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7 Trade in Differentiated Products and the Political Economy of Trade Liberalization

Paul Krugman

Why is trade in some industries freer than in others? The great postwar liberalization of trade chiefly benefited trade in manufactured goods between developed countries, leaving trade in primary products and North-South trade in manufactures still highly restricted. Within the manufacturing sector some industries seem to view trade as a zero-sum game, while in others producers seem to believe that reciprocal tariff cuts will benefit firms in both countries. In a period of rising protectionist pressures, it might be very useful to have a theory which explains these differences in the treatment of different kinds of trade.

This paper is an attempt to take a step in the direction of such a theory. I develop a multi-industry model of trade in which each industry consists of a number of differentiated products. The pattern of *interindustrial* specialization is determined by factor proportions, so that there is an element of comparative advantage to the model. But scale economies in production ensure that each country produces only a limited number of the products within each industry, so there is also *intraindustry* specialization and trade which does not depend on comparative advantage. The model thus draws on recent work on the theory of intraindustry trade by Dixit and Norman (1980), Lancaster (1980), and the author.

In the model, liberalizing trade within an industry leads each country to expand both its imports and its exports in that industry. A country which is a net exporter in an industry will still have some demand for the products produced abroad, so net exporters will still be gross importers and vice versa. This creates the possibility that reciprocal removal of trade barriers can lead to increased sales by producers in *both* countries.

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If this is the case, presumably trade liberalization will be relatively easy to achieve.

The paper shows that whether this happens depends in economically sensible ways on industry characteristics. Specifically, producers in both countries will gain from mutual trade liberalization in an industry if neither country has too great a comparative advantage and the products within the industry are strongly differentiated. This fits in well with casual observation: trade is more liberal in differentiated manufactures than in homogeneous primary products, more restricted between countries with very unequal wage-rental ratios than between countries with similar factor prices. Thus, although the model is admittedly dependent on a number of very special assumptions, it does produce results which seem to shed light on the variation in protection across industries.

The paper is organized in four sections. Section 7.1 sets out the basic model for a single economy. In section 7.2, the pattern of specialization and trade between two such economies is considered. Section 7.3 considers the effects of mutual trade liberalization on a single industry. Finally, section 7.4 suggests some conclusions.

7.1 Structure of the Model

The model developed in this paper is based on the recently developed theory of intraindustry trade. In this theory, an "industry" is a group of products which are all produced with the same factor proportions. Whether a country is a net importer or exporter in an industry thus depends on the conventional forces of comparative advantage. Because of scale economies in production, however, each country specializes in a limited subset of the products within each industry. The result is "intraindustry" trade—countries which are *net* exporters in a particular industry will still be *gross* importers, because foreigners will be producing differentiated products.

This theory of trade helps explain why there is so much trade between similar countries and why the trade between these countries consists largely of two-way trade in similar products. The price one pays for these insights is that one must deal with illuminating special cases rather than general models. Economies of scale mean that markets cannot be perfectly competitive, and we are only able to model monopolistic competition by making special assumptions about utility and production functions. In dealing with models of intraindustry trade, then, one must always be satisfied with illustrating propositions rather than proving them.

As one might expect from these remarks, the model about to be developed is one characterized by a number of very special assumptions.

These assumptions may at first seem too special; but I believe that their simplicity and the intuitive appeal of the results they yield justify them.

Let us consider, then, an economy consisting of a number of "industries," each of which consists of many products. The appropriate definition of an industry has been a major problem in discussions of intraindustry trade: should a "supply-side" or a "demand-side" concept be used? In the particular model considered here, there is a natural grouping of products which meets both concepts; we have "industries" whose products are relatively close substitutes on both the supply and demand sides. One might justify this as an empirically reasonable assumption by arguing that products with similar characteristics are likely to have relatively similar inputs. In the theoretical model presented here, however, the characteristics which differentiate products are not explicitly set out. Thus the convenient existence of a natural definition of industries should be regarded as one of the model's special assumptions.

On the demand side, then, everyone in the economy will be assumed to have the same tastes, which can be represented by a two-level CES utility function:

$$U = \left[\sum_{j=1}^{K} \delta_i C_i^{\gamma}\right]^{1/\gamma} \qquad \gamma < 1, \tag{1}$$

where we define

$$C_i = \left[\sum_{j=1}^{N_i} c_{ij}^{\theta_i}\right]^{1/\theta_i} \qquad 0 < \theta_i < 1, \qquad i = 1, \ldots, K, \tag{2}$$

Here c_{ij} is an individual's consumption of the j^{th} product of industry i, and N_i is the (large) number of potential products in the i^{th} industry. We note that the *interindustry* elasticity of substitution is $1/1 - \gamma$, while the *intraindustry* elasticity of substitution (which varies across industries) is $1/1 - \theta_i$ for the i^{th} industry.

On the supply side, I will assume that the products of each industry are produced by a single factor, "labor," which is wholly specific to that industry. That is, we have a labor supply L_i corresponding to each industry i. This is a relatively crude way of introducing a supply side into the model; it has the virtue, as we will see, of allowing an easy parameterization of the amount of comparative advantage in an industry. If we assume full employment of resources, we can write the resource constraint as

$$L_i = \sum_j \ell_{ij} \qquad i = 1, \ldots, K, \tag{3}$$

where ℓ_{ij} is labor used in producing product j of industry i.

Labor used in the production of a particular product will be assumed to involve a fixed set-up cost and constant marginal costs thereafter:

$$\ell_{ij} = 0 \text{ if } q_{ij} = 0 \qquad i = 1, \ldots, K$$

$$= \alpha_i + \beta_i q_{ij} \text{ if } q_{ij} > 0 \qquad j = 1, \ldots, N_i, \tag{4}$$

where q_{ij} is the output of the j^{th} product of industry i and the parameters α_i and β_i are assumed constant across the products within an industry.

