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THE NEW THEORIES OF INTRA-INDUSTRY TRADE

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1. INTRODUCTION

Intra-industry trade refers to the simultaneous import and export of the output of a given industry, over a given period of time. Its study has been a frontier subject for international trade specialists for the last decade or so. Although references to intra-industry trade can be found in Ohlin (1935) and Hildgerdt (1936) the origins of current interest in the phenomenon lie in its inadvertent identification by Dreze (1961), Verdoorn (1962) and Balassa (1966) when examining the effects of European integration.

For some years documentary analyses of the phenomenon were prevalent. Since, however, the publication of Grubel and Lloyd (1975), and more especially Dixit and Stiglitz (1977) and Lancaster (1979) there has been a blossoming of work concerned with modelling the conditions under which intra-industry trade will emerge, constructing econometric models to identify the determinants of intra-industry trade and more latterly, exploring its policy implications.

This paper is concerned with surveying recent work on models of intra-industry trade, or to be more precise the extension of imperfect competition models to an open economy setting. As anyone with an acquaintance with the theory of the firm might anticipate, the literature is replete with a large number of different (a cynic might say differentiated) models. In an earlier survey of the literature Helpman (1984) attempted 'a unified approach to the subject to bring out the common logic in much of the seemingly unrelated parts of the literature'. (p. 307) The objective of this survey is rather more modest in that it attempts to explain the circumstances under which trade in differentiated goods can take place, and the characteristics of such trade. Although there are '... seemingly unrelated parts of the literature', it is nonetheless possible to categorize models by types of market structure, and this is the approach which is adopted

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in this paper. Accordingly, Section 2 is concerned with models of trade in behaviourally competitive markets, or 'small number' cases, Section 3 examines the determinants of intra-industry trade in structurally competitive markets, or 'large numbers' cases, and Section 4 looks at the role of multi-product firms and multi-national firms. Section 5 offers some concluding comments.

It should be emphasized from the outset that this paper is only concerned with the positive aspects of trade and largely ignores policy issues. This is not because it is uninteresting, but rather because it has been separately surveyed elsewhere, by Dixit (1984), Greenaway (1985) and Venables (1986). In addition, documentary and econometric work has been surveyed by Greenaway and Milner (1986), and measurement problems are analysed in Greenaway and Milner (1983).

2. INTRA-INDUSTRY TRADE IN BEHAVIOURALLY COMPETITIVE MARKETS

The models to be discussed in Section 3 all assume free entry, scale economies which are exhausted at a relatively low level of output and unified markets. As we shall see the resulting trading equilibria are characterized by firms earning zero profits engaged in 'armslength trade'. In practice, however, entry may be restricted or temporarily blocked, and/or the minimum efficient scale of production may be large relative to total market demand. In consequence the number of firms operating in the market may be relatively small such that it can be described as behaviourally competitive. In this section we examine the extension of oligopoly models to an open economy context. As we shall see, alternative assumptions regarding conjectural variation, entry conditions, and product specification result in different patterns and directions of trade. To keep the analysis manageable we will focus on three genres of model which result in trade in identical commodities, trade in vertically differentiated commodities and trade in horizontally differentiated commodities.

2.1 Cournot Behaviour and Trade in Identical Commodities

The simplest assumption to be made with regard to conjectural variation is the Cournot assumption, i.e. firms view output as their strategic variable and select a profit maximizing output for all markets in which they operate, on the assumption that any competitor(s) will leave their output unaltered. To see how the assumption can be used consider a model of the type developed by Brander and

Krugman (1983). Assume there are two identical countries ($j = 1, 2$) with one producer of a given identical commodity in each country. The cost function of both producers is described by

$$C(Q) = F + fQ \tag{1}$$

where F is fixed costs and f marginal costs. In the absence of transport costs, demand in each of the two countries can be written as:

$$p^1 = a - b(Q_1^1 + Q_2^1) \tag{2}$$

$$p^2 = c - d(Q_2^2 + Q_1^2) \tag{3}$$

where superscripts refer to countries and subscripts refer to producers. To keep the analysis as simple as possible we assume intially that $a = c$ and $b = d$.

From (1), (2) and (3) profit functions for the two producers can be written as:

$$\pi_1 = [a - b(Q_1^1 + Q_2^1)]\, Q_1^1 + [c - d(Q_2^2 + Q_1^2)]\, Q_1^2 - f(Q_1^1 + Q_1^2) - F \tag{4}$$

$$\pi_2 = [c - d(Q_2^2 + Q_1^2)]\, Q_2^2 + [a - b(Q_1^1 + Q_2^1)]\, Q_2^1 - f(Q_2^2 + Q_2^1) - F. \tag{5}$$

In maximizing these functions each producer assumes that the output of the other in each market is fixed and will not alter. Furthermore, it is assumed that the two markets are segmented, i.e. producers take output decisions in one independently of the other. The first order conditions for profit maximization are:

$$\frac{\partial \pi_1}{\partial Q_1^1} = -2bQ_1^1 - bQ_2^1 + a - f = 0 \tag{6}$$

$$\frac{\partial \pi_1}{\partial Q_1^2} = -2bQ_1^2 - dQ_2^2 + c - f = 0 \tag{7}$$

$$\frac{\partial \pi_2}{\partial Q_2^2} = -2bQ_2^2 - dQ_1^2 + c - f = 0 \tag{8}$$

$$\frac{\partial \pi_2}{\partial Q_2^1} = -2bQ_2^1 - bQ_1^1 + a - f = 0. \tag{9}$$

The assumption of constant marginal costs means that the system can be separated into two sub-systems to provide solution values for the equilibrium quantities in each market (equations (6) (9) for the home market and (7) (8) for the foreign market). It should in fact be obvious that our assumptions of identical cost functions, identical demand functions and zero transportation costs for each producer result in:

$$Q_1^{*1} = Q_1^{*2} = Q_2^{*2} = Q_2^{*1} \tag{10}$$

where * denotes an equilibrium value. In other words each producer supplies half the market in each country. Cournot behaviour results in intra-industry trade in our identical commodity.

