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MONOPOLISTIC COMPETITION IN TRADE THEORY

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1 INTRODUCTION

In 1979, Kelvin Lancaster and Paul Krugman published independent formalizations of an idea that had been around for many years, namely, that the manufacture of differentiated products with brand-specific economies of scale leads to intra-industry trade (two-way trade in similar, although not necessarily identical, products). They made their point with simplified one-sector models in which *all* trade is of the intra-industry type. Though they used different approaches to the specification of preferences and other details, the same central message emerged from their writings: the time was ripe for an incorporation of important sectors of the industrial world into the formal theory of international trade (see also Balassa, 1967; Grubel and Lloyd, 1975; and Norman, 1976).

In the ensuing years, this building block was effectively used to reformulate trade theory. It also opened the door to a broader treatment of noncompetitive market structures. Thus, for example, Frank Graham's famous argument for tariff protection and his debate with Frank Knight (see Knight, 1924, 1925, and Graham, 1925) were examined with modern tools. It was shown that Graham was right (see Ethier, 1982b): a country that produces import-competing goods with increasing returns to scale may lose from trade, and a tariff may help in these circumstances.

Ten years after the turning point is a suitable time to take stock of these developments. The entire literature on noncompetitive trade theory is too vast to be reviewed in a single paper, so I confine the discussion to monopolistic competition in differentiated products. Restrictive as this choice may seem, it has much to offer. Not only was this line of research central to the development of the new theory of international trade during the 1980s, but it also has become central to the recent rethinking of macroeconomics in general and economic growth in particular. And, most recently, it has become a cornerstone in the treatment of dynamic trade issues.

I discuss substantive issues in two parts. The first part begins with a brief review of developments in the early 1980s, emphasizing fundamentals (Chapter 2). Then I show how the basic framework was applied to various problems, such as the explanation of the volume of trade and the share of intra-industry trade, the effect of resource expansion on North-South terms

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of trade and welfare, and the effects of international factor mobility (Chapter 3). In Chapter 4 I explain commercial-policy implications in a static framework. The first part closes with a discussion of multinational corporations (Chapter 5).

The second part deals with dynamic issues. Chapter 6 begins with the description of a recent formalization of endogenous product innovation. This approach is then used to characterize the dynamic evolution of trade. In Chapter 7 the approach is used to describe endogenous product cycles, the link between endogenous long-run growth and structural features of the international economy, the effects of commercial and industrial policies on long-run growth, and the relationship between growth promotion and economic welfare.

Lancaster (1979, Chap. 10) and Krugman (1979a) designed their work to describe intra-industry trade. They formalized an economic story that can be summed up as follows: Certain industries manufacture many varieties of the same product. Producers cater to markets in which there is a demand for a wide spectrum of brands. To penetrate the market with a new brand, the manufacturer must incur fixed costs arising from the need to develop, advertise, and market the product. Nevertheless, the existence of brand-protection rights and the economic calculus itself suggest that entrepreneurs will find it profitable to differentiate their products from those of other suppliers. Therefore, every manufacturer ends up supplying a different brand. More specifically, in an integrated world market every country specializes in a subset of the available brands.

Once this is understood, the next step is straightforward. Suppose there is a demand in every country for a wide spectrum of brands. It may arise from consumers' varied tastes for final goods or from producers' demand for differentiated intermediate inputs. Because every country specializes in a different subset of brands, it will import brands that are not produced at home, thereby bringing about intra-industry trade.

In the early 1980s, this idea was formally incorporated into multisector models by Dixit and Norman (1980, Chap. 9), Lancaster (1980), Helpman (1981), and Ethier (1982a). These extensions were important because they allowed a clear distinction between intersectoral and intra-industry trade, a distinction that did not exist in the 1979 formulations. Every contribution used a blend of Chamberlin's (1933) notion of monopolistic competition in horizontally differentiated products (the large-group case) and a formal structure of preferences that relied either on the love-of-variety approach proposed by Dixit and Stiglitz (1977) or on the ideal-variety approach proposed by Lancaster (1979). Alternative specifications of preferences did not make much difference, however, as far as trade structure was concerned. The critical element was the preferences' ability to provide brand-specific demand functions and, from them, brand-specific elasticities of demand.