Equilibrium in this model will take the form of monopolistic competition. Each product will be produced by only one firm, while free entry will drive profits to zero. The simplified structure of the model makes it easy to determine pricing behavior and the size and number of firms in each industry.

First, consider pricing behavior. If the number of firms in each industry is large, each firm can disregard interindustry substitution and focus solely on intraindustry competition. Thus each firm in the i^{th} industry will face a demand curve with an elasticity equal to the industry elasticity of substitution:

$$\varepsilon_i = 1/1 - \theta_i \qquad i = 1, \ldots, K. \tag{5}$$

Profit-maximizing pricing behavior will involve setting the price at $\varepsilon_i/\varepsilon_i - 1$ times marginal cost, so that we have

$$p_i = \frac{\varepsilon_i}{\varepsilon_i - 1}\beta_i w_i \tag{6}$$

$$= \theta_i^{-1}\beta_i w_i \qquad i = 1, \ldots, K,$$

where p_i is the profit-maximizing price of firms in industry i—the same for all firms—and w_i is the wage rate of industry i's sector-specific labor.

Consider next the profitability of firms. Economic profits earned by a firm in industry i, charging price p_i and with sales q_i, are

$$\pi_i = p_i q_i - (\alpha_i + \beta_i q_i) w_i \qquad i = 1, \ldots, K. \tag{7}$$

Using the pricing rule (6), we can rewrite this as

$$\pi_i = \left[\theta_i^{-1}\beta_i q_i - \alpha_i - \beta_i q_i\right] w_i \qquad i = 1, \ldots, K. \tag{8}$$

If there is free entry and exit, the number of firms in an industry will fall if profits are negative and rise if they are positive, so that in equilibrium $\pi_i = 0$. But this lets us determine the equilibrium level of output:

$$q_i = \alpha_i \theta_i / \beta_i (1 - \theta_i) \qquad i = 1, \ldots, K. \tag{9}$$

Given the size of firms, the number of firms and thus of products actually produced within an industry can be determined from the full employment condition:

$$n_i = L_i/(\alpha_i + \beta_i q_i)$$

$$= L_i(1 - \theta_i)/\alpha_i \qquad i = 1, \ldots, K. \tag{10}$$

Finally, we need to determine relative wages w_i. We need not go into detail here; it is enough to note that relative demands for industry outputs are determined by the utility function (1) and that relative supplies are determined by the sector-specific labor forces L_i. We will return to this question in section 7.4.

This model, then, gives rise to an equilibrium in which all industries are monopolistically competitive, containing a number of firms producing differentiated products and charging prices above marginal cost. In the next section we will consider what happens when two such economies are allowed to trade. First, however, we should note that, while all industries are monopolistic, the degree of monopoly varies. This variation will turn out to be crucially important in determining the consequences of trade liberalization.

Consider the pricing equation (6). Price exceeds marginal cost by the ratio θ_i^{-1}. We can view θ, which is inversely related to the intraindustry elasticity of substitution, as an inverse index of product differentiation; if θ_i is low, products are highly differentiated and firms have considerable monopoly power. Further, since price equals average cost in equilibrium, θ is the ratio of marginal to average cost, and is thus an inverse index of unexploited economies of scale.

7.2 Comparative Advantage and the Trade Pattern

Suppose that there exists another economy very similar to the one described in section 7.1. It shares the same technology, and its consumers have the same utility function. The only difference is that the second economy has a different endowment of industry-specific labor supplies, which we will represent as L_i^*, $i = 1, \ldots, K$.

Suppose that these economies are able to trade at zero transportation cost. What can we say about the resulting pattern of trade?

Determining pricing and production in the second country is somewhat simpler than might appear. First, given the identity of utility and cost functions in the two countries, pricing behavior and the equilibrium size of firm in each industry are the same in our second country as in our first. Price is a markup on marginal cost:

$$p_i^* = \theta_i^{-1}\beta_i w_i^* \qquad i = 1, \ldots, K. \tag{11}$$

Output is determined by the condition of zero profits:

$$q_i^* = \alpha_i\theta_i/\beta_i(1 - \theta_i) \qquad i = 1, \ldots, K. \tag{12}$$

The number of products produced in the second country in each industry is proportional to its labor force in that industry:

$$n_i^* = L_i^*(1 - \theta_i)/\alpha_i \qquad i = 1, \ldots, K. \tag{13}$$

Notice that we cannot determine *which* products in the industry will be produced in which country. What we can be sure of is that there will be no overlap. Since firms can costlessly differentiate their products, no two firms will ever produce the same product; and thus firms in different countries will specialize in different products.

Finally, given the symmetry of the problem, wages in each industry will be equalized across countries:

$$w_i = w_i^* \qquad i = 1, \ldots, K. \tag{14}$$

Before proceeding to the pattern of trade, it is useful to begin by regarding the two countries together as a single economy. The industries in the world economy have labor forces $L_1 + L_1^*, \ldots, L_K + L_K^*$; and these labor forces receive equilibrium wages $w_1 = w_1^*, \ldots, w_K = w_K^*$. If we let Y be the first country's income, Y^* the second country's, then we have

$$Y = \sum_{i=1}^{K} w_i L_i, \tag{15}$$

$$Y^* = \sum_{i=1}^{K} w_i L_i^*. \tag{16}$$

The wage rates w_i are determined by demand. Since the countries have identical, homothetic tastes, they will spend the same share of income on each industry's products:

$$n_i p_i q_i + n_i^* p_i^* q_i^* = \pi_i (Y + Y^*), \tag{17}$$

where π_i, the share of expenditure falling on industry i's products, is of course dependent on relative prices. Since profits are zero, sales of an industry equal its factor payments:

$$w_i L_i + w_i^* L_i^* = \pi_i (Y + Y^*). \tag{18}$$

We are now prepared to examine the pattern of trade. Let X_i be the value of the first country's exports in industry i. We know that the second country will spend a share π_i of its income on industry i's products. At the same time, it will spend an equal share of this expenditure on each of the products within the industry. So the share of i expenditure falling on the first country's products is $n_i/(n_i + n_i^*)$. Thus the value of i exports is

$$\begin{aligned} X_i &= \frac{\pi_i n_i}{n_i + n_i^*} Y^* \\ &= \frac{\pi_i L_i}{L_i + L_i^*} Y^* \qquad i = 1, \ldots, K. \end{aligned} \tag{19}$$

