INTRA-INDUSTRY TRADE IN SOUTH AFRICA

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EXCEPT FOR QUOTATIONS SPECIALLY INDICATED IN THE TEXT,

AND SUCH HELP AS I HAVE ACKNOWLEDGED,

THIS THESIS IS WHOLLY MY OWN WORK AND HAS NOT

BEEN SUBMITTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

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16 JANUARY 1987

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ABSTRACT

Intra-industry trade is a recent development in international trade theory. This study attempts, for the first time, to measure the extent of intra-industry trade in South Africa. It is found that approximately a one-third of total South African trade is of the intra-industry type.

The first chapter places theoretical developments accounting for intra-industry trade in relation to the conventional models of trade. This chapter is followed by a detailed coverage of seven models that allow for intra-industry trade, in order to ascertain the major determinants of intra-industry trade. A third chapter examines the "existence problem" and discusses measures of intra-industry trade and a fourth chapter estimates the level of intra-industry trade in South Africa. Statistical analyses of the major determinants of intra-industry trade were generally successful, except for the poor performance of product differentiation proxies.

A final chapter concerns the commercial policy and welfare aspects of intra-industry trade, concluding that there are gains to be had, from social and political changes within South Africa, if such changes lead to greater economic integration and co-operation in the Southern Africa region.

chapter 1.

AN OVERVIEW OF DEVELOPMENTS IN INTERNATIONAL TRADE THEORY

1.1 Introduction

International trade theory is undergoing new developments. These developments arise from a need to explain the increasing levels of trade within industries, referred to as intra-industry trade, between countries at similar levels of development. To place these developments in proper perspective, an overview of conventional trade theory, which deals with trade between industries, or inter-industry trade, is presented. Theoretical developments dealing with intra-industry trade are then outlined, showing the possibility of such trade, and showing links with conventional theory. The purpose of this paper is to present a brief and abstract overview of trade theory and not to deal with intricate details of trade models.

The Smithian, Ricardian and Heckscher-Ohlin-Samuelson (HOS) models have been at the forefront of developments in international trade theory. Ricardian and Smithian trade theory can demonstrate the possibility of trade based on comparative or absolute advantage arising from different production functions in countries, and the basis for and pattern of trade does not rely on the supply of a factor of production. In the HOS model trade arises because of comparative advantages as a result of different factor supplies in combination with identical production functions. However these models of trade are of little use in explaining trade flows between countries with similar factor endowments, therefore giving rise to the need to develop new models of trade.

1.2 Conventional Trade Models

1.2.1 Adam Smith's Trade Model

Adam Smith presents in Book IV, Chapter 2 of the Wealth of Nations (1776 [1961], pp.474-495) a concise argument supporting free trade. This support rests on the proposition that a country will export that commodity in which it has an absolute advantage. An absolute advantage in any commodity exists when, with a given quantity of a single factor of production, labour, a country produces a greater output of that commodity than it is possible to produce in another country. Obviously the latter country must employ the same quantity of labour, yet produce a smaller output. It is not necessary that the two countries have the same endowment of the factor. It is conceivable that a country with a relative abundance of the factor may not have an absolute advantage in any commodity.

In formulating Smith's trade model a number of difficulties appear. The first difficulty in presenting a formal account of the theory is that in the second chapter of Book IV, as mentioned above, a model of trade is not explicit. A model is a method of theorizing which includes definitions of concepts, assumptions about those concepts and finally, a deductive process or model's workings, which allow one or more statements to be made concerning the concepts, or economic variables that were defined. Such a model is not explicit as the definitions, assumptions and workings are not detailed in the chapter. To obtain the model requires "going behind" the passages in the relevant chapter of the Wealth of Nations. The second difficulty is the paucity of textual evidence that can be fruitfully used for the purpose of formulating the model.

An examination of the Wealth of Nations (1776 [1961],pp.478-480) might be consistent with the following assumptions:

1. two countries;
2. two commodities;
3. there is one factor, labour, and this factor is sold in a perfectly competitive market;
4. the commodity markets must be perfectly competitive;
5. labour cannot move across national boundaries;
6. the production functions must exhibit constant returns

to scale;

7. a fixed demand for the two commodities;
8. no transport costs;
9. absence of tariff barriers;

and a commodity is the output of an industry which satisfies the requirements of consumers. Any supply of the labour in each country is possible, as it is the production function and labour productivity that determine the possibility of trade. The two commodities are usually designated wine and cloth. Combining these assumptions and the idea of absolute advantage the two countries will specialize in those commodities in which they have an absolute advantage. Any excess of those commodities, after local demand has been satisfied, will be exported and through exchange allow the importation of the commodities not produced.

Adam Smith did not have a labour theory of value, which theory implies that labour expended in the production of a commodity and in the production of commodities used to make the first commodity (Blaug, 1978, p.40). However in a single factor world with no land and capital, the most significant cost will be wages, and commodities will exchange in ratios which correspond to the labour inputs used in their production. Thus it is possible to assign to Smith a labour theory of value if his model has a single factor of production, namely labour. Further, the prices of both commodities will be driven to the point where they equal the product of the factor input required per unit of output multiplied by the payment or reward to that factor. With domestic mobility of labour, wage rates between the industries will be equalized. Equality of wage rates implies that in the price relationship between price and inputs of labour and rewards, relative labour requirements determine relative commodity prices. It is now possible to use relative labour requirements to determine if trade will take place. For Smith's model, trade occurs when both countries have an absolute cost advantage in the production of one of the commodities.

The model does have an additional problem. Smith's model cannot explain the occurrence of trade in the situation where a country has no commodity in which it has an absolute advantage, or where a country has an absolute advantage in all commodities. Such a situation implies that there exists no basis for advantageous or profitable trade.

1.2.2 The Ricardian Trade Model

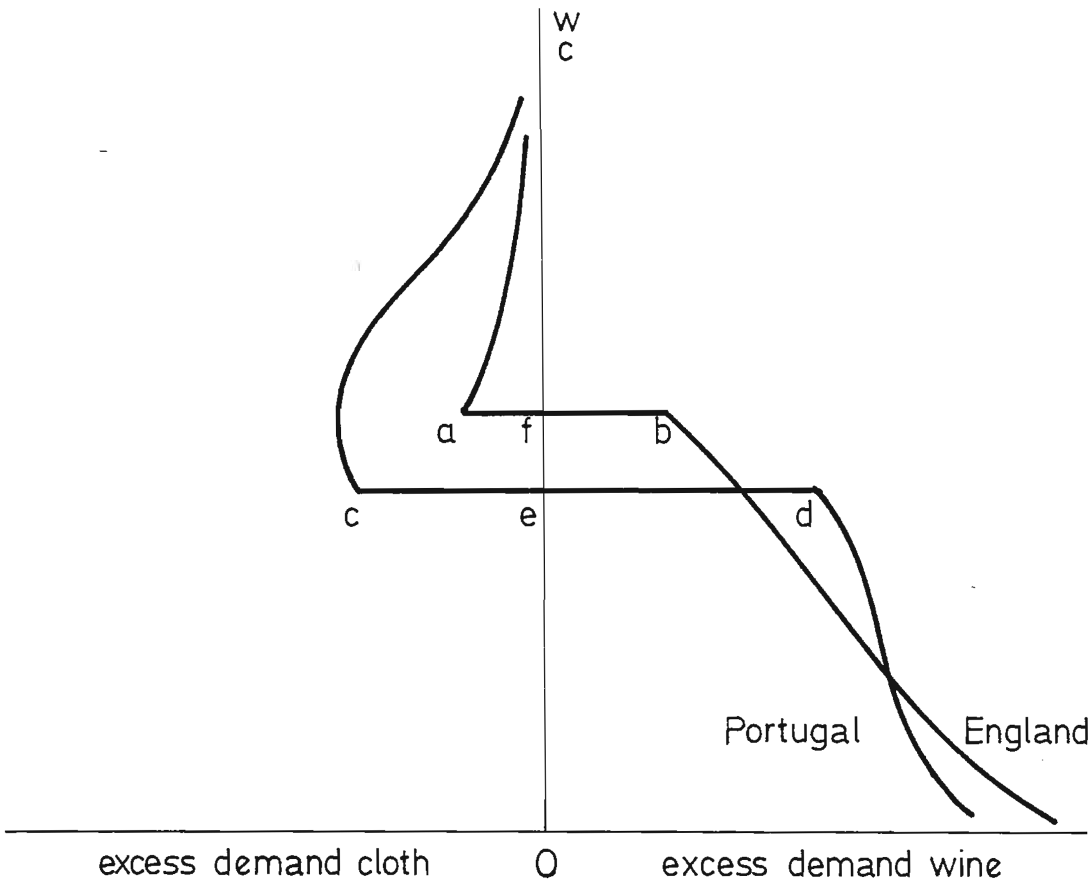
Ricardo is accepted as the first economist to emphasize the importance of comparative advantage in the explanation of the pattern of trade. The Ricardian trade model has the following assumptions:

1. two countries, England and Portugal;
2. two commodities, wine and cloth;
3. there is one factor, labour, and this factor is sold in a perfectly competitive market;
4. commodity markets must be perfectly competitive;
5. there is only internal, or domestic, factor mobility;
6. no transport costs;
7. absence of tariff barriers.

Having one factor, labour, coupled with the assumption of perfect competition implies the relative price of wine in terms of cloth will be equal to the labour requirement to output ratio. This leads to the Ricardian trade theorem that a country exports that commodity in which it has a labour productivity advantage. This theorem has been demonstrated by Bhagwati (1983) using excess demand curves. Figure 1.1 shows the excess demand curves for two countries, England and Portugal. The distances AB and CD correspond to the production possibility frontiers, between wine and cloth, in each of the two countries.