In order to identify the basic elements of this approach, it is easiest to examine first a single, fully integrated world economy in which technology is the same everywhere and factor inputs move freely around the globe. Also assume that in an industry capable of manufacturing different brands all brand-specific production functions are the same. Profit-maximizing producers equate marginal revenue to marginal costs, leading to a symmetrical equilibrium in which all brands of a given industry are supplied in the same quantity and equally priced:

$$p_i = R_i(p,n)mc_i(w,x_i) , \tag{1}$$

where i is an industry index; p_i is the price of a product in industry i; $R_i(\cdot)$ is the markup of price over marginal costs, which depends on the elasticity of demand; $mc_i(\cdot)$ is marginal costs; p is the vector of product prices; w is the vector of primary input prices (intermediate inputs are assumed away at this stage); x_i is output per brand in industry i; and n is the vector whose typical element is the number of brands in industry i, denoted by n_i. With constant returns to scale, marginal costs are independent of output; with perfect competition, the markup function is identically equal to 1. Under these conditions, equation (1) reduces to the standard output-independent pricing condition: price equals marginal cost. With the Dixit-Stiglitz specification of preferences, the markup function is a constant larger than 1, while with Lancaster's specification, it depends on prices and the number of brands.[1]

Following Chamberlin, assume that free entry drives profits down to zero (the large-group case). Then price equals average (unit) costs:[2]

$$p_i = c_i(w,x_i) . \tag{2}$$

Unit costs (c_i) decline with output whenever there are increasing returns to scale.

The pricing equations (1) and (2), the former resulting from profit maximization and the latter from free entry, coincide for competitive constant-return sectors but not for sectors with increasing returns to scale that supply differentiated products. Given factor rewards and the number of brands, they determine prices and output per brand. The result is that employment of an input is the same for every brand in a given sector. Hence, if $a_i(w,x_i)$ is the vector of employment per unit of output and X_i (= n_ix_i) is aggregate output in industry i, factor-market clearing requires that

$$V = \sum_i a_i(w,x_i)X_i , \tag{3}$$

where V is the vector of available inputs.[3]

The model is closed with a specification of product market-clearing conditions of the usual type (see Helpman and Krugman, 1985, Chap. 7, for an explicit statement). The point is that the entire system can be used to solve for prices, factor rewards, the number of brands in every sector, output per

[1] In fact, in the Dixit-Stiglitz specification, the markup function depends on the number of brands in the industry unless there is a continuum of brands.

[2] Unit costs $c_i(w,x_i)$ are related to marginal costs by $mc_i(w,x_i) = c_i(w,x_i) + x_ic_{ix}(w,x_i)$.

[3] The unit-output employment vector $a_i(w,x_i)$ equals the gradiant of the unit-cost function $c_i(w,x_i)$ with respect to w.

brand in every sector, and the sectoral allocation of inputs. Now one can ask two questions: If the world is divided into countries by dividing the input vector V into country-specific inputs, (1) are there world structures for which international trade leads to an equilibrium with the essential features of an integrated world, and (2) what is the nature of trade in such equilibria? These questions were addressed by the factor-proportions theory, and they were carefully investigated for many years (see Travis, 1964, Chap. 2, and Dixit and Norman, 1980, Chap. 4). For this reason, answering them in the extended framework provides a natural way of discovering the value added by the new approach.

The answer to the first question is in the affirmative. Moreover, the characterization of the relevant set of world structures follows step by step the analysis of competitive constant-return economies, except for one little twist. Recall that in the traditional framework the set of world structures that ensures factor-price equalization is constructed by adding up all possible cross-country distributions of the sectoral employment vectors $a_i(\cdot)X_i$. This way, every country can produce part of the aggregate-output vector with the same techniques of production that are employed in the integrated equilibrium, ensuring an aggregate level of world output that equals the level of output in the integrated equilibrium. Given identical homothetic preferences, or given that every owner of inputs is located in the same country as his inputs, this ensures market clearing at the original commodity prices and factor rewards. The same argument applies when some sectors produce differentiated products with brand-specific economies of scale, except that the distribution of those sectoral employment vectors has to be restricted to multiples of the firm-specific employment vectors $a_i(\cdot)x_i$. This restriction is of no consequence whenever the market provides a continuum of brands. Otherwise, the set of structures providing factor-price equalization is much smaller (see Helpman and Krugman, 1985, Chap. 7). A critical feature that allows us to reproduce this result is that in the integrated equilibrium all brands of the same good are manufactured with identical inputs per unit of output.

This feature also implies that Vanek's (1968) chain proposition holds. Each country is a net exporter of the services of those inputs with which it is relatively well endowed. Here, too, one can use the standard argument. The factor content of a country's net imports equals the difference between the factor contents of consumption and production. The former equals a share of the world's endowment of inputs, where the share is the country's share in world spending. This stems from preference homotheticity. The latter equals the country's input vector. Hence, we obtain the well-known relationship between the international flows of factor content and the factor endowments, thereby answering part of the second question.