A similar argument shows that the first country's imports are

$$M_i = \frac{\pi_i L_i^*}{L_i + L_i^*} Y \qquad i = 1, \ldots, K. \tag{20}$$

We can use (19) and (20) to establish two interesting propositions about trade. First, notice that a country's net export position in an industry depends on its relative endowment of the industry-specific factor. Consider, for example, a widely used measure of "revealed comparative advantage":

$$R_i = \ln(X_i/M_i). \tag{21}$$

From (19) and (20), we have

$$R_i = \ln(L_i/L_i^*) - \ln(Y/Y^*). \tag{22}$$

Since Y/Y^* is a term common to all industries, the ranking of industries by revealed comparative advantage is determined by relative factor endowments.

The second proposition concerns the importance of "intraindustry" trade. Obviously, (19) and (20) imply that a country will import even where it has a comparative advantage, export where it has a comparative disadvantage. A widely used measure of this intraindustry trade is the index of trade overlap,

$$I_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}. \tag{23}$$

Algebraic manipulation allows us to rewrite this as

$$I_i = \frac{2}{1 + \exp|R_i|}. \tag{24}$$

Thus intraindustry trade will predominate in those industries in which the absolute value of R is close to zero, i.e., in which comparative advantage is weak.

We have shown in the last two sections that it is possible to develop a relatively simple trade model in which there are many industries, and in which the degree of monopoly and the extent of comparative advantage vary in economically meaningful ways across industries. It remains to show why these industry characteristics matter. The next section considers how the parameters which describe an industry can make trade liberalization easy or difficult.

7.3 Effects of Trade Liberalization

Suppose that some particular industry, say industry i, is subject to trade restrictions. Ordinarily, producers in each country will oppose any uni-

lateral elimination of their country's restrictions; by exposing them to foreign competition this will lower the wages of industry-specific labor and will not usually offer a compensating consumption gain. But a simultaneous removal of restrictions by both countries may be another matter. Not only will it increase the welfare of producers in the country with a comparative advantage; it may benefit producers in the country with a comparative disadvantage as well!

How is this possible? The products of different countries are imperfect substitutes for one another; removing trade restrictions offers consumers a wider range of choice and may lead them to spend a larger share of their income on industry i's products. If the products are sufficiently differentiated and comparative advantage is weak, this effect may be enough to raise the industry-specific wage rate in the country with a comparative disadvantage.

To establish this point, it is helpful to make several simplifying assumptions:

i) Industry i is taken to be "small," so that we disregard the effect of trade liberalization on national income and on other industries' prices.

ii) Trade liberalization is assumed to take an extreme form. Before liberalization, trade in industry i (though not in other industries) is wholly prohibited. After liberalization, trade is completely free. Thus we exclude limited or differential liberalization.

iii) To exclude effects which arise from differences in the size of countries, as opposed to specific industry characteristics, the countries are assumed to have equal national incomes: $Y = Y^*$.

We can now begin the formal analysis. The crucial aspect of the model is the existence of many products within each industry and the value consumers place on this diversity. This aspect can be viewed as creating a divergence between *physical* output in an industry and "true" output taking into account the value of diversity. Consider the utility formulation (1) and (2). One way of reading this (a way suggested by Ethier 1980) is to think of consumers assembling final consumption goods C_i from components C_{ij}. It is then apparent that the output of these final consumption goods depends on the diversity of products available as well as on physical output. Specifically, an index of "true" output for industry i can be written

$$Q_i^t = \tilde{n}_i^{1/\theta_i} q_i, \tag{25}$$

where $\tilde{n}_i$ is the number of products available and q_i is the output of a representative product.

Similarly, there is a divergence between the actual prices of products and the "true" price index reflecting the value of diversity. For a given price of representative products in an industry, the price of the final consumption good "assembled" from these products will fall as the

diversity of products increases. Again, by inspecting (1), we can see that a "true" price index will have the form

$$P_i^t = \tilde{n}_i^{(\theta_i - 1)/\theta_i} p_i, \tag{26}$$

where p_i is the price of a representative product.

What is the definition of $\tilde{n}_i$? Since we are deriving our indices from the utility function, the relevant number of products is the number *available to the consumer.* Before trade liberalization, $\tilde{n}_i = n_i$, the number of domestic products; after trade, $\tilde{n}_i = n_i + n_i^*$, the number of products produced worldwide. As Ethier (1979) has pointed out, in this kind of situation increasing returns apply on a world scale.

Now consider the situation of the industry before trade liberalization. We already know how n_i, q_i, and p_i are determined; using (6), (9), and (10) and writing the results in logarithmic form, we have

$$\ln Q_i^t = \ln \alpha_i \theta_i / \beta_i (1 - \theta_i) + \theta_i^{-1} \ln L_i (1 - \theta_i)/\alpha_i \tag{27}$$

for the true index of output, and

$$\ln P_i^t = \ln \theta_i^{-1} \beta_i w_i - \frac{1 - \theta_i}{\theta_i} \ln L_i (1 - \theta_i)/\alpha_i. \tag{28}$$

The demand for true output will depend on income and prices. The form of the utility function ensures that all industries will face an income elasticity of demand of one and a price elasticity of $1/1 - \gamma$. Thus we can write a demand function in terms of true output and prices:

$$\ln Q_i^t = A_i + \ln Y - \frac{1}{1 - \gamma} \ln P_i^t, \tag{29}$$

where A_i is a constant term.