Brander (1981) and Brander and Krugman (1983) have incorporated transport costs into the model by assuming that some proportion of exports are absorbed by freight charges. Thus if z of commodity 1 is exported from country 1 to country 2, gz actually arrives in 2, where $0 < g < 1$. Incorporating transport costs in this form leads to comparatively minor revisions to the model.[1] The higher are any transport costs the smaller the share of the home market accounted for by imports. (These changes apply mutatis mutandis to the foreign market.)

The intuition behind what happens is as follows. A positive g raises the marginal costs of exporting above marginal cost of producing for the home market. This results in reduced output being sold on the overseas market, at a higher price and higher marginal revenue. The reduction in imports in each market leads producers to revise their output for their home market upwards. In equilibrium both producers equate MC and MR in both markets. Note, however, that although MR is higher in the export market than in the home market, the 'ex-factory' price is in fact lower as a consequence of the fact that most of the costs of transportation are absorbed by the producer. This has led Brander and Krugman (1983) to describe the resultant intra-industry trade as *reciprocal dumping* – firms charging lower effective prices in export markets than in the home market. Note also however, that as Phlips and Neven (1984) demonstrate, consumers of the imported commodity *and* the home produced commodity ultimately pay something towards costs of transportation as the prices of home output and imported output both increase.

As Brander (1981) has argued, focusing on the 'dumping' nature of this type of trade allows one to think of it in a price discrimination context. Moreover, rather than being the outcome of 'arbitrary' factors price discrimination appears to be systematically related to

[1] The final terms in (4) and (5) need to be altered to:

$$\pi_1 = [\ldots] - f(Q_1^1 + Q_1^2/g) - F \tag{4a}$$

$$\pi_2 = [\ldots] - f(Q_2^2 + Q_2^1/g) - F \tag{5a}$$

In turn (19) and (21) need to be revised to:

$$\frac{\partial \pi_1}{\partial Q_1^2} = -2dQ_1^2 - dQ_2^2 + c - f/g \tag{7a}$$

$$\frac{\partial \pi_2}{\partial Q_1^2} = -2Q_2^1 - bQ_1^1 + bQ_1^1 + a - f/g \tag{9a}$$

Equations (6) and (8) remain unaltered.

oligopolistic behaviour in segmented markets (see also Phlips and Neven (1984)).

Models which rely on a Cournot mentality on the part of duopolists producing for segmented markets are therefore capable of explaining two-way trade in identical products. The assumption is robust in the sense that the predictions of the model hold for a variety of demand and cost conditions. Brander (1981) assumed linear demand but Brander and Krugman (1983) show that the central predictions hold for arbitrary demand. In the model developed above, constant marginal costs were assumed; one can in fact permit marginal costs to decrease with increases in output.[2] Moreover, although in the model discussed above (as in many similar models) the number of firms is parametric, as Venables (1985) demonstrates, the number of firms can in fact be made endogenous.

The assumption of zero conjectural variation is fundamental. It is heuristically convenient in that it serves to generate a Nash equilibrium and the non-cooperative equilibrium is a useful reference point. However, as a behavioural assumption zero conjectural variation is arguably counter intuitive and tends to lack any empirical foundations. Hwang (1984) has relaxed the assumption in a similar model of trade in identical commodities. Defining conjectural variation as α, Hwang considers outcomes for values of α between -1 (the competitive solution) and $+1$ (the collusive joint profit maximization solution). The amount of intra-industry trade varies directly with α since this is, in effect, a measure of the degree of effective collusion. As α increases, competition decreases and the market share of the foreign firm increases. At the other extreme of course where $\alpha = -1$, no intra-industry trade will occur since the domestic firm enjoys a price advantage over the foreign firm.

Finally, it should be noted that this type of trade can yield positive gains. Gains result from pro-competitive effects. However, if transport costs are important pro-competitive gains can be outweighed by the wasteful effects of cross hauling. Trade will not therefore be unambiguously welfare improving.

2.2 *Natural Oligopoly and Trade in Vertically Differentiated Goods*

A radically different mode of analysis has been developed in the work of Gabszewicz, Sutton, Shaked, and Thisse (GSST). In contrast to the Cournot models, Bertrand behaviour is assumed. As a result the number of firms becomes endogenous. Moreover, the emphasis

[2] The model becomes more complicated since equations (18)–(21) cannot be separated and must be solved simultaneously. Nevertheless, the Cournot assumption still generates intra-industry trade.

here is on markets where products are vertically differentiated and where sunk costs and therefore entry considerations are important.

The central features of these models can be illustrated by reference to the papers of Shaked and Sutton (1982) (1983) (1984). On the demand side of the economy assume that all consumers have identical tastes and will uniquely rank products according to their quality. Consumers' willingness to pay for alternative qualities depends on their income and it is assumed that consumers are uniformly spread over the income interval (a, b) with 'a' being the lowest income consumer and 'b' the highest. The demand which the producer of a given quality (u_n) faces depends on several factors. Clearly, it will be a function of the price of his own quality (P_n) as well as the prices of qualities offered by other firms. This can be straightforwardly illustrated by following the example from Shaked and Sutton (1984). Assume initially that only an inferior quality version of our given product is available (u_{n-1}) and that this can be obtained free of charge. As long as consumers have some willingness to pay for quality improvements we can identify a demand schedule for n, even when $P_{n-1} = 0$. The consumer with the highest income (b) will have the highest willingness to pay for product n and this fixes the intercept on the demand schedule in Figure 1 at b^*. Consumers with lower incomes are willing to pay less to consume n rather than $n-1$