With differentiated products, however, a reproduction of the integrated equilibrium also requires the correct number of brands of every product. Hence, it is not enough to endow each country with inputs that are multiples of brand employment vectors; it is also necessary to ensure that the inputs are used to manufacture the correct number of brands. This implies that countries have to specialize in *different* brands. Since all brands are demanded in each and every country, we have intra-industry trade. We measure the extent of intra-industry trade between two countries, say k and j, in a particular product i by twice the minimum of the bilateral exports of product i. For a differentiated product this is given by $2\min[s^k p_i X_i^j, s^j p_i X_i^k]$, where s^k and s^j represent the shares of countries k and j in world spending. Country k imports from j its pro rata share of j's output of each and every brand, and country j imports its pro rata share of k's output.

3 APPLICATIONS

We have seen that the more general theory preserves some fundamental features of the neoclassical approach. This is quite remarkable given the introduction of economies of scale and imperfections in market structure. If all one could achieve were a reproduction of neoclassical results, however, the usefulness of these generalizations would be severely limited. Their main power comes from their ability to shed new light on old questions and to handle new problems. I will give four examples of this ability.

Trade Volume

The factor-proportions theory predicts larger trade volumes the larger the difference in the relative composition of factor endowments of the trading partners. This stems from the fact that trade is driven by differences in factor composition (as measured by relative ratios). In their absence, there is no trade. At the same time, this theory makes no prediction concerning the role of differences in country size in determining the volume of trade. In practice, however, there *are* large trade volumes between countries with similar factor proportions, and relative country size seems to play an important role in explaining them (see Linnemann, 1966).

The more general approach predicts a link between the volume of trade and differences in factor proportions when some sectors supply homogeneous products, precisely because such a link exists in the factor-proportions theory (see Helpman, 1981). In the more general approach, however, intra-industry specialization also drives trade, so that it can explain trade flows between countries with similar factor proportions. In addition, it assigns a natural role to relative country size.

In order to see the latter point as sharply as possible, consider a world in which all sectors manufacture differentiated products and sectoral preferences are homothetic. In this world, the share s^k of country k in world spending likewise defines the share of that country's imports from j of every brand manufactured in j and vice versa. Hence, k's imports from j equal a proportion s^k of j's GDP, denoted by G^j. Assuming that expenditure is proportional to GDP, the bilateral volume of trade is given by

$$T^{kj} = s^k G^j + s^j G^k = 2G^k G^j / G \, , \qquad (4)$$

where G is world GDP. Hence, in a cross-country comparison we should observe trade between countries with similar factor proportions, and bilateral volumes of trade should be positively related to income levels. Both predictions conform to the evidence. Moreover, equation (4) yields the following formula for the world's volume of trade:

$$T = [1 - \Sigma_k(s^k)^2]G \ ,$$

where the term in the square brackets measures the degree of dispersion in relative country size. It therefore states that trade as a proportion of GDP is larger the more similar countries are in size. In the post-war period, differences in relative country size have declined while trade has grown faster than GDP, as this formula would indeed predict (see Helpman, 1987).

The critical element in this analysis is the degree of specialization. The analysis shows that high degrees of specialization assign an important role to relative country size in the determination of the volume of trade, while monopolistic competition in differentiated products leads naturally to high degrees of specialization of the intra-industry type. It is not intersectoral specialization, as in Ricardian models, but specialization nevertheless. This tendency toward intra-industry specialization has additional implications, as I show next.

Share of Intra-Industry Trade

To a large extent, the impetus for the new line of research came from a desire to explain intra-industry trade, and the extended model can indeed be used to decompose the total volume of trade into intra-industry and intersectoral. It can therefore be used to investigate the determinants of the *share* of intra-industry trade. For this purpose consider a simple world with two inputs, two sectors, and two countries. Also assume that factor-price equalization obtains. Then condition (3) implies that every country produces relatively more of the good that is intensive in the input with which it is relatively well endowed (which is the Rybczynski effect). Let both sectors manufacture differentiated products. In this case, two-way trade prevails in both sectors, but every country is a *net* exporter of products that are relatively intensive in the input with which it is relatively well endowed. This, of course, is the Heckscher-Ohlin intersectoral pattern of trade.