Note that we have not specified the units in which income and prices are measured. Since the industry is assumed small, however, and we are considering a liberalization of trade *in one industry at a time*, the relative prices of all other industries' products can be taken as fixed, and thus all other output (and all other factors) can be regarded as a composite commodity. We can then use this composite commodity as *numeraire.*

We can solve (29) for the wage rate of industry i labor. Using (27) and (28), we can derive the expression

$$\ln w_i = K_i + (1 - \gamma) \ln Y - \frac{\theta_i - \gamma}{\theta_i} \ln L_i, \tag{30}$$

where K_i includes all of the terms which will not change when trade is liberalized.

Trade liberalization amounts to moving to a larger economy, with an income of $Y + Y^* = 2Y$ and with an industry i labor force of $L_i + L_i^*$.

Let us define σ_i as the share of the first country in the i^{th} industry's labor force:

$$\sigma_i = L_i/(L_i + L_i^*). \tag{31}$$

Since Y and Y^* are assumed equal, σ_i can be regarded as an index of comparative advantage. We will be concerned with the case $\sigma_i \leq \frac{1}{2}$; i.e., what happens to wages in the industry at a comparative disadvantage?

Using the definition of σ_i, the change in the wage rate in industry i can be written

$$\Delta \ln w_i = (1-\gamma)\ln 2 + \frac{\theta_i - \gamma}{\theta_i}\ln \sigma_i. \tag{32}$$

The first term is positive, the second of ambiguous sign. There are three relevant parameters: γ, which is common to all industries, and θ_i and σ_i, which are specific to industry i.

Both of the industry-specific parameters have economic interpretations. As just noted, σ_i is an index of comparative advantage; the lower is σ_i, the greater the disadvantage of domestic producers. And we have already noted that θ_i is an index of product differentiation: the lower is θ_i, the more value consumers place on diversity and the greater the monopoly power of firms.

The effect of these factors can be determined by noticing the following:

i) For $\theta_i \leq \gamma$, i.e., a situation of highly differentiated products, $\Delta \ln w_i$ is always positive.

ii) For $\theta_i > \gamma$, $\Delta \ln w_i$ is increasing in σ_i and decreasing in θ_i.

iii) $\Delta \ln w_i = 0$ when $\theta_i = 1$, $\sigma_i = \frac{1}{2}$.

The implications of these points are shown in figure 7.1. On the axes are shown the industry characteristics of product differentiation and comparative advantage. In the relevant region, what we have shown is that we can draw a line dividing industries into two groups. In the lower right are industries with strong comparative advantage and weak product differentiation. In these industries the producers in the comparatively disadvantaged country stand to lose from liberalization. In the other group of industries—those with weak comparative advantage and strong product differentiation—producers in both countries gain from liberalization.

7.4 Conclusions

This paper has developed a simple multi-industry model of trade which is designed to give some insight into the reasons why trade is freer in some goods than others. While the model is dependent on many special assumptions, the two factors it points to seem intuitively plausible. The

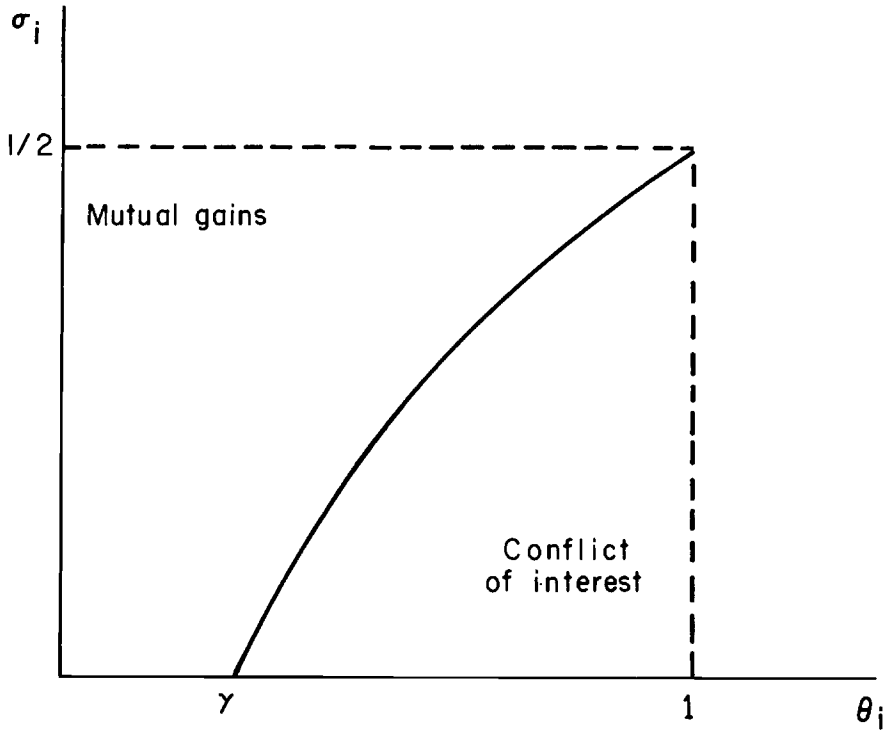

Fig. 7.1

analysis suggests that bilateral trade liberalization will be favored by producers in both countries if (i) neither country has a strong comparative advantage in the industry and (ii) the products of different firms within the industry are highly differentiated.