FIGURE 1.1

RICARDIAN TRADE PATTERN



Source: Bhagwati (1983)

The distances OE and OF on the relative price ratio axis correspond to the price ratios implied by those production possibility frontiers. The excess demand curves may show constant, increasing or decreasing excess demands in the region A, B, C and D. However, the curves are assumed never to move into the other quadrants. For price ratios above OF, there is excess demand for cloth, and for price ratios less than OE there exists excess demand for wine. Further England, will export cloth and import wine and Portugal will export wine and import cloth as W/C at F is greater than W/C at E. The relative price of wine in terms of cloth, W/C, is equal to

$$\frac{\dfrac{L_c}{Q_c}}{\dfrac{L_w}{Q_w}}$$

where

Q = quantity of wine (w) or cloth(c)
L = labour required for each Q

when the two countries are self-sufficient.

Thus in terms of Figure 1.1 England will export cloth and import wine when

$$\left(\frac{\dfrac{L_c}{Q_c}}{\dfrac{L_w}{Q_w}}\right)_F > \left(\frac{\dfrac{L_c}{Q_c}}{\dfrac{L_w}{Q_w}}\right)_E$$

F (England) E (Portugal)

which can be re-arranged

$$\frac{\left(\dfrac{Q_c}{L_c}\right)_E}{\left(\dfrac{Q_c}{L_c}\right)_F} > \frac{\left(\dfrac{Q_w}{L_w}\right)_E}{\left(\dfrac{Q_w}{L_w}\right)_F}$$

or England will export cloth, the good in which it enjoys a comparative labour productivity advantage. The Ricardian trade model has been extended to many countries and many commodities, but will not be dealt with here.

A number of attempts have been made to test the validity of the Ricardian model. These include work by MacDougall (1951), Stern (1962) and Balassa (1963). The studies provide some confirmation of the Ricardian model's theorem. For instance MacDougall, found strong cross-section correlations between British and American labour productivity and export shares in third markets. Bhagwati (1964) has produced work refuting the theorem. However, this has not subtracted from the empirical confirmation to any significant extent.

1.2.3 The Heckscher-Ohlin-Samuelson (HOS) Trade Model

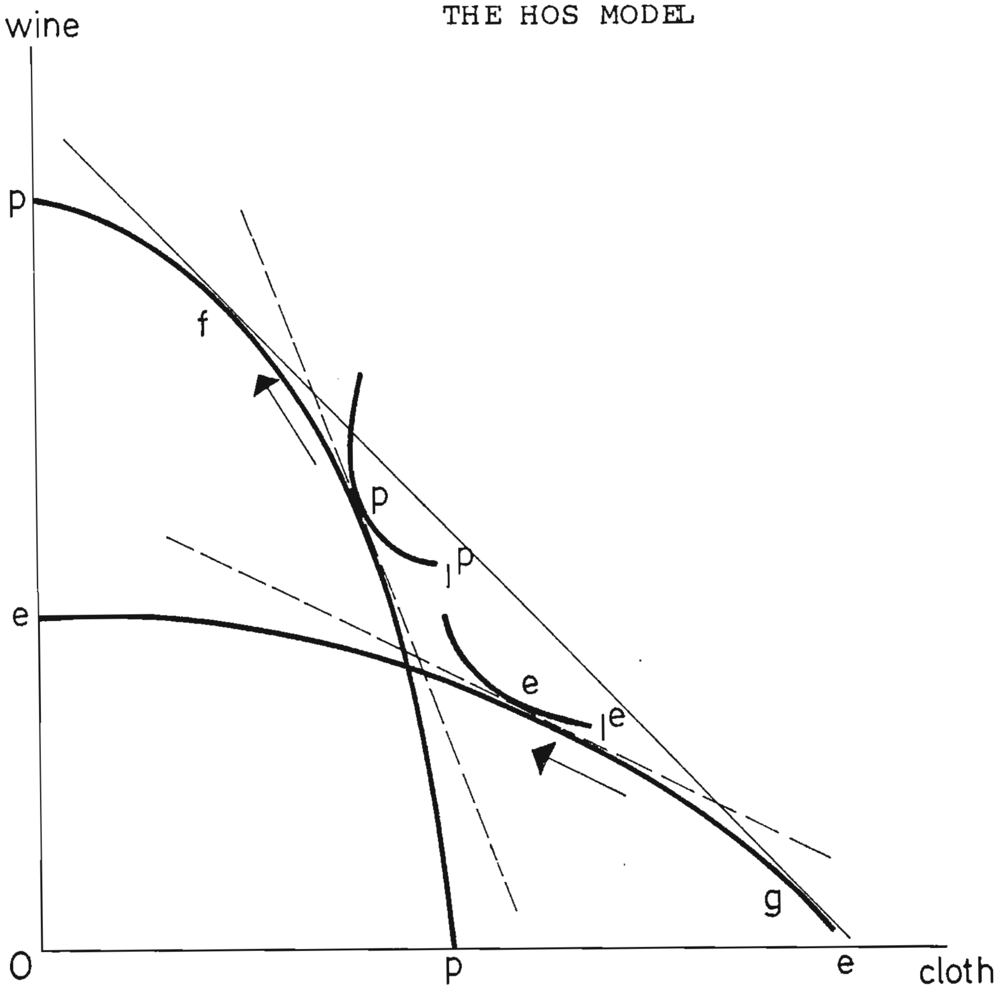
In the Ricardian trade model, differences in productivity were paramount in leading to comparative advantages in the production of commodities. In the HOS model the emphasis shifts from productivity to the importance of the abundance or scarcity of resources or factors of production. This is not to say that Smith and Ricardo viewed factor abundance as being unimportant. Myint (1977) argues that Smith to some extent anticipated the HOS trade model. Further one can obtain scant textual evidence from Ricardo's Principles of Political Economy and Taxation that he regarded natural endowments as important (Greenaway 1977). However, it was not until the 1950s that the work of Eli Heckscher, Bertil Ohlin and Paul Samuelson came to be formulated as the HOS theorem. As the scarcity of resources is related to the concept of opportunity cost it follows that the HOS model, once it was coupled with general equilibrium analysis, became incorporated into, and holds an important position in, neo-classical economic theory (Caves 1984).

The HOS theorem states that a country tends to export that commodity which uses intensively the factor with which it is relatively well endowed. The model makes a number of simplifying assumptions:

1. two countries;
2. two commodities;
3. two variable factors of production capital (K) and labour (L);
4. production functions are everywhere the same, but are different for each commodity. In fact one commodity is labour intensive and the other is capital intensive;
5. the two countries have different initial quantities of the factors of production. England has more labour and Portugal has more capital. Therefore the price of capital will be relatively low in Portugal, and the price of labour will be relatively low in England;
6. all markets are perfectly competitive;
7. demand is given in the sense that consumers in both countries, at any price of wine and cloth will consume the same quantity of each commodity, assuming a physical definition of factor abundance;
8. factors cannot move across national boundaries.

The HOS proposition, that each country will specialize in the production of (and export) that commodity which makes intensive use of its relatively abundant factor, will be derived more formally. In Figure 1.2 production of wine and cloth are shown on the vertical and horizontal axes. Portugal's production possibility curve (PPC) is PP. Given that Portugal has a greater amount of capital, and wine production is capital-intensive, Portugal could produce more wine than England in complete specialization. The reverse would be true for Portugal's production of cloth. The PPC in England is EE.

FIGURE 1.2
THE HOS MODEL



Source: Greenaway (1977)

With the community indifference curves I^p in Portugal and I^e in England, pre-trade equilibria would obtain at p and e respectively. At e the relative price ratio between cloth and wine (C_e/W_e) is less than (C_p/W_p) at p. This is because wine is cheaper in Portugal and cloth is cheaper in England. The difference in relative prices provides a basis for exchange. Portugal will demand cloth from England and England will ask for wine in exchange for that cloth. In Portugal resources will be transferred from cloth production to wine production and the opposite will occur in England. This process of specialization will occur until relative commodity prices are equal. This will be at the points f and g. The price of wine rises in Portugal, as with greater wine production it becomes necessary to draw increasingly unsuitable factors of production from the declining cloth industry, in wine production. As cloth production is a labour-intensive industry, proportionately more labour will be released and an excess supply of labour will result. Likewise capital will become relatively scarce and with an increase in the rental cost must come a rise in the price of the capital-intensive commodity. Thus production will be at f and g while consumption will be at points to the right of p and e, indicating higher levels of satisfaction. Further, with full-employment of factors, the factor used intensively in each country gains from trade, as factor rewards are higher.

Without trade Portugal, with more capital per unit labour time, will have a higher wage to rental cost of capital ratio and thus the cost of producing the commodity which uses labour intensively, will be higher. Looked at in another way, each country will have a comparative advantage in that commodity which makes use of that country's relatively abundant factor. This gives a basis for trade and is known as the HOS theorem. In addition, three other propositions, related to the theorem, have become part of international trade theory.

First is the factor-price equalization theorem proposed by Samuelson (1948 and 1949). If free trade exists, commodity prices will be equalized and the associated costs of production will be the same in each country. As an increase in the cost of capital relative to wages would increase the cost of the capital-intensive good, relative costs are linked to relative factor prices. More specifically then, the equalization of commodity prices, through trade, implies the equalization of factor prices. The factor-price equalization theorem underscores the notion that trade in commodities substitutes for world-wide factor movements. If factor supplies are not similar, free trade is a perfect substitute for international factor movements.