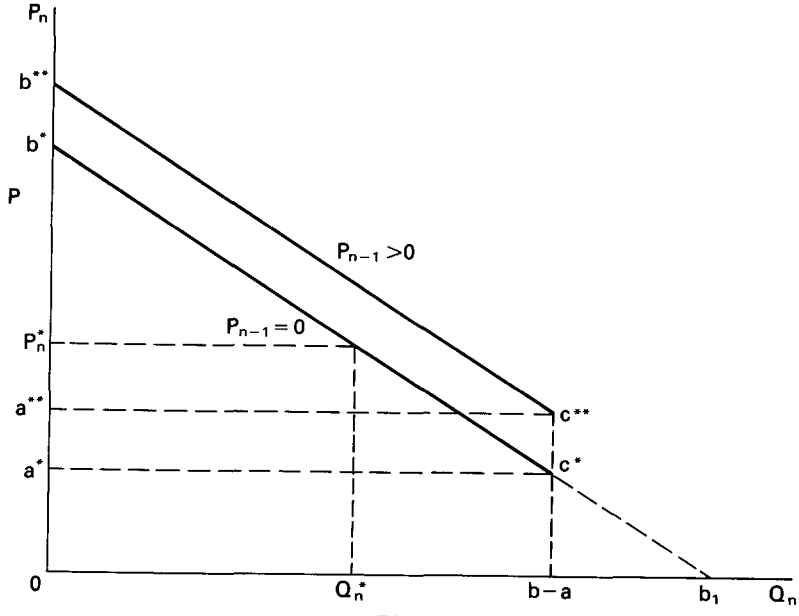

Fig. 1.

therefore demand slopes downwards until we reach a^*, i.e. the willingness to pay of the lowest income consumer. At a price of a^* quantity demanded is $b-a$. If the producer of $n-1$ set a positive price the schedule b^*c^* would shift out to $b^{**}c^{**}$. Note that the intercept on the horizontal axis is b_1, i.e. a consumer with zero income is willing to pay a zero price for n rather than $n-1$.

If it is assumed that average variable costs are zero, and that price is the strategic variable, the producer of n will equate MC and MR and set a price of P_n^*. In these circumstances if $b-a<\frac{1}{2}b(=Q_n^*)$ the producer of n can capture the entire market. This occurs when $a>b/2$, in other words when the range of incomes is relatively narrow. If the range of incomes is wider then more than one producer will operate in the market. For example if $\frac{1}{4}b<a<\frac{1}{2}b$, Sutton and Shaked (1982) demonstrate that the number of firms which will earn positive profits will be two, each supplying a different quality both of which are superior to the lowest quality $n-1$. This follows because price competition between producers of the higher quality products drives their price down to a point where demand for the lower quality product is zero. This can occur because average variable costs for production of *both* qualities is assumed to be zero. At the Nash equilibrium price for the higher quality only two firms can have prices exceeding average variable costs and positive market shares. This is described by Shaked and Sutton as a *natural oligopoly*.

The actual number of firms which will exist in a given situation depends in fact on consumer tastes, the distribution of income and the way in which average variable costs alter in response to variations in product quality. The important point to note is that, in general, the number of producers will be bounded. In the example described above it clearly arises as a result of the income distribution assumed, and the fact that we assume average variable costs do not increase with quality improvements. Where average variable costs do rise as quality improves the scope for price competition between qualities is limited and a large number of firms can coexist in the market. In fact with a wide distribution of income and an infinite number of consumers the number of producers which can coexist is infinite.

Shaked and Sutton (1984) examine the short run and long run effects of the opening of international trade in a situation where firms in two different countries produce different qualities. In the short run the effect of opening the economy to trade can be thought of simply as an extension of the market. The precise effect of trade depends in particular on the distribution of incomes in the two trading economies. Take the simplest case of two economies which are identical and have income distributions similar to that used in our closed economy example. In autarky each market would support two firms. When trade opens two of the firms will exit and two will

remain to service the joint markets. This follows because the number of products is independent of the *size* of the economy (as measured by the number of consumers). Bertrand price competition between the two pairs of identical products results in the departure of one producer of each, with the survivor serving both countries. (Note that we are abstracting from transport costs, and note that the post-trade prices of each quality will be lower.)

The actual pattern of trade which emerges depends in particular on income distributions across trading partners. We noted above how with identical economies two firms will be driven from the joint market. In the event that one firm from each country exits then the result would be intra-industry trade in the vertically differentiated commodity. Even if this outcome results however, the *direction* of trade is indeterminate. When income distributions differ between two (potential) trading partners the direction of trade becomes determinate. Differences in income distribution facilitate a larger number of firms in the post-trade equilibrium with the higher (average) income country specializing in higher quality products. Since, however, trade results in a lowering of prices, it can be predicted that the lowest quality firms will exit the market.[3]

It is impossible to do justice to the richness and complexity of the GSST models in so short a space. It should be evident however, that the analysis is somewhat more sophisticated than the simple Cournot models. Firms are required to take decisions on entry, product specification and price, and the interaction among the latter two provides us with an explanation of how we end up with an oligopolistically structured market. By contrast the number of firms tends to be exogenously determined in the Cournot model. Intra-industry trade opens not because markets are segmented and firms assume a zero conjectural variation, but rather because firms perceive increased sales and profits from market expansion. Once trade opens the model provides an explanation of how the equilibrium number of producers is determined. The model we have focused on here is one where the burden of quality improvement falls on fixed costs, which can be thought of as R and D costs. Average variable costs are assumed to increase slowly (if at all) as quality is improved. Revision of the latter assumption to permit average variable costs to increase sharply with quality improvement leads in fact to a large numbers solution which has similar characteristics to the neo-Chamberlinian monopolistically competitive models to be discussed in Section 3.

[3] If we were to assume that relatively high income countries are relatively capital abundant countries, the direction of trade would be consistent with that predicted by the Falvey–Kierzkowski model to be discussed in the next section.

With regard to the gains from trade, these models predict that trade will be unambiguously welfare improving. In the short run gains from trade arise from pro-competitive effects on price resulting from a reduction in profits (where the number of firms is fixed), or an increase in the scale of production (where there is free entry). In the long run these gains are supplemented by gains from quality improvement.

2.3 Oligopoly and Trade in Horizontally Differentiated Goods

In common with Shaked and Sutton, Eaton and Kierzkowski (1984) examine trade in differentiated goods within an industrial structure where decisions on whether or not to enter a particular market, product specification, and price and output are taken sequentially rather than simultaneously. They, however, are interested in a situation where products are horizontally rather than vertically differentiated, and their assumption regarding conjectural variation differs from those of the two previous sections.