This analysis is very suggestive. In actual experience trade liberalization has typically taken place between countries with fairly similar economic structure; it has been biased toward industries in which comparative advantage has been weak, so that growth in trade is largely intraindustry in character; and it has been easier to liberalize trade in industries producing differentiated products than where firms' output is more homogeneous. This is casual, impressionistic evidence; but the theory does seem to accord in at least a rough way with experience.

The analysis has mixed implications for the political economy of trade, in that it suggests more optimism on the "economy" side than the "political" side. In the traditional view of trade, moves toward freer trade always involve a struggle between special interests which favor protection and the general interest, which is served by liberalization. According to this view, actual experiences of liberalization show that the general

interest does sometimes prevail. But we have seen that the special interests will not always oppose liberalization. This is good news: but it casts some doubt on the favorable evaluation of past liberalization. Is it possible that the general interest, in fact, never does prevail?

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Comment Kelvin Lancaster

The model of product-differentiated trade presented by Paul Krugman, which is based on the Dixit-Stiglitz model of monopolistic competition,[1] represents a different approach from that developed in my own work,[2] and masks, I believe, the real problems associated with import competition when products are differentiated.

Differentiated models, like differentiated products, have characteristics in different proportions, and so do the Dixit-Stiglitz and Lancaster models. The important differences for the present purposes have been listed in table 7.1, and I believe the table saves a great deal of verbal explanation. Some of my criticisms of the Dixit-Stiglitz model are on

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record elsewhere,[3] and I am concerned here only with those features of the original model or with Krugman's extension which give what I consider to be an erroneous picture of import competition under product differentiation.

The feature of the Dixit-Stiglitz-Krugman model which differentiates it most from my own is the absence of any reference to the properties or characteristics (specification) of the products. All products, however similar to or different from other products of the same industry, are equal substitutes for all industry products. A consumer does not benefit because a new product is closer to what he or she would order on a custom basis (his preferred specification), but simply because there is a greater number of goods, all of which are purchased by every consumer. Firms do not need to agonize over the design of a new product: whatever the design, it is guaranteed a market with properties identical to those of the markets for all other goods in the industry. The simplicity of the Krugman model, which can derive some results much more expeditiously than mine, must be weighed against special predictions that do not generalize and some notable eccentricities.

Import Competition with Identical Countries

In both the Krugman and Lancaster models, identical countries can gain from trade of an intraindustry kind even though there are no comparative advantage or factor endowment differences between them, and the special features of trade in differentiated products can be seen most clearly in this case. Since the countries are identical, their economies will have the same structure in a no-trade situation, and, in particular, the number of goods in each product-differentiated industry will be the same in the two countries. In the Lancaster model, the same goods will be produced in both countries since the decisions as to specification will be made under identical circumstances. In the Krugman model, the goods need not be the same since there is no decision mechanism for determining specification, and the choice of goods to be produced can be considered as a random draw from a very large, even infinite, number of possibilities, except that no two firms in the same country will produce the same good.

If costless trade is now opened up between the two countries, both models agree that (1) there will be intraindustry trade in each product-differentiated industry, and (2) each good will be produced in one country only, half for domestic use and half for export.

The models differ considerably, however, in the predicted post-trade structure of the product-differentiated industries and in the nature of the gains from trade. In the Krugman model, the number of products depends only on the amount of the industry-specific factor so that the world industry will produce twice as many products as each country in isola-

Table C7.1 **Comparison of Krugman and Lancaster Models of Product Differentiation**

	Krugman	Lancaster
Nature of goods	Direct objects of utility	Possess properties or characteristics in certain, proportions (specification). Goods desired for their characteristics.
Individual consumers	Treat all goods symmetrically (within industry); purchase all goods	Each has "most preferred specification" for good in group, chooses single good on basis of both price and specification (will pay more for good closer to most preferred specification)
Consumer diversity	All consumers identical	No product variety within industry without diversity (e.g., automobiles). Extent of diversity determines degree of variety, given other conditions.
Welfare gain from product variety	Individual utility greater from $1/n$ units each of n goods than from $1/(n-1)$ units of $n-1$ goods (utility becomes infinite as $n \to \infty$)	Greater variety enables more consumers to have a good closer to most preferred specification. Variety raises average welfare level, but not necessarily that of every individual.

Elasticity of demand for single good	Fixed parameter of utility function. Independent of number of goods. Does not depend on events outside industry.	Depends on specification difference from close goods. (Approaches infinity as goods become more similar.) Increases with number of goods. Depends on interindustry relationships.
Production and cost properties	Fixed plus variable cost. System explodes (infinite utility) without fixed cost. Factors immobile between industries.*	Any form permissible. Custom production (infinite differentiation) if no economies of scale. Factors freely mobile.
Decisions faced by firms	Price/quantity and entry only	Specification of product as well as price/quantity and entry
Product variety at market equilibrium	Given system parameters, determined solely by supply of industry-specific factor. Independent of market size, output levels, or events outside industry.	Determined by size of market, diversity of preferences, cost structures, equilibria of other industries
Equilibrium output	Determined by utility and cost function parameters only. Independent of size of market, number of products, events outside industry.	Determined jointly with number of products; depends on same factors
Chief virtues	Simplicity	Realism and flexibility

*This is a special feature of the Krugman model, not part of the Dixit-Stiglitz analysis.

tion—that is, each country will produce the same number of products after trade as before. Furthermore, since equilibrium outputs are determined entirely by system parameters, the output of every good will be the same after trade as before. *There are no gains from economies of scale* as a result of trade. The gains are due to the fact that consumers now purchase twice as many different goods as before, although each in only half the pre-trade quantity, which increases welfare because of the assumed structure of the utility function.