Second is the Stolper-Samuelson (1941) theorem which holds that an increase in the relative price of one commodity raises the return to the factor used intensively in producing that commodity. After trade, as was shown shown in Figure 2, production in England of labour-intensive cloth must increase. Likewise the production of capital-intensive wine must decrease. The contraction of wine output causes relatively more capital to be released than can be taken up in the cloth industry. This implies, given the relative abundance of capital, that the rental cost of capital must fall. As the cloth industry expands, the wage-rate will be bid up. Capital will now be cheaper and both cloth and wine producers will seek to employ more capital. Thus combining the fixed quantity of labour in each industry with greater quantities of capital imply a lower marginal productivity of capital and thus the factor will receive a lower absolute return. Labour will have a greater quantity of capital with which to work and thus labour's absolute wage will also increase. As each commodity price change is limited to the extent of the change in factor cost the income changes, for capital and labour, are in measured in real terms.

The final proposition was developed by T M Rybczynski (1955). This theorem states that if commodity prices are held constant, an increase in the quantity available of one factor causes a greater than proportionate increase in the output of the commodity which uses that factor intensively. If the supply of capital increases with an unchanged labour supply, the output of both goods cannot increase. In fact, the capital-intensive industry will expand its output while the output of the labour-intensive industry will contract.

Empirical testing of the HOS theorem began with the now-famous work of Wassily Leontief, who showed that the United States, the most capital abundant country in the world by any standard, exports commodities that use labour intensively. This has become known as Leontief Paradox. It was to generate theoretical and empirical studies in an attempt to resolve the paradox.

1.3. New Models of Trade

International trade theory has been dominated by the trade models of comparative advantage and the HOS model discussed in previous sections. However, it is true that the greatest increases in world trade have been in manufactured goods, between the industrial market economies. As a percentage of total trade manufactures accounted for 45 per cent of such trade in 1953. This figure had, by, 1980 risen to nearly 60 per cent (Ethier 1983). For the same period, trade of all commodities between the industrial market economies rose from roughly 40 percent of total trade to nearly 60 per cent. These countries can only be described as having similar relative factor endowments. The HOS model is of little help in explaining such trade flows. These trade flows have been increasingly of the intra-industry type. Intra-industry trade is described as the exchange, between countries, of commodities from within the same industry. This contrasts with inter-industry trade where commodities in one industry, are exchanged between trading nations, for commodities of a different industry.

Intra-industry trade was noted by Verdoorn (1954) in the context of European integration, where all the countries of the European Community expanded exports of nearly all manufacturers. Further intra-industry trade was observed in many other countries, and not only in conditions of economic integration. The most famous work in this regard was Grubel and Lloyd (1975). Theoretical explanation for intra-industry trade includes the incorporation of increasing returns to scale and imperfect competition into models of trade.

Although imperfect competition can include increasing returns, some analysis has been concerned only with the latter. Ethier (1982) models increasing returns to scale and their relationship to trade, especially to intra-industry trade. Ethier distinguishes between increasing returns in the "traditional sense", where economies of scale are external to the firm, and those which are dependent on the size of the world market and might be called "international" returns to scale. Ethier, with such a concept, is able to develop a theoretical basis for intra-industry trade. He shows, using a new technique, the allocation curve, that, unlike the HOS model where inter-industry trade substitutes for factor movements, intra-industry trade and factor similarity are complementary. Thus if factor endowments between countries are similar, then intra-industry trade will be encouraged. Further, Ethier (1982) analyses the theorems of factor-equalization, Stolper-Samuelson and Rybczynski associated with the HOS theorem and shows that the propositions do not change in a fundamental manner.

As was mentioned above, the second development concerns the incorporation of monopolistic competition into trade theory. The literature extends the Dixit and Stiglitz (1977) formulation of Chamberlinian monopolistic competition to international trade. The most robust contributions have been that of Krugman (1979, 1980 and 1981), Dixit and Norman (1980), Lancaster (1980) and Helpman (1981).

The most interesting of these models are those of Krugman. In Krugman (1982) an economy with two industries, each producing a large number of products, is considered. There are two factors of production, type one and type two labour each specific to the two industries. For each industry, each variety is produced subject to increasing returns to scale. Considering two identical countries, with economies of scale, the pattern and volume of trade can be determined. Krugman shows that intra-industry trade increases as the degree of similarity in factor endowments increases. The relationship between the Krugman models and conventional trade theory is not clear. On the one hand, the industry specific-labour is similar to Ricardian Trade theory. Alternatively, as the endowments of the two types of labour may change, the Krugman models may be closer to the HOS model.

Very much closer to the HOS model is the work of Helpman (1981). In an economy of two sectors, one sector has trade being explained by HOS trade theory, and the other sector's products are differentiated commodities made under conditions of economies of scale. With demand being determined in the tradition of Lancaster (1966, 1979 and 1980), in the above model, intra-industry trade is shown to depend on *per capita* income differentials and country size.

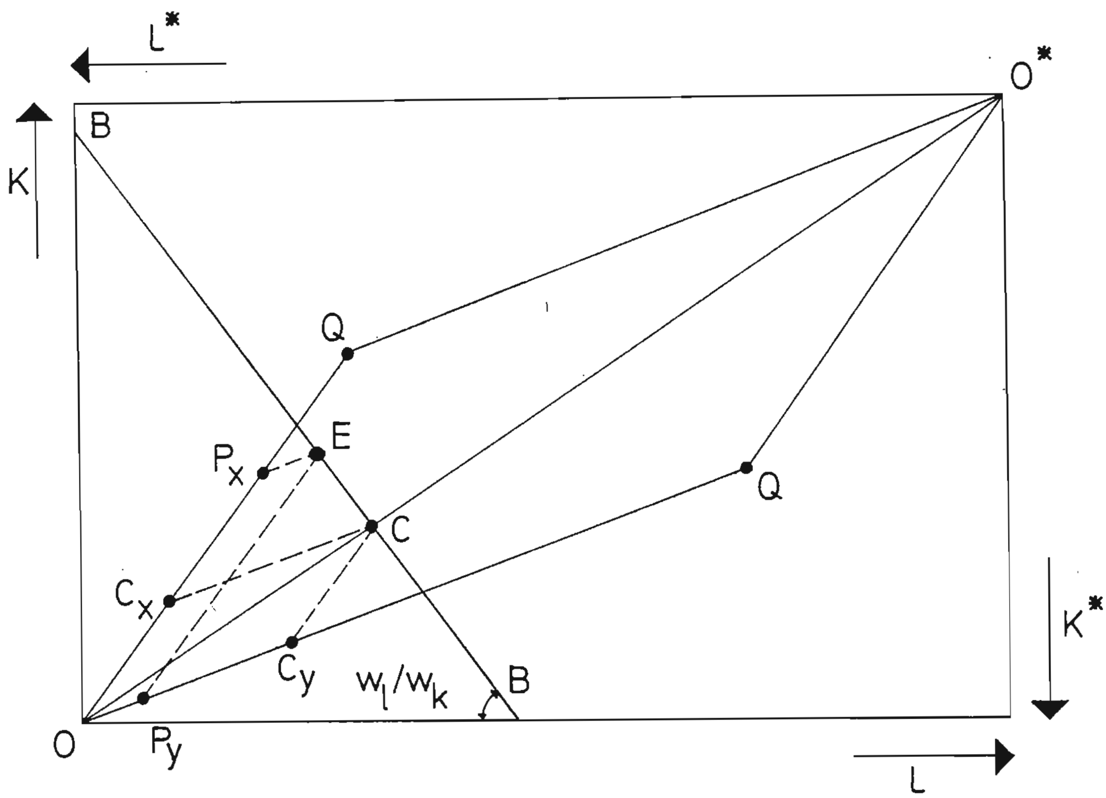
Recently Helpman and Krugman (1985) developed an interesting model which explains not only the existence of intra-industry trade based on economies of scale, but also the possibility of inter-industry specialization based on factor endowments and makes the following assumptions;

1. two countries;
2. two sectors, a food sector and a capital-intensive manufacturing sector. The manufacturing sector produces a number of varieties of a commodity. Each variety is produced with increasing returns to scale. If these are small, an industry can support a large number of firms, each producing a different variety of the industry product;
3. two factors of production, namely capital and labour;
4. every variety is produced with the same production function;
5. increasing returns to scale in production implying falling average costs;
6. a given demand for commodities where each consumer consumes a portion of every variety;
7. production is characterized by monopolistic competition.

Combining these assumptions with the aid of Figure 1.3, it is possible to demonstrate the existence of intra-industry trade.The analysis uses the concept of an integrated equilibrium which has been employed in trade theory by Travis (1964) and Dixit and Norman (1980).

FIGURE 1.3

THE HELPMAN AND KRUGMAN MODEL



Source: Helpman and Krugman (1985)

In Figure 1.3 Portugal's origin is O and England's origin is 0^*. The distances OK, OL and 0^*K, 0^*L show the world endowments of capital and labour respectively. Portugal's resources employed in manufacturing are given by 0Q and resources used in food production given by 0Q'. As production of manufacturers is capital-intensive 0Q is steeper than 0Q'. Consider a point E showing an initial resource endowment distribution where Portugal has relatively more capital than England. Construct through E a negatively sloped line (requiring a change of the units of measurement) equal to W_l/W_k or world factor rewards. The intersection of this line, BB, and 00^* give distances 0C and 0^*C which are proportional to income in Portugal and England respectively. Initially production is at a point E and consumption is located at C. Converting resources to output (again changing the units of measurement) Portugal produces $0P_x$ of manufactured commodities and $0P_y$ food. England produces QP_x manufactures and $Q'C_y$ of food. With consumption at C Portugal imports food and is a net exporter of manufactures. The reason that Portugal is a net exporter of manufactured commodities is that individuals in Portugal consume a portion of every variety, and as our assumptions ensure that every variety is not produced in Portugal, those varieties not produced in Portugal must be obtained from England. Further for the same reason England is a net importer of capital-intensive manufactures from Portugal.