The demand side of the model is essentially the same as that discussed in detail below in connection with the Lancaster (1980) model. On the production side the cost function for any firm can be written as,

$$C(Q) = K + cQ \tag{11}$$

where K refers to fixed costs and cQ to marginal costs. The former are incurred prior to any decisions on output level, when the firm decides to enter the market and chooses a variety to produce. It is only after these have been incurred that price-output decisions are taken (and c becomes relevant).

Despite this there is nothing in the basic structure of the Eaton–Kierzkowski model to suggest that were one to assume an even distribution of preferences across consumers, anything other than a monopolistically competitive solution would emerge. An essential pre-requisite to generating a small numbers solution is the restriction which the authors impose on the number of varieties which are demanded. Two cases are considered, first where there is only one 'type' of consumer which demands a specific variety; second, where there are two 'types' of consumer each demanding a different ideal variety. Although the authors make no attempt to rationalise this restriction one could view it as representing a situation where tastes are 'bunched' around a particular specification(s). In the present context the case which is of greatest interest is one where there are assumed to be two types of consumer. Here Eaton–Kierzkowski contend that in equilibrium there will be no more than two firms, each specializing in one variety. In order to generate this particular

equilibrium, specific rules with regard to entry are specified, and specific assumptions with respect to competitive behaviour are made.

Entry into the market for the differentiated good is unconstrained in the sense that if a potential entrant believes that it can earn positive profits it will enter. It is assumed, however, that entry is sequential rather than simultaneous. In other words, one firm decides to enter the market by offering a particular variety. Subsequent potential entrants take this variety as given then decide whether or not to enter. Take the two consumer case where n_1 consumers wish to purchase variety V_1 and n_2 consumers wish to purchase variety V_2. Eaton and Kierzkowski (1982) demonstrate that the number of producers in the market is determined by the magnitude of K, c, n^1, n^2 and the varieties' prices, and by the distance between V^1 and V^2 on the product spectrum. It is conceivable for example that K and c could be relatively large, but n^1, n^2 and p relatively small, in which case it could be unprofitable for any entry to occur. Assuming, however, that c and k are sufficiently small and n^1, n^2 and p sufficiently large to encourage entry, Eaton and Kierzkowski show that the market will be served by one, or *at most* two firms. When the first firm enters it may endeavour to produce both varieties, or it may produce only one but attempt to locate it on the product spectrum in an attempt to deter further entry. Where entry deterrence is neither feasible nor profitable then a second firm will enter the market. As long as two incumbent firms are producing V^1 and V^2, further profitable entry is impossible. Should an entrant locate at V^1 or V^2 he would get involved in Bertrand price competition which would drive price to marginal costs and result in the exit of at least one of the firms.

The specific reaction function assumed by Eaton and Kierzkowski is a modified *Bertrand reaction function*, which relies upon asymmetric expectations with respect to price increases and price cuts. When considering a price reduction each firm makes the Bertrand assumption that the other's price will remain unaltered. When contemplating a price increase, however, it is assumed that the other firm will react with a price *cut*. The rationale behind the latter assumption is the argument that a price increase by one producer encourages the other to attempt to supply consumers of both varieties. In order to do so he cuts the price of his own variety. Neither firm has the incentive therefore to raise price in isolation. The rationale behind the former assumption is that the profit maximizing price which is initially chosen by each firm ensures that profits cannot be raised by selling to both markets at a price below the initial equilibrium price *given the other firm's price*. This equilibrium is described by the authors as a *semi-reactive Bertrand equilibrium*. It has the advantage over the simple Cournot and Bertrand assumptions in that actual

behaviour does not contradict expectations, and conjectures turn out to be consistently correct. (This notion of consistent conjectures is also explored by Eaton and Grossman (1986) who investigate the impact of policy under alternative assumptions about conjectural variation.)

International trade in horizontally differentiated goods can emerge in this setting. The number of varieties traded, the number of firms producing those varieties and the magnitude of the net benefits of trade clearly depend on the initial assumptions made with regard to autarky in the trading economies. More specifically it depends on the autarkic distribution of preferences in each country. The distance on the product spectrum between pre-trade and post-trade varieties and whether there is any overlap is also important. If for instance the economies are identical then the opening of trade will result in a single producer of each variety, with each being sold at a lower price. In the event that one producer is located in each country we would clearly have intra-industry trade in horizontally differentiated goods. (In the Eaton–Kierzkowski model, however, this need not necessarily follow. There is a homogenous good sector and, in some circumstances, one country can specialize in both varieties of the differentiated good, exchanging this for the homogenous good).

2.4 *Intra-Industry Trade in Behaviourally Competitive Markets: Summary*

In this section we have examined oligopoly models where both the initial structural conditions vary, as well as behavioural assumptions. The Cournot models take the existence of autarkic monopoly as given, then proceed to demonstrate how intra-industry trade in identical products can emerge if firms behave like naive Cournot duopolists. By contrast Eaton and Kierzkowski endogenize market concentration. What turns out to be particularly crucial here, however, is initial assumptions regarding tastes and preferences. Likewise Sutton and Shaked demonstrate how autarkic oligopoly emerges but in their case consumers demand vertically rather than horizontally differentiated products. What is particularly crucial here is the initial distribution of income (since quality demanded is a function of income), and technological conditions. Thus in both the horizontal and vertical differentiation models an account is provided of how highly concentrated markets emerge and from here to how two-way trade may open. These models are also multi-stage decision models in the sense that decisions regarding entry and model specification are sequentially separated from decisions regarding price and output.

These models suggest that several demand and supply factors are likely to be important to the opening of trade. Where there are

diverse preferences the structure of preferences is relevant; where different consumers demand different qualities the distribution of income is important; as is the degree of taste overlap. Technological conditions are such that scale economies can be reaped from the spreading of fixed costs. Even given free entry this results in a small number of firms operating in the market who may regard each other in different ways.

Finally, as Markusen (1981) and Horstmann and Markusen (1986) demonstrate, the volume of trade and the gains from trade are both sensitive to whether the international market is segmented or integrated. Because firms lose discretion over the amount they can supply to the home and foreign market when these are integrated, the volume of intra-industry trade becomes indeterminate.

