (the generalization to two industries is obvious):

$$U = \left[\sum_{i=1}^{N} (\delta_i C_i)^\theta\right]^{1/\theta}, \; 0 < \theta < 1, \tag{A1}$$

$$l_i = \alpha_i + \beta_i X_i, \quad i = 1, \ldots, n. \tag{A2}$$

Here we allow goods to enter with different weights into utility and to have different cost functions; thus no assumption is made about comparability of units. Given certain restrictions on parameters, however, it is possible to choose units so that a formulation where all products appear identical is valid. Let us suppose first that $\alpha_i = \alpha$ for all i. The measurement of this cost is independent of the choice of units, so this is a meaningful assumption. Let us also assume $\beta_i/\delta_i = \beta$ for all i. This again does not depend on units of measurement; measuring product 27 in batches of 10 instead of individual units will increase both β_{27} and δ_{27} by a factor of 10 and leave the ratio unchanged.

If the assumptions about parameters are granted—and they are special assumptions, not general properties—we can justify the model in the text by a choice of units. Let $\hat{C}_i = \delta_i C_i$ for all i. Then the utility and cost functions become

$$U = \left(\sum_{i=1}^{N} \hat{C}_i^{\,\theta}\right)^{1/\theta} \tag{A3}$$

$$l_i = \alpha + \beta \hat{X}_i, \quad i = 1, \ldots, n. \tag{A4}$$

II. *Elasticity of Demand for Individual Products*

The analysis in Section I depends on the result that the elasticity of demand for any particular product is $1/(1 - \theta)$. This Appendix gives a demonstration of this.

Consider an individual maximizing his utility function (1) subject to a budget constraint. The first-order conditions from that maximization will have the form

$$p_{1,i} = \frac{c_{1,i}^{-(1-\theta)}}{\lambda \Sigma_k c_{1,k}^{\theta}}, \quad i = 1, \ldots, n_1$$

$$p_{2,j} = \frac{c_{2,j}^{-(1-\theta)}}{\lambda \Sigma_m c_{2,m}^{\theta}}, \quad j = 1, \ldots, n_2,$$

where λ is the shadow price on the budget constraint, that is, the marginal utility of income.

If there are many products, however, the firm producing a particular product can take the denominators of these expressions as given. Thus each individual's demand for a particular product, and therefore also market demand, will have elasticity $1/(1 - \theta)$.

References

Balassa, Bela. *Trade Liberalization among Industrial Countries: Objectives and Alternatives.* New York: McGraw-Hill, 1967.

Dixit, Avinash K., and Stiglitz, Joseph E. "Monopolistic Competition and Optimum Product Diversity." *A.E.R.* 67 (June 1977): 297–308.

Ethier, Wilfred. "Internationally Decreasing Costs and World Trade." *J. Internat. Econ.* 9 (February 1979): 1–24.

Grubel, Herbert G. "The Theory of Intra-Industry Trade." In *Studies in International Economics,* edited by I. A. McDougall and Richard H. Snape. Amsterdam: North-Holland, 1970.

Grubel, Herbert G., and Lloyd, Peter J. *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products.* New York: Wiley, 1975.

Hufbauer, Gary C., and Chilas, John G. "Specialization by Industrial Countries: Extent and Consequences." In *The International Division of Labour: Problems and Perspectives,* edited by Herbert Giersch. Tübingen: Mohr, 1974.

Kravis, Irving B. "The Current Case for Import Limitations." In *United States Economic Policy in an Interdependent World,* Commission on International Trade and Investment Policy. Washington: Government Printing Office, 1971.

Krugman, Paul R. "Increasing Returns, Monopolistic Competition, and International Trade." *J. Internat. Econ.* 9 (November 1979): 469–79.