Thus it is possible to have intra-industry trade, as not all varieties of a commodity are produced in a country, yet individuals in that country will consume a portion of every variety. In addition as factor endowments are increasingly similar, as E approaches C, intra-industry trade will be at a maximum with exports in a particular commodity, exactly matching imports. Inter-industry trade in food and manufactures would be explained by the conventional HOS trade model. The above helps an understanding the increases in trade in manufactured commodities between industrial market economies.

The above analysis attempts to position the recent development of intra-industry trade theory in pure positive trade theory. To this end the classical and neo-classical trade theories were presented. These theories had two dominant assumptions, namely, perfectly competitive industries and constant returns to scale. However, a great deal of trade flows in the post-war years have been of the intra-industry type. To explain this phenomenon the two dominant assumptions were altered. However, as has been shown, models explaining intra-industry trade, especially those of Krugman, Ethier and Helpman, retain strong links with conventional trade theory. In Chapter 2 it is proposed to cover in detail a number of models of intra-industry trade. The model in this chapter is meant to be brief so as to satisfy the requirement that only a short and abstract overview of trade theory be covered.

1.4. Conclusion

A difference between Ricardian trade theory and HOS trade theory is that the former assumes different production functions in each country, while the latter assumes production functions everywhere the same. Both, however, have as part of the analysis perfect competition and constant returns to scale. The different production functions in Ricardian trade theory are the source of comparative advantages which provide for the possibility of trade. For HOS trade theory, comparative advantages are given when different factor supplies are incorporated with identical production functions. However, these older trade models cannot explain trade in manufactures between industrial countries. New theories have been formulated relaxing the assumptions of perfect competition and constant returns to scale in the Ricardian and HOS models. As regards these new theories two developments occurred, namely, one including increasing returns to scale and another incorporating Chamberlinian monopolistic competition into the analysis. The former can take place in a Ricardian or HOS world and demonstrates the possibility of intra-industry trade when production functions are similar. Further, the HOS-related theorems of factor-price equalization, Rybczynski and Stolper-Samuelson require no fundamental alteration. The second approach, incorporating Chamberlinian monopolistic competition, links intra-industry trade to factor endowments and can be said to have links with both Ricardian and HOS trade models. Thus, while these new developments retain links with the two older trade models, they can explain the possibility of trade in manufactures, or intra-industry trade, between countries of similar factor supplies.

1.5 Plan of the Thesis

This chapter places intra-industry trade in a theoretical framework. In the remaining chapters, aspects of intra-industry trade will be dealt with in more detail. Chapter 2 presents seven models that allow intra-industry trade and gives the determinants of such trade. Chapter 3 investigates the existence and measurement of intra-industry trade. Further, the same chapter makes an estimate of the extent of intra-industry trade in South Africa. Chapter 4 conducts an empirical test of the determinants of intra-industry trade, using various statistical techniques. The penultimate chapter concerns the commercial policy and welfare effects of intra-industry trade. A final chapter attempts to summarize and draw out the conclusions of the previous chapters.

chapter 2.
MODELS OF INTRA-INDUSTRY TRADE

2.1 Introduction

In an effort to explain the phenomenon of increasing levels of intra-industry trade, various models have been formulated. In this chapter these models are presented and explained, in order to investigate their respective similarities and differences. In addition, the presentation of the models hopefully will reveal the major determinants of intra-industry trade. Furthermore, the major determinants of intra-industry trade will emerge from the models which will be incorporated in an empirical model to explain South Africa's level of intra-industry trade.

In Chapter 1 it was seen that intra-industry trade cannot be explained by conventional models of trade. A model of Intra-industry trade was presented in Chapter 1 to compare conventional trade models with newer models. These newer models attempt directly to explain, and allow for, intra-industry exchange taking place. This chapter develops a taxonomy of these models and presents them in greater detail than was given in chapter 1. As the majority of these models depart from the assumptions in conventional trade theory of competitive behaviour on the part of firms and constant returns to scale they can be divided into two strands, first, those incorporating the assumptions of increasing returns to scale and second those conducting the analysis in terms of monopolistic competition. Although theoretical attention has concentrated on the latter, there are two theoretical models of intra-industry trade that do require neither the assumption of increasing returns nor monopolistic competition, and provide a third category of models of intra-industry trade. However it is proposed not to deal with these two models of Brander (1981) and Falvey (1981).

2.2 Increasing returns to scale

Neo-classical trade theory usually incorporates the assumption that returns to scale are constant. This is not because trade theory cannot cope with increasing returns but rather that the existence of economies of scale is incompatible with the assumption of perfect competition. However, the justification for economies of scale is widely accepted and arises from larger firms being able to further divide the productive process, making use of more specialized tasks and equipment and thus promoting efficiency. Further, large firms have lower fixed costs per unit of output with larger production runs. The analysis of such economies has assumed that they are internal to the industry and have been incorporated into trade theory via their effects on market structure. This will be done in this chapter when models of imperfect competition are considered. Ethier's (1982) model of intra-industry trade, unlike the other models presented in this chapter, has differentiated producer goods rather than differentiated consumer goods.

2.2.1 Ethier's Model

Ethier initially assumes:

1 Capital and labour combine to produce wheat (W) and manufactures (M).

2 Wheat production is produced subject to constant returns to scale.

3 Manufactures are produced with potential economies of scale arising from the possibility of gains from increased specialization or economies in the traditional sense that rely on the geographical concentration of industries. Further economies may arise depending on the size of the market, both national and international, for manufactures.

4 Manufactures are produced by a production function:

$M = km$

k = index of scale economies

m = index of the scale of operations

and m is produced by a standard production function. Therefore there is a production possibility boundary, given the amount of capital and labour, which shows the relationship between output of wheat and m;

$$W = T(m)$$

5 Manufactures are costlessly assembled from components, and the number of which, n, is determined within the model, and are produced from identical production functions. All components are required to produce finished manufactures. The output of each component is x, thus the output of all components is nx.

6. It is assumed that the output of finished manufactures is given by

$$M = n^{\alpha - 1}(nx)$$

or

$$M = n^{\alpha}(x)$$

with $\alpha > 1$. A specific form of the function is

$$M = n^{\alpha}[\ (x_i^{\beta}/n)]$$

where x_i = quantity of the ith component

and a high value of β indicates greater substitutability of one component for another.

7 There is some indivisibility in the production of components.

8 The scale variable, m, is the quantity of factors required for manufacturing production, such that to produce x units of any component requires ax + b factors, so

$$m = n(ax + b)$$

which displays economies of scale in the traditional sense. However with $M = n^{\alpha - 1}(nx)$, or the production function describing manufactures, the expansion of the manufacturing sector from an increase in the number of components results in M rising in greater proportion than an increase in nx. These economies depend on the size of the market and are external to the firm. However components are manufactured by a large number of competitive firms, each taking n as given and viewing its output as subject to constant returns to scale.

Ethier then details the characteristics of autarkic equilibrium using the above assumptions. A producer of a finished manufacture uses components with the manufactures production function and takes n as given. If q_o and q are the prices, in terms of wheat, of a pair of components with outputs x_o and x then cost minimization by producers requires;

$$x_o = x(q/q_o)^{1/1-\beta}$$

which intuitively states that if one is to change from using x to x_o the quantity of x_o that can be used without affecting costs is given by the relative prices of the two components, adjusting for the substitutability of x for x_o. This is the demand curve for the component x_o faced by producers of the component and has an elasticity of $1/1-\beta$. The marginal cost of the factors of production will be given by the transformation curve. Thus if factor markets are competitive, then the cost function will be

$$-T'(m)ax_o+b$$

Profit maximization yields the following price for x_o

$$q_o = (-T'(m)a) / \beta$$

and profits are given by

$$q_o x_o + T'(m)ax_o+b$$

and will be driven to zero by the exit and entry of firms. Each component is produced by only one firm. It can be then shown that:

$$x_o = b\beta / a(1-\beta)$$

and x_o is independent of m. Therefore with a given m, the number of components is

$$n = (1-\beta)m/b$$

This can be used to solve for k in M = km and is equal to

$$k = ([1-\beta /b]^{\alpha-1}\beta/a)m^{\alpha-1}$$

The supply price, P_s, of M is;