3. INTRA-INDUSTRY TRADE IN STRUCTURALLY COMPETITIVE MARKETS

The circumstances under which trade in differentiated goods will emerge in structurally competitive markets has been extensively investigated. Three distinct types of model can be identified, neo-Heckscher-Ohlin, neo-Chamberlinian and neo-Hotelling. These models share some common characteristics, for example in contrast to some of the models discussed in the previous section, free entry and exit is assumed in all cases. Differences, however, exist in each case with regard to the treatment of both the demand and supply sides of the economy. Thus the neo H-O models are perfectly competitive and generate standard welfare results whilst the neo-Chamberlinian and neo-Hotelling models are imperfectly competitive.

3.1 Neo-Heckscher-Ohlin Trade

Falvey (1981) and Falvey and Kierzkowski (1984) have extended the Heckscher-Ohlin (HO) model in a comparatively minor fashion. The models are $2 \times 2 \times 2$ in structure, two factors being used to produce two commodities in two countries. The central HO assumption of differential factor endowments which results in autarkic factor price differences between potential trading partners is retained. So too is the assumption of constant returns to scale. The models differ, however, from the HO model in two crucial respects. First, although two factor inputs are permitted, one of these (capital) is industry specific. The second difference is that at least one sector produces a differentiated good. The commodity concerned is *vertically differentiated*. Product quality is determined by the capital labour ratio (α) and consumers are assumed to prefer high quality to low

quality products. Since, however, choice is income constrained some consumers will initially be confined to some low quality variety with substitution towards higher qualities resulting from income increases. Following Falvey (1981) the way in which intra-industry trade emerges can be easily illustrated. Denoting product quality by α, domestic production costs (c) and foreign production costs (c^*) for a given α_i are:

$$c = w + \alpha_i r \tag{12}$$

$$c^* = w^* + \alpha_i r^* \tag{13}$$

where w is the wage rate, r the rental on industry specific capital, and the superscript * denotes a foreign variable. It is assumed that the home (foreign) country is relatively well endowed with capital (labour) resulting in $w^* < w$ and $r^* > r$. Given these autarkic factor price differences the home country will enjoy a comparative advantage in a range of high quality products whilst the foreign country enjoys a comparative advantage in a range of low quality products. To see this first identify the 'marginal quality' α_1, where,

$$c(\alpha_i) - c^*(\alpha_i) = 0$$

or,

$$w + \alpha_j r - (w^* + \alpha_j r^*) = 0. \tag{14}$$

From (14)

$$\alpha_j = \frac{w - w^*}{r^* - r}. \tag{15}$$

For all other qualities,

$$c(\alpha_i) - c^*(\alpha_i) = \frac{w - w^*}{\alpha_j}(\alpha - \alpha_j). \tag{16}$$

It can be seen from (16) that the home country has a comparative advantage (disadvantage) whenever

$$[c(\alpha_i) - c^*(\alpha_i)] < 0 (> 0).$$

Since $w - w^*/\alpha_j > 0$,

$$[c(\alpha_i) - c^*(\alpha_i)] \lesseqgtr 0 \quad \text{as} \quad \alpha_j \lesseqgtr \alpha_i.$$

Thus the home (foreign) country specializes in and exports those qualities which are superior (inferior) to the marginal quality. Because it is assumed that a higher capital labour ratio is associated with a higher quality, the capital abundant country exports relatively high quality products whilst the labour abundant country exports relatively low quality products.

These models extend the Heckscher-Ohlin theorem to provide an explanation of intra-industry trade in vertically differentiated commodities. Since certain key assumptions of the HO model are retained (in particular constant returns to scale and differential factor endowments), the predictions of the model are analogous, as are the welfare effects, the gains from trade being unambiguously positive. The similarity of the Falvey-Kierzkowski models to the HO model has led some commentators to dismiss them as being of minor relevance. One would argue, however, that they are of interest since many international markets are characterized by intra-industry trade in vertically differentiated goods.

3.2 Neo Chamberlinian Trade

A more radical departure from the HO paradigm builds upon the work of Dixit and Stiglitz (1977). The forces which create the preconditions for mutually beneficial intra-industry trade are decreasing costs in production and (horizontal) product differentiation. Early neo-Chamberlinian models (Krugman (1979) (1980), Dixit and Norman (1980)), provide an explanation of trade which is independent of relative factor endowments. One of the shortcomings of these models, however, is indeterminacy in the direction of trade and, to rectify this, more recent work (Lawrence and Spiller (1983), Helpman and Krugman (1985)) has embedded the neo-Chamberlinian monopolistic competition model in a setting of differential factor endowments. The essential features of the neo-Chamberlinian model can be illustrated by reference to Krugman (1979).

Krugman assumes a one-factor economy (labour) capable of producing some combination of a large number of goods, all of which are assumed to have identical cost functions:

$$l_i = \alpha + \beta X_i \tag{17}$$

where l refers to labour inputs, α and β denote fixed and marginal costs respectively and X represents output. Clearly the existence of fixed costs creates conditions where unit costs decline as output increases.

Products are horizontally differentiated. For simplicity it is assumed that all individuals have the same utility function and that all available varieties enter the utility function symmetrically. In other words the elasticity of substitution between *any* pair of varieties is identical. This is described by the function:

$$u = \sum_{i=1}^{n} v(c_i). \tag{18}$$

Each firm in the economy attempts to maximize profits by equating marginal revenue with marginal cost,

$$P_i x_i(1 - 1/e_i) = \beta w \tag{19}$$

where e_i denotes the elasticity of demand facing any one firm and w represents the competitively determined wage rate. Free entry and exit combined with Cournot behaviour ensures, however, that profits will be zero:

$$\pi_i = p_i x_i - (\alpha + \beta X_i) w = 0. \tag{20}$$

The zero profit condition determines the number of firms in the industry and the price which the representative firm will charge is derived from (20) as

$$p = \left(\beta + \frac{\alpha}{X}\right) w \tag{21}$$

in other words, price is equal to average cost which, given the zero profit condition is equal to average revenue. Since all varieties enter consumers' utility functions symmetrically and since differentiation is costless no two firms will ever produce the same variety. The output of any single firm is described by

$$X_i = L_{c_i} \tag{22}$$

where

$$L = \sum_{i=1}^{n} l_i \tag{23}$$

in other words the output of each variety sums to the total of individual consumptions. The number of varieties which are actually produced (n) is exclusively determined by supply side conditions, which in this model means the size of the labour force (L), and the amount of labour required to produce a given variety (l_i), or

$$n = \frac{L}{l_i} = \frac{L}{\alpha + \beta X_i}. \tag{24}$$

Finally, as one might expect, symmetry ensures that all varieties are produced in the same quantities and, in equilibrium, sell at the same price.