Using the formula for the measurement of intra-industry trade that was derived in Chapter 2, the volume of intra-industry trade in this simplified world can be represented by

$$T_I = 2\min[s^1 p_i X_1^2, s^2 p_1 X_1^1] + 2\min[s^1 p_2 X_2^2, \ s^2 p_2 X_2^1] \ .$$

Now denote by θ_m^k, $k = 1,2$, the GDP share of country k's import-competing sector (hence, $\theta_m^1 < 1 - \theta_m^2$). Then, using equation (4), this equation can be rewritten as

$$T_I = (\theta_m^1 + \theta_m^2)T \ .$$

That is, the share of intra-industry trade equals the GDP share of country 1's import-competing sector plus the GDP share of country 2's import-competing sector. In the limiting case in which both countries have the same composition of relative inputs, the share of intra-industry trade equals 1, that is, there is no intersectoral trade. The larger the difference in factor proportions, the smaller are the shares of the import-competing sectors in GDP and the share of intra-industry trade. When both countries specialize in the exporting sector, the share of intra-industry trade equals 0, that is, all trade is intersectoral. Hence, this model predicts smaller shares of intra-industry trade for countries with larger differences in factor proportions (see Helpman, 1981). Numerous empirical studies support this prediction (e.g. Balassa, 1986, and Helpman, 1987).

North-South Trade

There are many facets to the argument that, absent explicit policies, the secular worsening of the South's terms of trade is inevitable and that, as a consequence, not only must its relative position decline but the standard of living of its residents also must decline. Two elements seem to play an important role in this line of reasoning: (1) the North exports manufactures while the South exports raw materials, and (2) the North exercises monopoly power. Dixit (1984) examined this issue in a framework that contains both elements by postulating that the North produces differentiated products from inputs that are imported from the South.

In order to see the importance of product differentiation in this argument, consider a stripped-down version of his model. Every country consumes only differentiated products that are produced in the North. Preferences are of the symmetric CES type, with the elasticity of substitution given by $\sigma = 1/(1 - \alpha) > 1$. The South, which is competitive, produces only one good, an input that is required in the production of Northern manufacturers. One unit of Southern labor produces a unit of this input, and one unit of this input is needed to produce a unit of any variety of the differentiated product. Hence, the price of the input p_z equals the South's wage rate w_S. Given the market power of Northern manufacturers, however, they mark up price above marginal costs. Their marginal costs equal the price of intermediates p_z, while their elasticity of demand equals σ. Therefore $\alpha p = p_z = w_S$, where p is the price of a variety of the differentiated product. The South's terms of trade are thus fixed at $p_z/p = \alpha$ and aggregate output of intermediate goods equals the South's labor force L_S.

Northern producers need to hire f units of Northern labor in order to produce a brand. This input requirement generates fixed costs. There is free entry into the industry. Therefore, the number of products (n) is L_N/f, where L_N is the North's labor force, and price equals unit costs. This condition, together with the previous pricing equations, implies

$$w_N/w_S = (1 - \alpha)L_S/L_N .$$

Hence, relative wages are inversely related to the relative size of the labor force.

From the CES utility function, we find that the welfare level of a typical worker in country i is proportional to $(w_i/p)n^{(1-\alpha)/\alpha}$. Therefore, given that $\alpha p = w_S$, a Southern worker's welfare depends only on the number of products. By implication, a Southern worker prefers a larger North but is indifferent to the size of the South. This feature underlines the importance of product variety. In particular, it shows that Southern workers can gain from an expansion of the North even when expansion does not affect commodity terms of trade, because they prefer more variety choice.

In a more elaborate model that allows for substitution between Northern labor and imported inputs in fixed and variable costs, labor growth in the South leads to a deterioration of its terms of trade. But it also leads to an increase in variety. The former is detrimental to a Southern worker's welfare, while the latter is helpful. The variety effect dominates as long as the elasticity of substitution in these cost components is sufficiently high (see Dixit, 1984). This shows that variety effects can be as important as terms-of-trade effects. A similar point is made by Krugman (1981), who has shown that a factor of production that is hurt by the Stolper-Samuelson proposition, in the sense that the purchasing power of its earnings is reduced, may nevertheless gain in welfare terms if the change producing the fall in its purchasing power also expands variety choice.

Factor Movements

My last example concerns the role of product differentiation in the analysis of factor movements. In a competitive economy with nonincreasing returns to scale, GDP depends on commodity prices and factor endowments; that is, $G = G(p,V)$, where $G(\cdot)$ represents the maximum value of output that can be achieved at the price vector p with the available technology and factor endowments. An important property of such economies is that the contribution to $G(\cdot)$ of a marginal unit of an input exactly equals its market reward. This implies that a small country facing constant commodity prices and constant rewards to internationally mobile factors of production need not adopt policies to encourage or discourage either trade or factor movements; the private calculus coincides with the social calculus. If the domestic reward to a factor of production falls short of the international reward, private incentives lead to exports of the input, which increases home GNP (in this context, GNP equals GDP *plus* earnings of domestic inputs abroad *minus* earnings of foreign inputs at home). Conversely, if the domestic reward exceeds the international reward, private incentives lead