$$P_s M = q_o nx$$

or $$P_s n^{\alpha} x = q_o n$$

and $$P_s = n^{1-\alpha} . q_o$$

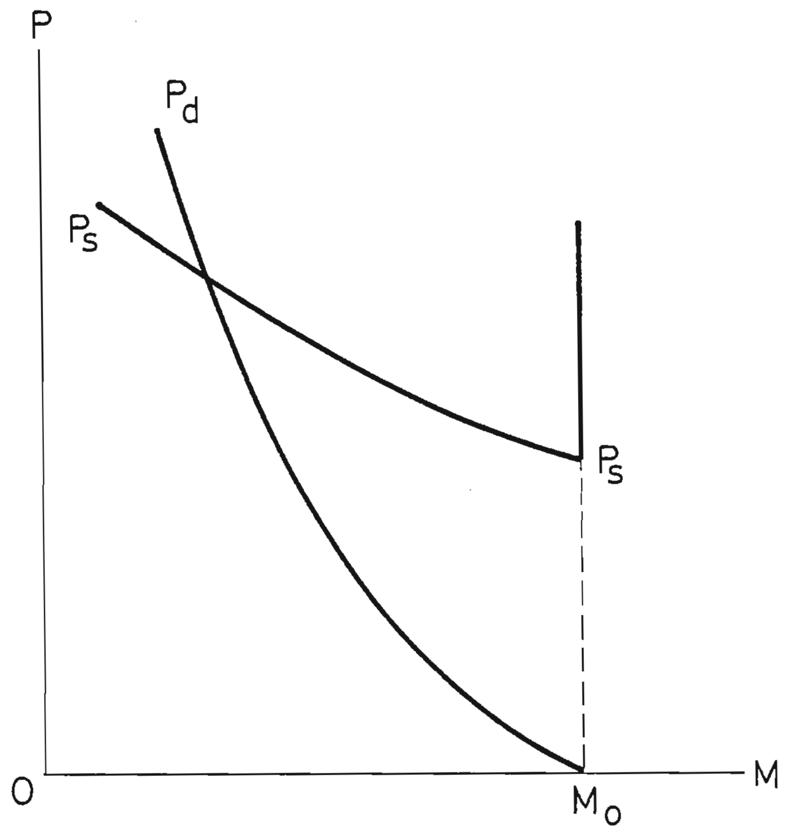
and substitution gives the supply curve of M

$$P_s = -T'(m)/k$$

and P_s is the supply curve shown in Figure 2.1

FIGURE 2.1

SUPPLY AND DEMAND IN ETHIER



Source: Ethier (1982)

M_o is the quantity of M when W = 0 and the supply curve shows the minimum price at which M_o would be supplied. The negative slope of the supply curve indicates increasing returns to scale.

As regards demand for manufactures, a constant fraction of income y is spent on manufactures. Each M and W determine a demand price

$$P_d = y(W+P_dM)$$

$$P_d = [y/1-y]T(m)/km$$

and this demand curve is shown in Figure 2.1 as P_d. The intersection of the demand and supply curves implies a unique equilibrium with the production of both wheat and manufactures. Opening up the model to trade requires a second economy identical to the first with asterisks distinguishing the second country. The number of components produced abroad is

$$n^* = (1-\beta)m^*/\beta$$

thus

$$n^* + n = (1-\beta)m + m^*/b$$

so $$M^* + M = (\beta/a)[1-\beta/b]^{\alpha-1}(m+m^*)^{\alpha}$$

However, it is still necessary to establish m and m* and the relative prices of manufacturers produced in terms of wheat. The world demand price for finished manufactures must equal

$$\begin{aligned} P_d &= [y/1-y]T(m)+T^*(m^*)/M+M^* \\ &= [y/1-y]a/\beta(b/1-\beta)^{\alpha-1}.T(m)+T^*(m^*)/(m+m^*)^{\alpha} \end{aligned}$$

where T*(m*) is the second country's transformation curve. The home supply price P_s^h is given by

$$P_s^h = -[((1-\beta)(m+m^*)/b)^{1-\alpha}]T'(m)a/b$$

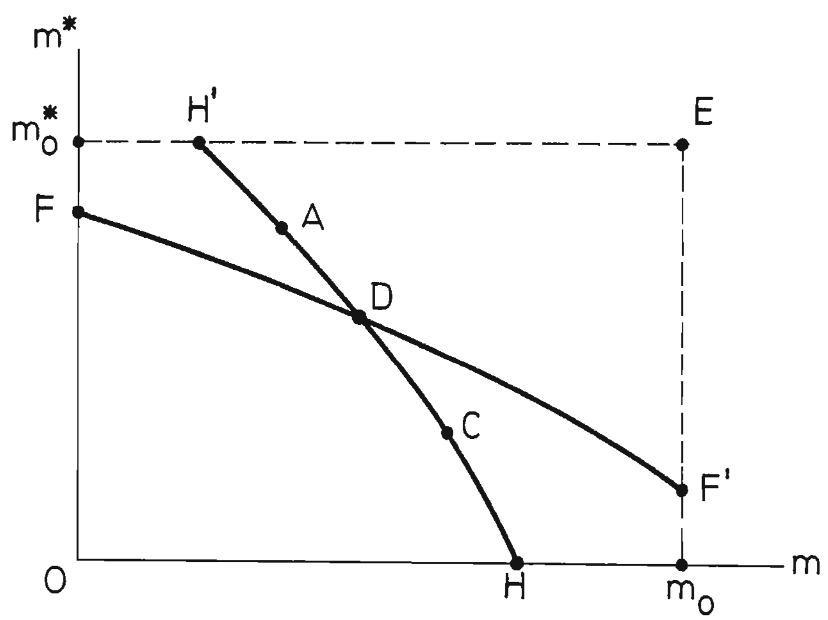
In the first country equilibrium will result if $P_d = P_s^h$ which occurs if

$$y[T(m)+T^*(m^*)]+ (1-y)(m+m^*)T'(m) = 0$$

This shows the combinations of m and m* for which the first country is in equilibrium in the international economy. In Figure 2.2, m and m* are the manufacturing scales if if each country specializes to manufactures. The relationship between m and m* keeping $P_d = P_s^h$ can be described as follows. Choose an initial equilibrium point such as A in Figure 2.1 . Now have the home country increase the supply of m, at an unchanged m*, then from the equilibrium condition P_s^h must rise and P_s^h will be greater than P_d. The only way for equilibrium to be restored is by a decrease in m*. Thus there exists a negative relationship between m and m*. The increase in m from A to B implies a fall in m* from A to C. Connecting all the points of equilibrium will yield the so-called allocation curve. Clearly points on m^*_o and m_o are possible if specialization takes place.

FIGURE 2.2

ALLOCATION CURVES



Source: Ethier (1982)

For the second country the allocation curve is given by

$$y(T(m)+T^*(m^*)+(1-y)(m+m^*)T^*(m^*)=0$$

In Figure 2.2 two allocation curves are shown for the first (H'H) and second (FF') country respectively.

As each country's supply price is more sensitive to that country's allocation of resources H'H is steeper than FF'. International equilibrium requires the intersection of two allocation curves and one possible intersection is shown in figure 2.2. The precise nature of the slope of the allocation curve is determined by the nature of the transformation curves in each country. The equilibrium values of m and m* (from the allocation curves) determine, via the structure of the model outputs, prices and the number of components. The above can be used to show that intra-industry trade has a factor-endowments basis. Intra-industry trade could result if the different components produced in both countries were required for the production of manufactures produced in both countries and no component entered a trade flow more than once. All consumption of manufactures is in the respective country of manufacture. With the above assumptions, the first country's import and export of components must equal

$$M_c = n_f xg \qquad X = n_h x(1-g)$$

where n_f = foreign components required locally
n_h = home components required in the second country
g = national income as a fraction of world income

and substituting in a Grubel and Lloyd (1975) measure of intra-industry trade yields

$$B_i = 1 - [|X_c - M_c| / X_c + M_c]$$

if $n_h > gn$

$$B_i = 2gn_f / [(1-g)n_h + gn_f]$$

and if B_i equals unity, all trade in components is intra-industry. This will occur if $g = 1/2$ and $n_h = n_f$ which is the case if the two countries have identical factor endowments. By substitution,

$$IIT = 2gn^* / (1-g)m + gm^*$$

and the index of intra-industry trade is invariant with respect to the degree of product differentiation and the level of fixed and marginal costs. Thus, if product differentiation were to increase, that is, were to fall, the number of components would rise from

$$n = (1-\beta)m/b$$

and x falls as the numerator falls and the denominator rises in

$$x = b\beta / a(1-\beta)$$

Therefore product differentiation plays a strange role in Ethier. It is required as an integral part of the model and its structure, however, that changes in product differentiation have no or perverse effects on the level of intra-industry trade. This will be useful in the empirical analysis of Chapter 4.

2.3 Monopolistic Competition

The following models are usually presented to show the possibility of intra-industry trade in a monopolistically competitive setting. Certain assumptions are made about consumer behaviour, production and cost. However unlike Ethier, whose model had differentiated producer goods, the following models have differentiated consumer goods. This section should not be seen as entirely separate from the previous section, as increasing returns to scale may support a market structure that is monopolistically competitive. Negishi (1972) was one of the first contributors to this area of trade theory. However, it is proposed to deal with more recent work in this section. A number of models have been formulated to explain intra-industry trade and each will be dealt with in a comprehensive manner. The first of these is the Dixit-Norman (1980) model which makes assumptions about consumer utility and the cost structure of firms. Certain relationships are derived from these assumptions in an equilibrium setting. Following this, three interesting models of Paul Krugman will be detailed. They incorporate a complex structure of assumptions about demand and production to explain high levels of intra-industry trade in manufactures among industrialized countries. In order to clarify the relationship between the HOS model and intra-industry trade, Helpman's (1981) model is enlightening. It is not completly correct to separate increasing returns fom monopolistic competition, as increasing returns may support monopolistic competition.

2.3.1 The Dixit-Norman Model

The Dixit-Norman (1980) model incorporates a two-commodity utility function characterized by homothetic and identical consumer preferences between countries. Using this utility function, the demand function for commodities can be obtained. The first, with label 0, is the numeraire commodity, which is that commodity not part of an industry producing a set of differentiated commodities. The differentiated industry has varieties of the commodities labelled k=1,2,3...n. Using the following assumptions:

1. The elasticity of substitution between any pair of the differentiated commodities is finite.
2. Perfect symmetry is assumed so varieties of differentiated commodities can be assigned any label.
3. The utility function is Cobb-Douglas in the quantity of the numeraire commodity and a scalar measure of consumption of differentiated commodities.