The features describe the autarkic equilibrium in a single economy. To provide an explanation of intra-industry trade Krugman simply assumes the existence of a second economy identical in every respect to the home economy. In the absence of transportation costs trade in the differentiated commodity opens because no one firm has an

incentive to replicate the variety of another firm, and altering one's product specification is costless. Any given variety will only therefore be produced in one country with half the output being sold on the domestic market and half exported. As in the autarkic equilibrium the prices of all varieties are equalized and the output of each is identical. Gains from trade result because consumers benefit from increased product variety and also (as in Krugman (1982)) lower prices. Thus in this type of model the demand for greater variety on the part of consumers, free entry and exit, and decreasing production costs over the relevant range of output combine to generate intra-industry trade in a differentiated commodity.

The generality of the Krugman model has been questioned by Venables (1984) who demonstrates that it is in fact a special case in a wider family of models. Two important points emerge from Venables' paper. First the model exhibits a potential for multiple equilibria, not all of which are stable. Moreover, relatively small changes in the parameters of the model can shift it from one equilibrium to another. Second, under certain circumstances complete specialization by one economy in the differentiated commodity is a feasible and stable outcome. Intra-industry trade need not therefore result from integrating the two economies.

Several further limitations of the basic neo-Chamberlinian models can be identified. Although the post trade number of varieties can be specified, the location of firms, and therefore the pattern of trade is indeterminate. Nothing can be said about which varieties will be produced domestically and which will be imported. Lawrence and Spiller (1983) and Helpman and Krugman (1985) have reacted to this shortcoming by extending the model to accommodate differences in initial factor endowments. Lawrence and Spiller for instance develop a two sector model where the differentiated commodity is relatively capital intensive, and the homogenous commodity is relatively labour intensive. The consumption side of the economy is modelled in just the same way as in other neo-Chamberlinian analyses. If one assumes differential factor endowments however, it becomes possible to comment upon the relocation of firms, once trade opens. Specifically the number of varieties produced in the capital abundant country rises whilst the number produced in the labour abundant country falls. The synthesis of monopolistic competition in the differentiated goods sector with factor proportions theory permits some comment on the co-existence of intra- and inter-industry trade. So long as some firms in both economies produce differentiated goods there will be intra-industry trade because the output of the monopolistically competitive firm sells in both economies. The more dissimilar the economies' factor endowments the greater the extent to which trade in the differentiated

good is imbalanced, and therefore the greater the extent of trade in the homogenous good (to support trade balance).

3.3 Neo-Hotelling Trade

The Dixit–Stiglitz specification of the utility function which underpins the neo-Chamberlinian models has convenient properties for the theoretician. The assumption that all varieties enter the utility function symmetrically can, however, be questioned. This appears to conflict with the fact that consumers very often appear to have preferences between varieties. Moreover, in this setting 'excessive' product variety, a phenomenon which has received some empirical support in the recent industrial economics literature (e.g. Scherer (1979)) can never emerge because additional varieties *always* add to welfare. For those reasons it may be more appropriate to model the demand side of the economy using Lancaster's (1966) attributes approach, as the neo-Hotelling models of Lancaster (1980) and Helpman (1981) do.

In the neo-Hotelling models products are assumed to be horizontally differentiated. Instead of endeavouring to consume all possible varieties, however, different consumers have different most preferred varieties or 'ideal specifications'. In the basic neo-Hotelling model it is usual to assume that consumer preferences are uniformly distributed across a product spectrum, or around a circle (as in Helpman (1981)). Decreasing costs in production ensures that the number of varieties produced is finite. Thus some consumers obtain their ideal variety, others consume a variety which is not ideal, or do not consume at all. Where a consumer has to settle for a variety which is not ideal the price he will be willing to pay falls. In fact it is inversely related to the distance of this variety from his ideal.[4]

The closed economy equilibrium characteristics of the neo-Hotelling model bear some resemblance to those of the neo-Chamberlinian model. Each firm faces two decision variables, price and product specification. The profit maximizing solution for any individual firm is achieved where marginal revenue is equal to marginal cost and marginal revenue is equal for the two 'half-markets' either side of the product specification.

Free entry, decreasing costs and profit maximizing behaviour ensure that the number of varieties actually produced is finite and the Nash 'locational equilibrium' guarantees an equal spacing of firms along the product spectrum (or around the circle). Each variety has an equal market area therefore and sells at the same price. This

[4] It is usual to identify a compensating function to describe this relationship.

equilibrium with n firms producing n varieties and earning zero profits (since $P = AC$) is described by Lancaster (1980) as *perfect monopolistic competition*[5] (see also Greenaway (1982)).

To demonstrate the opening of intra-industry trade Lancaster assumes the existence of two economies exhibiting all of the above characteristics, and therefore identical in every respect. Thus the autarkic equilibrium features of the two economies are identical. If the opportunity to trade opens, the two individual economies effectively constitute one larger economy. The opening of trade and the ensuing adjustments are analogous to those associated with the closed economy case discussed above. In other words, each differentiated variety is produced by only one firm, and therefore in only one country. Half of the output of each variety produced is sold on the domestic market whilst half is exported. Moreover, the final arrangement of varieties is an interleaved arrangement with each home variety having an imported variety located on either side. As long as the two economies are identical in every respect, the number of varieties produced in each country in the post-trade equilibrium will be the same in each country.