In the Lancaster model, the equilibrium number of goods in the post-trade world market cannot be so easily determined, since the degree of product differentiation depends in a complex way on the size of the market and the structure of the cost functions. However, it can easily be shown that the number in this case must be less than twice the pre-trade number in each country, and the equilibrium output levels are always greater than in a single isolated country. Thus the Krugman outcome is impossible in the Lancaster model, in which gains from trade due to economies of scale will always occur. The extreme case in the Lancaster model occurs with production functions which are homogeneous of degree greater than unity (conventional increasing returns to scale without fixed costs), when the number of goods is independent of the size of the market and thus there will be the same number of goods after trade as before, so the number produced in each country is halved and the output of each good approximately doubled.[4]

The differences between the two models as to the predicted structural changes in the differentiated-goods industries lead to crucial differences concerning the assessment of the effects of import competition and the associated political economy.

The Krugman model depicts a very smooth transition from pre- to post-trade conditions. The world industry will consist of the same number of firms, each producing the same level of output, as in the two countries together before trade. The worst that can happen to a firm as a result of trade is that, by chance, the independent random choice of products in the two countries should have resulted in a firm in the other country producing the same product, in which case either or both firms can costlessly switch to a different product with no loss. The incomes of the industry-specific factors are unchanged by trade in the identical country case, so both the entrepreneurs and the factor owners are neutral as between trade and no trade. The gains from trade are all consumption gains (variety), so the consumers' vote in favor of trade would be unopposed.

The Lancaster model predicts a very different situation, in which some firms in each country must leave the industry. In the homogeneous production function case, the opening of trade will lead to a direct one-on-one clash between every producer in one country and his counter-

part in the other, since there will be only one producer of each good at the final equilibrium. Half the firms in each country should close down, but which ones? If the economies are truly identical, there is no obvious mechanism (or even a convenient hidden hand) for choosing the particular firms,[5] a situation that could result in *all* firms in *both* countries feeling simultaneously threatened, so that there might be industry-wide lobbying against imports in both countries. On the other hand, the firms that survive will be better off than before (they will have greatly increased outputs), so if firms differ in their perceptions of their own powers to compete, there may be firms that perceive the opening of trade as an export opportunity rather than as import competition, and thus favor it.

The homogeneous production function case presents the head-on clash in its most extreme form. In the more general case, the world equilibrium will call for fewer firms than in the two countries before trade so that firms must close down in both countries, but not as many as half. On the other hand, the new equilibrium will require a different set of products, so that even the firms that remain will have to change the specifications of their products to a greater or lesser degree. The search for the appropriate new products provides a potential selection mechanism for determining which firms survive—those that choose the right specifications. This process means that all firms must adapt and none can hope to survive merely by continuing as before and hoping its opposite number will go under. The one-on-one element is removed, with less potential for universal opposition to trade.

Consumer gains from trade in the Lancaster model are more tangible than in the Krugman model, since in the former they include the effect of economies of scale as evidenced in lower prices for the traded goods, and this presumably makes the case for trade rather easier to argue. On the other hand, a particular individual may actually lose from trade under the Lancaster conditions, since the post-trade world equilibrium may not produce some product very close to his preferred specification, even though this had been produced in the pre-trade situation. Such a loss may not be counterbalanced by the lowered price of whatever product is now closest to his personal preference. There will, however, be more consumers for whom the reverse is true, since the greater variety will enable more consumers to have goods very close to their preferred specification than in the pre-trade situation.

Comparative Advantage

Comparative advantage is not required to explain the existence of a large volume of trade in a world economy in which product-differentiated industries are of major importance, but comparative advantage effects may exist along with those effects (scale economies in Lancaster, variety in Krugman) which generate intraindustry trade in its absence.

I have discussed several aspects of comparative advantage within the Lancaster framework elsewhere,[6] primarily in the context of a product-differentiated sector (manufacturing) and a nondifferentiated sector (agriculture). The broad features are simple enough: for a sufficiently large comparative advantage difference, specialization will occur with exchange of one industry's products for those of another, as in traditional trade theory. For a lesser difference in comparative advantage there will be intraindustry trade, but the country with the comparative advantage in the industry will produce a larger number of the products than the country with the comparative disadvantage. Each good will be produced in only one country but sold in both, the country having the comparative advantage in a particular industry running a surplus on the intraindustry trade which is offset against industries in which it has the comparative disadvantage.

Commencing from a no-trade situation, the opening of trade will necessarily result in a shrinking of the industry with the comparative disadvantage, a shrinking that will be more severe than in the identical country case. If the comparative disadvantage is great enough, the whole industry will close, but in general it will remain with a small number of firms. The output of the firms that remain will, however, expand, and these firms will thrive even though the industry has declined. Since factors are mobile in the Lancaster model, labor and capital will move out to the country's expanding industries (although capital might migrate to the same industry in the other country) and interindustry effects will be much the same as in the traditional analysis. The important difference in the political economy of the situation between the product-differentiated and homogeneous cases is that the surviving firms will be better off after trade in the former case, and thus firms that believe they will survive may favor trade liberalization even though they are in the disadvantaged industry.