This implies the utility function

$$u = \left(\sum_k c_k^{\beta} \right)^{\alpha/\beta} \cdot c_o^{1-\beta} \tag{1}$$

where the term in parentheses is the consumption of differentiated products. Assuming that it is easier to substitute goods within the industry than between the industry and the numeraire goods then $\beta > o$. However, we would not like the industry goods to be perfect substitutes. Thus β must be less than unity. For this reason we need $o < \beta < 1$.

The elasticity of substitution between the differentiated commodities is $1/1 - \beta$. The world demand for commodities can be found by maximizing (1) subject to

$$c_o \div \sum_k p_k \, c_k = y \tag{2}$$

where p_k are prices and y is total world factor income plus profits. The demand functions for differentiated goods will be

$$p_j = \alpha \cdot c_j^{\beta-1} \, y/z \qquad (3)$$

where

$$z = \sum_k c_k^{\beta-1} \qquad (4)$$

Each country's demand function is found by multiplying (3) by the country's share in world income.

2.3.1.1 Production in Dixit-Norman

The numeraire is produced under conditions of constant returns to scale. Chamberlinian monopolistic competition in the differentiated products' industry and economies of scale are assumed. Further, it is assumed that production functions are the same for all varieties, the number of varieties is infinite and technologies are identical in each of two countries. Even though the number of varieties is infinite, only a finite number are produced. The cost function of the numeraire is b(w) where w is the vector of factor prices in the first country and W is the vector of factor prices in the second country. If both countries produce the numeraire good then with zero profits

$$b(w) = 1 = b(W) \qquad (5)$$

Each differentiated product has a cost function f(-)h(-) with f dependent on factor prices and h on output. There exist substantial economies of scale if h(x)/x decreases over the output levels covered by x. Production of each variety is undertaken by one producer and thus the industry is monopolistically competitive. If profits are maximized, entry will occur until profits of the marginal firm are zero, which in terms of the model, implies zero profits for all firms.

Dixit and Norman show that the marginal revenue for the producer of product j is p_j. For profit maximization this must be equated with marginal cost $f(w)h'(x_j)$ so

$$\beta \cdot p_j = f(w)h'(x_j) \tag{6}$$

And with average revenue $f(w)h(x_j)x_j$, then

$$\beta = x_j h'(x_j)/h(x_j) \tag{7}$$

which must hold for all products produced. With homothetic production functions, each product variety will have the same output level, the common value of x being

$$\beta = xh'(x_j)/h(x_j) \tag{8}$$

2.3.1.2 General Equilibrium

Given that each country produces at least one variety, using (6) and marginal costs $f(w)h'(x)$ then

$$\beta_p = f(w)h'(x) = f(W)h'(x) \tag{8a}$$

$$p.x = f(w)h(x) = f(W)h(x) \tag{8b}$$

will give equilibrium in product markets. Now turning to factor markets, the cost minimizing factor inputs are the derivatives of the cost functions with respect to factor prices.

With x_o as the first country's production of the numeraire good and n the number of differentiated products, then

$$x_o b_w(w) + n f_w(w) h(x) = v \tag{9}$$

where v is the vector of factor endowments. For the second country with the numeraire designated X_0 and N the number of differentiated products the equilibrium condition will be

$$X_o b_w(W) + N F_w(W) h(x) = V \tag{10}$$

with V the second country's vector of factor endowments.

Profits are zero in equilibrium so world income is (w.v + W.V). Substituting world income in (3) and the demand for the numeraire

$$c_o = (1 - \alpha)y \tag{11}$$

gives

$$p = \alpha(w.v + W.V)/[x(n + N)] \tag{12}$$

$$x_o + X_o = (1 - \alpha)(w.u + W.V) \tag{13}$$

Using equations (9), (10), (12) and (13) if m is the number of factors, the number of equations is 2m + 2. Ignoring problems of existence and uniqueness the whole system comprises equations (5); (8a); (8b); (8), in addition to the 2m + 2 above, giving 2m

+ 6 equations altogether. These determine, with 2 factors, the eight unknowns p, x, n, N, x, X, w, and W. With px=p the whole system is

$$b(w) = 1 = b(W) \tag{14}$$

$$\phi(w) = p = \phi(W) \tag{15}$$

$$x_o b_w(w) + n\phi_w(w) = v \tag{16}$$

$$X_o b_w(W) + N\phi_w(W) = V \tag{17}$$

$$x_o + X_o = (1 - \alpha)(w.v + W.V) \tag{18}$$

$$n + N = \alpha(w.v + \alpha W.V)/p \tag{19}$$

where constant unit cost $\phi(-) = f(-)h(x)$ and is sold at p=px. These are exactly the conditions for equilibrium in a competitive two-commodity economy with each good produced in both countries. The model can thus account for inter-industry trade between the numeraire and differentiated goods. If the differentiated goods are more capital intensive, the capital abundant country will export them and import the numeraire good from the labour abundant country.

However, the model allows for intra-industry trade. Given λ, that is the first country's share of world income, consumption of numeraire and it's share of differentiated products, then

$$c_o = \lambda(x_o + X_o) \tag{20}$$

$$c = \lambda x \tag{21}$$

For each of (n +N) goods. With the first country a net exporter of differentiated products set up σ, which is its share in world production of differentiated commodities, namely n/(n + N).

In the first country net imports of numeraire are

$$C_o - x_o = \lambda(x_o + X_o) - x_o = \lambda X_o - (1 - \lambda)x_o.$$

If exports varieties 1,2,....n are equal to $(1 - \lambda)x$, and imports are λx of n and 1,2....n. Total trade is balanced if

$$\lambda X_o - (1 - \lambda)x_o = np\ (1 - \lambda)x - Np\ \lambda x \tag{22}$$

Gross exports of differentiated products are

$$np(1 - \lambda)x = (n + N)px\,\sigma\,(1 - \lambda) \tag{23}$$

and net exports are

$$\begin{aligned} np(1 - \lambda)x - Npx\lambda &= (n + N)px[\sigma\ (1 - \lambda - (1 - \sigma)\lambda] \qquad (24) \\ &= (n + N)px(\sigma - \lambda) \end{aligned}$$

The second country's exports are equal to $(n + N)px(1 - \sigma)\lambda$. Gross trade is

$$\begin{aligned} T_G &= (n + N)px\ \sigma(1 - \lambda) + (n + N)px\ (1 - \sigma)\lambda \\ &= (n + N)px[\sigma\ (1 - \lambda) + (1 - \sigma)\lambda] \qquad (25) \end{aligned}$$

Subtracting (24) from (25) we get intra-industry trade IIT.

$$IIT = 2(n + N)px\ \lambda(1 - \sigma) \tag{26}$$

IIT will be important when λ is large and σ is small. It was assumed that $\sigma > \lambda$. Thus the maximum amount of IIT will occur when $\lambda = \sigma = 1/2$. Therefore, if two countries are the same size with no cross industry comparative advantage, trade will be of intra-industry type. Grubel and Lloyd's (1975) B_i can be expressed in terms of σ and λ.

$$B_i = \frac{2\lambda - 2\lambda\sigma}{\sigma - 2\sigma\lambda + \lambda} \tag{27}$$

The above is the Dixit-Norman Model. It is based on the Dixit-Stiglitz (1977) work on optimum product diversity. The model is useful, as it is able to combine both intra-industry trade and trade flows related to factor endowments. Its weaknesses are the numerous assumptions required and its inability to determine the pattern of intra-industry trade.

2.3.2 The Krugman Models

Krugman (1979, 1980, 1981) was responsible for the development of three distinct models in the intra-industry trade literature. For the purposes of this thesis they have been labelled Krugman One, Krugman Two and Krugman Three.

2.3.2.1 Krugman One

The model for the closed economy has one scarce factor of production producing a large number of products. Each consumer has the same utility function and purchases some amount of each good. The elasticity of demand for each good is assumed to fall as the quantity consumed of that commodity rises. The model has scale economies, as average costs are decreasing. Opening up the closed economy to another economy with identical tastes and technologies will have the same effect as increasing the labour force of the country and there will be an increase in the range of goods available. As consumers allocate expenditures equally over all products, half of that expenditure will be on imports and will equal exports. This then gives rise to intra-industry trade. This model shows formally that increasing returns to scale can result in trade. Scale economies are those that are internal to the firm and the market structure is one of monopolistic competition. Imagine an economy with labour the only scarce factor of production. The economy can produce a large number of goods i : $i = 1; 2; ..n$. The number is only a small fraction of the total number of potential goods. Each individual has the following utility function

$$U = \sum_{i+1}^{n} u(c_i) \tag{28}$$

into which all goods enter symmetrically, and c_i is the consumption of the ith good. The elasticity of demand is assumed to decrease as c_i rises.