Thus in the basic Lancaster model intra-industry trade opens as a consequence of preference diversity, and decreasing costs. As in the neo-Chamberlinian models, the general pattern and level of trade can be predicted, but *not* the direction of trade. Gains from trade result from the ability of both countries to benefit from the exploitation of scale economies, which results in lower product prices for manufactures, as well as gains from greater product diversity. The nature of the latter is qualitatively different, however, from that associated with neo-Chamberlinian models in that the average distance between varieties on the spectrum is smaller with trade than without. As a result some consumers are closer to their ideal varieties. In addition, the locational model allows for the possibility of adverse product selection and excessive product variety. This basic model can be extended relatively easily as Lancaster himself does, as well as Helpman (1981). For example, Lancaster considers the implications of permitting country size (as measured by number of consumers), to vary, which results in 'false comparative advantage'. Since production of differentiated goods is subject to initial economies of scale, in autarky the larger country will clearly produce a given variety at a lower unit cost – hence the notion of 'false' comparative advantage. Intra-industry trade still occurs, but the number of varieties produced in each country is proportional to country size. Thus in equilibrium, the smaller country (larger country) imports more than (less than)

[5] In this model there is also a sector producing 'outside goods', or homogenous goods produced under constant returns to scale.

half the total number of varieties available. An interesting feature of this case is that the gains from trade are not equally divided. The smaller country reaps the greater per capita gains (in contrast to the identical country case where per capita gains are the same in both countries).

Lancaster, as well as Helpman (1981) has also synthesized the model with factor proportions theory, which, as in the neo-Chamberlinian case allows us to comment on the direction of trade. On the assumption that manufactures are relatively capital intensive whilst agriculture is relatively labour intensive, one finds that the capital abundant country will produce a higher ratio of manufactures to agriculture (and vice versa for the labour abundant country). The capital abundant country will be a net exporter of manufactures whilst the labour abundant country is a net exporter of agricultural goods. This of course conforms to the predictions of the HO theorem. In addition, however, to this inter-industry trade there will also be intra-industry trade in manufactures since each variety will only be produced in one country. The relative importance of inter- vis a vis intra-industry trade depends on the initial differences in factor endowments. Other things being equal the greater the difference between these initial endowments the greater the relative importance of inter-industry trade.

3.4 Intra-Industry Trade in Structurally Competitive Markets: Summary

There are similarities in the equilibrium characteristics of the neo-Chamberlinian and neo-Hotelling approaches. Both provide explanations of intra-industry trade which can be embedded in a general equilibrium framework with inter- and intra-industry trade occurring simultaneously. Arguably the neo-Hotelling representation of consumer preferences is more appealing, not only because it seems to accord more closely with consumer behaviour, but also because it is capable of accommodating other phenomena which appear to be important in practice. For example, locational analysis admits the possibility of 'bunching' of preferences, something which fits in quite nicely with Linder's (1961) thoughts on overlapping demands. Also the framework is capable of accommodating adjustment costs, not only to firms which may have to alter product specification when a market becomes contested by foreign firms but also to consumers who may find their ideal variety disappears with the opening of trade. Finally, in drawing on the work of Spence (1976) and Scherer (1979) one can use this framework to comment upon the welfare changes associated with variety proliferation. As those authors have

demonstrated in a closed economy context, it need not follow that additional varieties are always associated with welfare improvements.[6]

4. MULTI PRODUCT FIRMS, MULTINATIONAL FIRMS AND INTRA-INDUSTRY TRADE

Everything we have said so far relates to single product firms operating in only one of the trading economies. Empirical analysis suggests that multi-product and multi-national firms are frequently associated with intra-industry trade. Some limited theoretical work has been undertaken with regard to both multi-product and multi-national firms and intra-industry trade. This will be briefly reviewed in this section.

4.1 Multi Product Firms and Intra-Industry Trade

The locational framework developed by Spence (1976) and Scherer (1979) has been used to evaluate the relative incentives to variety innovation which face market incumbents and new entrants.[7] In all of the horizontal differentiation models discussed so far it has been assumed that new varieties are produced by new entrants. In practice it may be the case that new varieties are in fact introduced by existing firms.

The Scherer–Spence framework suggests that in many circumstances the net benefit, measured by the sum of the change in producer surplus and fixed development cost, will be lower for an incumbent than a new entrant. This results when the market areas of the existing and new variety overlap. From the incumbent's standpoint part of any change in producer surplus in these circumstances is an internal transfer. By contrast from the entrant's perspective all of any change in producer surplus is a gain. This does not, however,

[6] For a neat comparison of the Dixit-Stiglitz Lancastrian and utility functions see Lancaster (1982). On the extension of the framework to preference bunching see Eaton and Kierzkowski (1981) and Greenaway (1982). On the net benefits of new varieties in this framework see Greenaway (1982) and Milner (1986).

[7] The feasibility of such a strategy depends upon the magnitude of product development costs. Where these are relatively small and/or fully recoverable in the event of exit, an incumbent has no real advantage over an entrant, and one cannot say a priori whether the 'large' number of varieties which will proliferate will be produced by single product or multi product firms. Where development costs are 'large' and/or non-recoverable (i.e. genuine sunk costs), the costs of altering product specification are greater. Indeed if price exceeds marginal costs for a given specification it is irrational to alter product specification. In this case the prior commitment to the market by incumbents may give them a strategic advantage. The potential cost of readjustment perceived by incumbents if faced with entry may make it rational to pre-empt entry by 'packing' the product spectrum.

mean that new varieties will always be supplied by new entrants. Existing firms may for several reasons introduce an additional variety(ies) and thereby become a multi-product firm:

(a) The supply of a number of varieties could be the basis to a strategy of entry deterrence on the part of market incumbents. Ceteris paribus the greater the number of varieties offered by an incumbent the lower are the potential gains in producer surplus to new entrants (see Lyons (1984)).

(b) An incentive to multi-product production may be provided by the lure of a cooperative solution which ensures the persistence of positive profits. Clearly the smaller the number of firms in the market the more feasible a cooperative outcome, not only with respect to prices but also with regard to variety locations (see Lancaster (1984)).

(c) There may exist multi-product scale economies deriving from the spread of fixed overheads.

(d) There may be economies of scope available from a given production facility producing a number of distinct varieties.