A special form of comparative advantage may exist in the Lancaster framework due to differences in the distribution of consumer preferences between the two countries. Suppose the home country's preferences are distributed in such a way that a majority prefer large cars to small, while the preferences in the foreign country are distributed in the opposite direction. If the countries are otherwise similar, the home country will produce more models of large cars, and those in larger quantities, than the foreign country. In terms of design experience, output capacity, and unit cost, the home country will have a comparative advantage in large cars, the foreign country in small. This is an intraindustry comparative advantage that makes it relatively clear which firms in each country's automobile industry are likely to gain from trade, and which to lose.[7]

Comparative advantage in the Krugman model has very special features. Since factors are immobile between industries, specialization can

never occur—indeed, the number of firms in each industry and the outputs of each firm remain the same before and after trade, with or without comparative advantage effects. The only effect of trade on the industry itself is its effect on the wages (really rent) of the industry-specific factors. Krugman defines comparative advantage as having a higher-than-average proportion of the industry-specific factor. In the normal case, trade makes the specific factor relatively less scarce in the world economy than it was beforehand in the country with the comparative disadvantage, so the rent falls relatively, while it rises in an industry with a comparative advantage. Owners of the specific factor gain in the advantaged industry and lose in the disadvantaged one. However, the fall in rent in the disadvantaged industry may be more than offset by the gain in utility per dollar due to the increased product variety with trade, so the factors in the disadvantaged industry may still gain in welfare. This gain requires the offset of two effects, and will only occur if the comparative advantage difference is relatively small. Krugman also introduces a perverse case (having the strange property that goods outside the industry are better substitutes for goods in the industry than are other goods asserted to be in the same industry) in which rent rises in the "disadvantaged" industry (which can actually be shown to have the advantage in terms of pre-trade prices). In this case, however, rent falls in the other industry. In either case, the results are similar to those of the Stolper-Samuelson analysis in that one factor makes an unambiguous welfare gain while the other makes a welfare gain only if the factor proportions are relatively similar between the countries. Krugman is incorrect in arguing that all industries may favor trade liberalization over a wide range of configurations—on the basis of his own model this can only occur when the economies are relatively similar, and even then one industry's gains will be intangible, due entirely to greater variety.

The Political Economy of Import Competition

In a product-differentiated industry, import competition is also export opportunity, unless comparative advantage effects are so great as to lead to industry specialization.[8] Thus there is a potential conflict of interest within the industry between those firms which fear to be put out of business by trade liberalization and those that expect to survive and expand their output, a quite different situation from that of the homogeneous product industry in which all firms will gain or all will lose.

Since the opening of trade for a differentiated product industry will lead to major changes within the industry—some firms vanishing, others expanding, all searching for the product designs appropriate to the world market—the political pressures in the industry for and against trade liberalization will depend on the distribution of expectations and approaches to risk over the firms. If all firms are cautious risk averters, it

is possible that all firms in both countries may oppose trade—even the firms in the country with the comparative advantage in the industry. At the other extreme, all firms (even those in the disadvantaged country) may favor trade if they are all optimistic risk takers. It seems reasonable to expect, however, that the net pressures will be in favor of trade in the advantaged country and against in the disadvantaged, on average. In the identical country case, the balance is unclear.

A special feature of the political economy of differentiated products is the likely pressure for highly specific trade barriers—special tariffs on industry products with specifications lying between narrow limits, those of the products already produced by the home industry.

If the industry is composed of multiproduct firms instead of the single-product firms assumed in the analysis, the views of individual firms will depend on their mix of products as well as their expectations, but the potential for divergent views about trade liberalization is still there.

Notes

1. Dixit and Stiglitz (1977).
2. Lancaster (1979, 1980*b*).
3. Lancaster (1980*c*).
4. The world market equilibrium outputs may be more or less than twice the pre-trade level in each country, depending on the elasticity of substitution with respect to goods outside the industry, the shape of the cost function, and other factors.
5. But the balance of payments mechanism, if stable, will ensure that neither country produces more than half the total number of products. See Lancaster (1980*a*).
6. Lancaster (1980*a*).
7. An application of this reasoning to the United States automobile market at the present time should also take account of a general shift in preferences toward small cars due to increased gasoline prices, an effect easily analyzed in terms of characteristics. In addition, it should be noted that the analysis is based on monopolistic competition (single-product firms), rather than the multiproduct oligopolies which characterize the international automobile industry. It should be noted that the United States automobile industry needs to (and is attempting to) change its product mix. Tariffs on small car imports would not help, but would probably hinder, this required structural change.
8. The comments in this section are based on the use of the Lancaster model only.

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Comment

Michael Mussa

Paul Krugman has provided us with a stimulating paper that argues pursuasively for the virtues of a nontraditional model of international trade that assumes increasing rather than constant returns to scale, that postulates monopolistic rather than perfect competition, and that focuses on the opportunities for consuming a greater diversity of commodities as a key benefit of international trade. I believe that the benefits of diversity are particularly important in economic theory, and that Paul Krugman's paper is especially valuable because it provides us with an alternative analytical framework that adds a new perspective to our understanding of many important issues in international economics. My task as a critic, however, is not to praise Caesar, but rather to suggest some possible limitations and deficiencies of his new imperial designs. Accordingly, I would like to emphasize three main reasons why we need to take very seriously Paul's own caution that his model is "dependent on a number of very special assumptions."

First, while the specification of productive technology implies that there are increasing returns to scale in producing each individual commodity, the profit-maximizing decisions of firms, under the assumption of monopolist competition, always lead to a constant level of production of each commodity. The opening of trade between countries therefore does not yield any benefits from a reduction in costs associated with an increase in the scale of production of individual commodities. Thus in Krugman's model we do not observe the important principle enunciated by Adam Smith that society benefits from the efficiencies generated by a more refined division of labor, made possible by broadening the extent of the market.

Second, Krugman's model has peculiar properties with respect to the degree of competition among firms in the same industry. As the number of firms in an industry grows, the cross-price elasticity of demand between the differentiated products of these firms tends to zero; that is, a change in the price of one firm's product has virtually no effect on the demands for the products of other firms in the same industry. Moreover, the own-price elasticity of demand for a firm's product converges to a constant, $\varepsilon_i = 1/(1 - \theta_i)$, that depends only on the parameters of the utility function. These properties of Krugman's model run counter to our normal intuition that, as the number of firms in an industry producing differentiated products grows, their products will tend to become closer and closer substitutes, the cross-price elasticities of demand will become large, and the monopoly power of any individual firm (measured by the

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inverse of the own-price elasticity of demand for its product) will become small. Because Krugman's model lacks these intuitively appealing properties, I question its relevance to the key question of the benefits of international trade in enforcing more competitive behavior in industries where increasing returns to scale limit the number of firms that may efficiently operate within any national economy. This question is of vital importance in discussions of antitrust policy for a number of industries in the United States and presumably in other countries.