The cost function is assumed to be the same for all goods, and labour inputs are a linear function of output such that

$$l_i = \alpha + \beta x_i \tag{29}$$

where l_i is labour used in producing good i and x is the output of good i. Thus marginal costs are constant and average costs are falling. Consumption of a good multiplied by the labour force must equal production. Assuming all individuals are workers then

$$x_i = Lc_i \tag{30}$$

Where L is the labour force. Lastly, full employment is assumed

$$L = \sum_{i+1}^{n} l_i = \sum_{i+1}^{n} [\alpha + \beta x_i) \tag{31}$$

Now consider the behaviour of a representative individual maximizing utility subject to a budget constraint. The first order condition is that

$$u'(c_i) = \lambda p_i \tag{32}$$

where λ is the marginal utility of her income (Chiang 1974, p.392). Rearranging (32) we obtain

$$p_i = \lambda^{-1} u'(x_i/L) \tag{33}$$

Each firm will maximize profit Π_i and charge the profit maximizing price p_i

$$\Pi_i = p_i x_i - (\Pi + \alpha x_i) w \beta \tag{34}$$

$$p_i = \frac{\varepsilon}{\varepsilon - 1} \cdot w \tag{35}$$

Prices and output are determined by (34), noting that in equilibrium in monopolistic competition profits are zero. In Figure 2.3 using (34) we can derive the PP curve which shows as c_i increases, in order to maintain equality, p_i must rise. If we set $\Pi = 0$ (34), can be rewritten

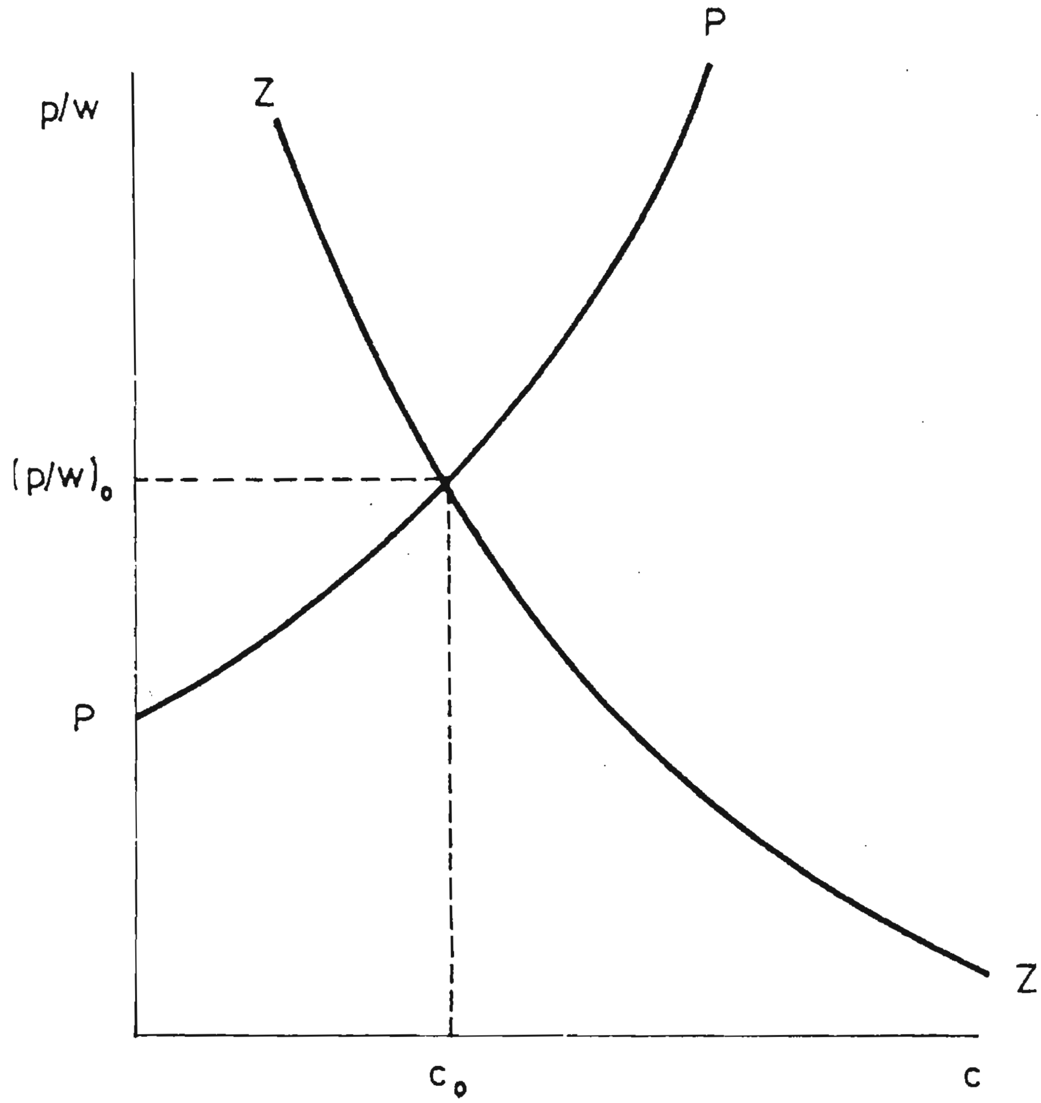
$$p/w = \beta + \alpha/x = \beta + \alpha/Lc \tag{35a}$$

and is the hyperbola zz in Figure 2.3. The intersection of the PP and zz curves gives the price and quantity consumed of each good. Output is $x = Lc$, and n, the number of goods produced, is

$$n = \frac{L}{\alpha + \beta x} \tag{36}$$

FIGURE 2.3

EQUILIBRIUM IN KRUGMAN ONE



Source: Krugman (1979)

Now assume there exists another economy exactly like the one above. The effects of the two trading would be the same as both obtaining an increased labour force. The utility function after trade becomes

$$U = \sum_{i+1}^{n} u(c_i) + \sum_{i=n+1}^{n+n^*} u(c_i) \qquad (37)$$

where n + 1;...n + n are consumption of the foreign country's production. The value of imports in the first country will be national income times the proportion of overseas labour to total world labour

$$M = w.L + L^{*}/L + L^{*} \tag{38}$$

where M are imports and L^* is the second country's endowment of labour. Imports are equal to exports and therefore from (38) we have

$$M = X^{*} \tag{39}$$

and we can see the effect of trade in Figure 2.3. From the equations of the ZZ and PP curve and noting that trade results in the ZZ curve shifting to the left, decreasing p/w. The implication of this is that both the number of varieties and the output of each rises.

Thus all the trade is of the intra-industry type and there are gains to be had from trade, via economies of scale, not related to tastes, technology of factor endowments (Krugman 1979, p.477).

With exports exactly equal to imports all trade is of the intra-industry type. This arises in a model with economies of scale that are internal to the firm and gains arising from greater co-ordination, communication and specialization within the firm. In the model this is ensured by having average costs greater than fixed costs and decreasing average costs when specifying the cost function. With trade product variety, and output increases giving rise to welfare ains from trade.

2.3.2.2 Krugman Two

In the second model of Krugman there are a large number of products which enter symmetrically into demand. There is only one factor of production, labour, and each product is produced with economies of scale as decreasing average costs are assumed. With symmetry, each consumer buys the same quantity of each product. Full employment is assumed, so that the total labour force must be used in production. Monopolistic competition ensures that profits will be zero in equilibrium. With a second country identical to the first and individuals allocating expenditure over home goods as well as goods produced abroad, consuming some of each product gives rise to intra-industry trade. In Krugman One the movement to free trade was equivalent to an increase in the home country's labour force. This had the effect of increasing both output and the number of varieties of each product. This was only possible if the elasticity of demand for a product increases when its price is increased. In Krugman Two this elasticity is assumed to be constant. Trade has no effect on the number of varieties. However gains are to be had as each consumer can consume the second country's products as well as those produced in his own country. Again a large number of goods is assumed that enter symmetrically into demand. The utility function is

$$U = \sum_i c_i^{\theta} \qquad (40)$$

with $0 < \theta < 1$. There is only one factor of production and that is labour. All goods have the same cost function

$$l_i = \alpha + \beta x_i \qquad (41)$$

for i + 1;...n; where l is the labour input and x is the output of the good. Thus marginal cost is constant and average costs are falling. Consumption must exhaust total production and, if all individuals are workers, then

$$x_i = Lc_i \tag{42}$$

where L is the labour force. Full employment

$$L = \sum_{i=1}^{n} (\alpha + \beta x_i) \tag{43}$$

is assumed along with freedom of exit and entry by firms so that profits are zero.

Before trade is analyzed, equilibrium in the closed economy is discussed. Equilibrium comprises demand, profit maximizing behaviour and the number of firms. The first order condition for profit maximization is

$$\theta\, c_i^{\theta - 1} = \lambda p_i \tag{44}$$

which is analogous to equation (32). The demand curve facing the firm producing x_i is

$$p_i = \theta^{\lambda - 1}(x_i/L)^{\theta - 1} \tag{45}$$

with a large number of goods the marginal utility of income is a constant. This implies from (45) that the elasticity of demand (ε)

$$= 1/1 - \theta \tag{46}$$

and the profit maximizing price is

$$p_i = \theta^{-1}\beta w \qquad (47)$$

where w is the wage rate in terms of any good. As θ, β and w are the same for all firms, prices for all goods are the same and

$$p_i = p \qquad (48)$$

for every one. Profits of any firm are

$$\Pi_i = px_i - [\alpha + \beta x_i]w \qquad (49)$$

and entry will occur until profits are driven to zero. Thus output is

$$x_i = \alpha / [p/w - \beta] \qquad (50)$$

with θ, β and w the same for all firms, let

$$x_i = x \qquad (51)$$

Given full employment the number of goods produced is

$$n = \frac{L}{\alpha + \beta x} \qquad (52)$$

In his analysis of the effects of trade, Krugman assumes that the other country is exactly the same as the one above. In the model transport costs are zero and tastes and technologies are similar.