Whatever the reasons behind the emergence of multi-product firms, the factors which influence the opening of trade are similar to those discussed in Section 2.2, namely the extent of any taste overlap between countries, the distribution of preferences across the product spectrum in each country and decreasing costs in the production function. The basic neo-Hotelling model can be easily revised to accommodate intra-industry trade with multi-product firms as Lyons (1984) shows. Lancaster (1984) has, however, argued that intra-industry trade need not emerge. He demonstrates that even where the foreign firm enjoys a cost advantage over an incumbent multi-product monopoly, the latter could still pursue a defensive strategy which would preclude entry. Basically, the monopolist lowers price and increases variety which, in some circumstances is sufficient to deter entry. Thus where a multi-product firm enjoys a monopoly of the domestic market in autarky, its defensive strategy may be explicitly directed at precluding the emergence of intra-industry trade.

4.2 Intra-Industry Trade and Multinational Corporations

Foreign direct investment and the structure, conduct and performance of multinational corporations are issues which have been closely examined over the post-war era. In examining the plethora of motives which may underly foreign direct investment, Dunning (1981) has recently proposed an 'eclectic' approach to the question which has become known as 'the OLI paradigm'. This suggests that

foreign direct investment will occur when three conditions hold. First the firm must enjoy certain *ownership* advantages (such as technical know-how or patent protection) that permit it to set up production facilities in a foreign market without being at any serious competitive disadvantage compared to local producers. Second, there must be specific *locational* advantages of producing in the foreign market (such as availability of relatively cheap labour, or a protected local market) which encourage the firm to invest in production facilities abroad rather than at home. Thirdly, the firm wishes to exploit ownership and locational advantages *internally*, i.e. through internal markets, rather than through other 'armslength' arrangements such as foreign licensing. For example the parent organization may have doubts as to whether local licenced firms have the ability to adapt their operations to the productive process of the parent company.

Although the OLI paradigm has been developed (at least implicitly) in the context of inter-industry trade, it can in fact be readily utilized in the context of intra-industry trade. Norman and Dunning (1984) discuss one way foreign direct investment, and two way foreign direct investment (intra-industry foreign direct investment) and their relationship to intra-industry trade in various types of goods. The precise factors which stimulate FDI and in turn intra-industry trade vary according to whether one is dealing with goods which are close substitutes in consumption, production, or both. One theme which runs throughout each case, however, is the OLI paradigm. Ownership advantages are again stressed as important, in the case of differentiated goods these may take the form of brand image. Locational advantages may follow from differences in factor prices across countries and perhaps the ability to respond more readily to changes in tastes through being located in the foreign market. Internalization may not only reduce uncertainty and encourage trade, but might also facilitate the exploitation of vertical economies of scale. To take one concrete example, where there are significant economies of scale associated with producing specific varieties, yet all varieties can be sold in all markets, one observes a tendency for FDI and intra-industry trade to go hand in hand. In general, therefore, the complexion of the influence is similar to the case of inter-industry trade, although precise details may differ.

The few theoretical papers on multi-nationals and intra-industry trade which have been completed so far confirm this intuition. Lyons (1984) stresses the ability of multinationals to space optimally product varieties on the product spectrum so as to deter entry, as well as their ability to locate geographically their production facilities optimally. Ownership advantages derive from occupying a specific location on the product spectrum; locational advantages derive from

the ability to minimize trading costs and internalization advantages are associated with optimal product spacing and pricing. Helpman (1985) extends the theory of multinational corporations to incorporate horizontal and vertical integration within the corporation. The model predicts intra-firm intra-industry trade in intermediate goods as well as invisibles. The model is cast in a general equilibrium setting and differences in factor endowments turn out to be important in explaining the emergence of multinational corporations.

Mainardi (1986) extends and develops the work of Hirsch (1976) and Agmon and Hirsch (1979) to explore the circumstances under which horizontal intra-firm intra-industry trade will take place (i.e. trade in differentiated goods); and vertical intra-firm intra-industry trade (i.e. trade in commodities at different stages of fabrication). In both cases the relative magnitude of production costs and marketing costs in the parent and subsidiary are crucial. Mainardi does not explicitly cast his analysis in the OLI framework although the model can be thought of in these terms.

Helpman and Krugman (1985) focus on multinational corporations, both where these are single product firms, and where they are vertically integrated. With regard to the former they find that differences in intra-firm trade are positively related to differences in factor endowments. However, allowing for vertically integrated firms weakens this link. Beyond some critical difference in relative factor endowments multinationals shift intermediate product lines to subsidiaries thereby lowering the share of intra-firm trade in total trade.

5. CONCLUDING COMMENTS

The fundamental reason why intra-industry trade has excited such interest on the part of trade theorists is that it is a phenomenon which is not readily explicable by the neo-classical factor proportions theory. Intra-industry trade in some commodities can in fact be rationalized in a Heckscher–Ohlin setting, for instance, border trade. The proportion of such trade is, however, relatively small.

In explaining intra-industry trade the perfectly competitive scenario of the Heckscher–Ohlin model has been supplanted by a range of models which admits an imperfectly competitive sector. A wide variety of such models have been developed which vary in their assumptions regarding entry conditions, product differentiation, cost conditions and conjectural variation. The predictions of these models with regard to the direction, composition and level of trade do appear to be sensitive to model specific assumptions. In turn this

means that the gains from trade and the welfare effects of trade intervention are also sensitive to model specific assumptions (see Greenaway (1985) and Venables (1985)). From the standpoint of the concern of this particular survey, i.e. the emergence of intra-industry trade, the models are fairly robust. Intra-industry trade can be shown to emerge in a wide range of circumstances. Although as we have seen the features of many of these imperfect competition models vary quite considerably two factors which appear to emerge as being of importance with striking regularity are preference diversity and decreasing costs. Moreover, at least in the large numbers cases, it has proved possible to embed these factors in a general equilibrium setting by incorporating factor proportions theory. Work in this area is still very much in its infancy and the empirical relevance of intra-industry trade together with the wide range of possibilities which can be explored in a small numbers setting will ensure that the subject remains a frontier area for some time to come.

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