Third, in my judgment Krugman's explanation of intraindustry and interindustry trade relies too strongly on unrealistic implications of his theoretical model. Under free trade, consumers in each country divide their expenditure equally among the products of all individual firms in a given industry. The ratio of foreign sales to domestic sales for any individual firm is equal to the ratio of foreign income to domestic income. Hence all firms in a given country, regardless of industry, are equally engaged in international trade, in the sense that all individual firms have the same ratio of foreign sales to domestic sales. This is a very strong and (I believe) unrealistic implication of Krugman's model. It leads directly to Krugman's conclusions concerning intraindustry trade. Specifically, for two countries of equal size (income), each individual firm in both countries always exports exactly half of its output. If the two countries have the same endowments of factors specific to the various industries and hence the same number of firms in each industry, then all trade will be "intraindustry" in the sense that trade will balance industry by industry. To the extent that endowments of specific factors are not the same between the two countries, there will be "interindustry" trade in the sense that trade will not be balanced on an industry by industry basis. My concern is that to reach these conclusions it should not be necessary to use a model with the unrealistic implication that all firms within a given country are equally engaged in trade.

Comment John S. Chipman

I would like to draw attention to a seemingly innocent assumption contained in Krugman's specification (4) of the production relations in his model. The condition that "the parameters α_i and β_i are assumed constant across the products within an industry" is not invariant with respect to changes in the units of measurement; this has consequences that

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somewhat impair the credibility of the model, as I shall show by means of a simple illustration.

Suppose that a technological change occurs in the production of commodity j' in industry i', so that for $ij = i'j'$ we have, henceforth,

$$(4') \qquad \ell_{i'j'} = \alpha_{i'} + \beta_{i'j'} q_{i'j'} \qquad \text{where } \beta_{i'j'} < \beta_{i'} \text{ (say)},$$

the relations (4) remaining valid for $ij \neq i'j'$. In order to handle such a situation one would have to change the units of measurement of this commodity and replace the term $q_{i'j'}$ (the output of the j'^{th} product of industry i') by

$$(4'') \qquad q'_{i'j'} = \frac{\beta_{i'j'}}{\beta_{i'}} q_{i'j'},$$

so that in terms of the new units of measurement

$$(4''') \qquad \ell_{i'j'} = \alpha_{i'} + \beta_{i'} q'_{i'j'}.$$

Krugman's relations (4) thus remain formally valid with (4) replaced by (4''') for $ij = i'j'$.

However, for the model to remain consistent, one obviously would have to make the same change in units of measurement on the consumption side. Specifically, in Krugman's equation (2) one would have to replace the term $c_{i'j'}$ (an individual's consumption of the j'^{th} product of industry i') by

$$(2'') \qquad c'_{i'j'} = \frac{\beta_{i'j'}}{\beta_{i'}} c_{i'j'},$$

resulting in

$$(2''') \qquad C_{i'} = \left[\sum_{\substack{j=1 \\ j \neq j'}}^{N_{i'}} c_{i'j'}^{\theta_{i'}} + \frac{\beta_{i'}}{\beta_{i'j'}} c'^{\theta_{i'}}_{i'j'} \right]^{1/\theta_{i'}}.$$

This term must replace the previous expression for $C_{i'}$ in the utility function (1).

In short, for the model to remain consistent it must be assumed that preferences are tied to the technology; a technological change must be accompanied by an exactly offsetting change in consumer preferences.

This is no accident. It has been well known since Marschak's classic discussion of the overdeterminacy of equilibrium under imperfect competition (Marschak 1950, pp. 92–93) that if all agents perceive the technology and the market demand functions as they actually are, the system of equations describing market equilibrium is overdetermined. One solution is then to introduce some manifestly artificial conditions that will guarantee functional dependence as between preferences and the technology. This is the solution adopted by Krugman.

Fifteen years ago (Chipman 1965, pp. 736–49) I sketched an argument outlining an alternative approach, and five years later (Chipman 1970) I carried it out precisely in the context of a model not unlike Krugman's in which labor was the sole factor of production. The key to overcoming the overdeterminacy is to assume that individual producers *perceive* their production processes to operate under constant returns to scale, even if they do not. This is strictly analogous to the assumption adopted in the perfectly competitive model that each individual *perceives* that he has no influence on the market price (whereas such a perception is obviously false, since the aggregate of all individuals would then also have no influence on the market price). Similarly, one can in the case of monopolistic competition assume that each firm *perceives* the demand curve for its product to be linear, say, and such as to pass through the equilibrium point with a slope equal to the slope of the true demand curve at that point. Such an approach was introduced by Negishi (1941) and has been carried out successfully by Silvestre (1977). The idea has recently been applied to international trade theory by Inoue (1981). It is an obvious generalization of the idealization used in the perfectly competitive model.

The above is certainly not the only viable alternative approach. Another is to follow the lead of Aumann (1964) in postulating the existence of a continuum of agents, each being identified, say, with a point on the unit interval [0,1]. In the Walrasian general-equilibrium framework, Zeno's paradox that the whole cannot exceed the sum of its parts is resolved by virtue of the fact that no one of the infinitesimal agents has any influence on the price, whereas any open interval of agents does; any single agent has measure zero. The same idea can be carried over to the theory of product differentiation and increasing returns to scale, as has indeed been done recently by Helpman (1981).

With either one of these approaches one can avoid the artificial functional dependence between technology and tastes that Krugman's formulation necessarily entails.

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