In such a world there will be both trade and gains from trade. The former will occur as each good will be produced in only one country but demand will exist in the other countries as well. Gains from trade arise from greater consumer choice as the world economy produces a greater diversity of products. In the first country, consumers will spend n /(n + n) of incomes on foreign goods, with the asterisk representing the foreign country. Imports into the first country will be

$$M = Ln^*/(n + n^*) \tag{53}$$

which equals

$$M = LL^*/ (L + L^*) \tag{54}$$

Equation (54) is the foreign country's imports so

$$M = X = M^* = X^* \tag{55}$$

and all trade is of intra-industry type. Krugman notes that the direction of trade is indeterminate as there is no mechanism within the model to ensure which country produces which commodity. In this model the gains from trade come from increased product diversity. This model is distinct from Krugman One where demand becomes less elastic as the consumption of commodities increases. Here the elasticity is assumed to be constant. Krugman Two predicts the presence of intra-industry trade.

2.3.2.3 Krugman Three

In Krugman Three there are only two goods, each of which can be any number of a large variety of products. Each consumer spends half his income on each good, thus (with symmetry and an elasticity of substitution between industries equal to unity) the total revenues of the two industries are the same. Each consumer purchases the same quantity of each product. The number of products is determined by monopolistic competition. There are two factors of production, both labour and each specific to one of the two industries. Further, as there is a greater elasticity of substitution between varieties than between industries, the the number of varieties will be less, but this will ensure economies of scale. Allowing for trade and making symmetrical assumptions about labour endowments in two countries gives rise to intra-industry trade. The last of Krugman's models differs from his former models in that each industry has, or uses, labour that cannot be used in any other industry. Like the other models, we begin with a closed economy, comprising two industries. Each industry consists of a large number of products. The industries are labelled 1 and 2 respectively. Individuals have the following utility function

$$U = \ln \left(\sum_{i=1}^{N_1} c_{1,i}^{\theta} \right)^{1/\theta} + \ln \left(\sum_{j=1}^{N_2} c_{2,j}^{\theta} \right)^{1/\theta} \qquad (56)$$

where $C_{1,i}$ = consumption of ith product of industry 1

$C_{2,j}$ = consumption of jth product of industry 2

N_1 ;N_2 = potential number of products in industry 1 and 2 (large)

n_1 ;n_2 = actual production

Equation (56) has some useful properties. Firstly, it allows half of income to be spent in industry 1. Secondly, the elasticity of demand is $1/1 - \theta$, a constant. Finally it can be used to illustrate the gains from trade.

As regards demand, products of an industry are considered imperfect substitutes. While from the point of view of supply, products will be perfect substitutes.

There are two factors of production, type 1 labour and type 2 labour. Each type is wholly specific to industry 1 and 2. Within each industry, the labour used is

$$l_{1,i} = \alpha + \beta x_{1,i} \quad i = 1, \ldots n_1 \tag{57}$$

$$l_{2,j} = \alpha + \beta x_{2,j} \quad j = 1, \ldots n_2 \tag{58}$$

where $l_{1;i}$ = labour used in producing ith product of industry

$x_{1;i}$ = output of ith product

Assume full employment structured as follows

$$\sum_{i=1}^{n_1} l_{1,i} = L_, = 2 - z \tag{59}$$

$$\sum_{j=1}^{n_2} l_{2,j} = L_2 = \frac{z}{2} \tag{60}$$

$$o < z < 1$$

The total labour force is set to 2, while z indicats factor proportions.

Before introducing trade it is necessary to establish equilibrium within the model. With the elasticity of demand a constant $1/1 - \theta$ then

$$p_1 = \theta^{-1} \beta w_1 \tag{61}$$

$$p_2 = \theta^{-1} \beta w_2 \tag{62}$$

where p_1 and p_2 are the profit maximizing prices. Given prices, profits are

$$\Pi_1 = p_1 x_1 - (\alpha + \beta x_1) w_1 \tag{63}$$

$$\Pi_2 = p_2 x_2 - (\alpha + \beta x_2) w_2 \tag{64}$$

with w_1 and w_2 equal to wage rates in each industry. With entry, profits are zero and

$$x_1 = x_2 = \frac{\alpha}{\beta} \cdot \frac{\theta}{1-\theta} \tag{65}$$

The number of firms is

$$n_1 = 2 - z/(\alpha + \beta x_1) \tag{66}$$

$$n_2 = z/(\alpha + \beta x_2) \tag{67}$$

As a final step, relative wages need to be discussed. Each industry receives an equal share of expenditure and there are no profits. This implies that

$$w_1 L_1 = w_2 L_2 \tag{68}$$

or

$$\frac{w_1}{w_2} = \frac{L_2}{L_1} = \frac{z}{2-z} \tag{69}$$

Thus we have the equilibrium conditions for a two sector monopolistically competitive economy. This economy has two parameters, z and θ. The value of z determines relative wages.If z is low, type 1 labour will receive a lower wage than type 2. The value of θ measures the degree of substitutability among products within any industry. If θ is low, the more differentiated products will be produced and consumed.

To introduce trade, suppose there are two countries, a home and foreign country. The foreign country will differ from the home in that the relative size of the labour force will be reversed. As

$$L_1 = 2 - z \qquad L_2 = z \tag{70}$$

this implies

$$L_1^* = z \qquad L_2^* = 2 - z \tag{71}$$

where the asterisk represents the foreign country.

The parameter z is an index of similarity in factor proportions. For $z = 1$, the countries' endowments are identical. Further, assuming these two countries are able to trade at zero, transport costs,and the volume and pattern of trade can be determined. With the elasticity of demand equal to $1/1-\theta$, then

$$p_1 = \theta^{-1}\beta w_1 \tag{72}$$

$$p_2 = \theta^{-1}\beta w_2 \tag{73}$$

$$p_1^* = \theta^{-1}\beta w_1^* \tag{74}$$

$$p_2^* = \theta^{-1}\beta w_1^* \tag{75}$$

and

$$w_1 = w_1^* = w_2 = w_2^* \tag{76}$$

with the assumed symmetry. Furthermore,

$$x = \alpha\theta / \beta(1 - \theta) \tag{77}$$

and

$$n_1 = n_1^* = 2 - z/(\alpha + \beta x) \tag{78}$$

$$n_1 = n_2^* = z/(\alpha + \beta x) \tag{79}$$

With international equilibrium it is now possible to determine the volume and pattern of trade. This requires two initial assumptions. First, each individual devotes an equal share of expenditure to each industry, and second, everyone spends an equal amount on each product within an industry. The implication of this is that the share of all individuals' income on industry 1 products, produced in the foreign country is

$$\tfrac{1}{2}[n_1^*/(n_1 + n_1^*)] \tag{80}$$

The number of products is however proportional to the labour force. With X for exports and M for imports the following will be true

$$X_1 = \tfrac{1}{2} Y [(2 - z)/2] \tag{81}$$

$$X_2 = \tfrac{1}{2} Y (z/2) \tag{82}$$

$$M_1 = \tfrac{1}{2} Y (z/2) \tag{83}$$

$$M_2 = \tfrac{1}{2} Y [(2-z)/2] \tag{84}$$

If (81)-(84) is substituted into Grubel and Lloyd's (1975) B_i :

$$IIT = B_i = 1 - \frac{\sum_k |X_k - M_k|}{\sum_k (X_k + M_k)} \qquad (85)$$

then

$$B_i = z \qquad (86)$$

And the index of IIT equals the index of similarity in factor proportions. In other words, increasing the degree of similarity of factor endowments in a model incorporating economies of scale, between two countries increases intra-industry trade.

2.4 The Lancaster Model

The economies in Lancaster's model (1980) have manufacturing sectors characterized by product-differentiated groups. A group is a product class in which all products possess the same characteristics. Different products will thus have these characteristics in different proportions. The groups are considered to be divisible. The proportions in which characteristics are possessed by any product within the group define its specification. These specifications are variable in a continuous manner over the product spectrum, so that the group has an infinite number of potential products. Individuals have preferences for characteristics of goods rather than the goods themselves and cannot obtain characteristics not in available goods by buying other goods and consuming them in combination. Using the concept of the most preferred good or ideal product, and a diversity in preferences, the good which would be most preferred if available at the price a consumer is willing to pay for a particular good is inversely proportional to the availability of the good and the most preferred good. Every consumer might have different preferred goods, but for each available good will pay the same price for goods the same distance from their preferred types. Using this analysis, demand functions may be calculated, where demand is not only a function of price, but also of the characteristics goods possess.

With regard to production, it is assumed there are economies of scale given by the ratio of average to marginal costs. The goods produced are measured so that the total cost of producing the first Q^o units is the same for all goods. The firm selling a product is concerned with both price and specification. The market structure used by Lancaster (1981) is called perfect monopolistic competition and has perfectly informed firms facing perfectly informed consumers under conditions of perfect flexibility in choice of specification.

There will exist a number of goods unique to equilibrium n*. his number will be larger:

1. the more responsive are consumers to differences in specification;
2. the lower the elasticity of substitution with respect to other goods;
3. the lower are economies of scale at each level of output;
4. the larger is the market.

To consider the effects of trade the economy will be seen as consisting of a manufacturing sector and an agricultural sector. In the latter there are neither economies of scale nor product differentiation. There is no collusion between firms in addition to freedom of exit and entry. If an identical second economy is assumed, the equilibrium condition will be identical. Each country will produce manufacturers in quantity Q^O at price p^O

$$p^O = \frac{c(Q^O)}{Q^O} \tag{87}$$

where $c(Q^O)$ is the cost function. If the countries trade freely, in effect there is one market, but the population will be twice as big as each in isolation. A feature of perfect monopolistic competition is that no two firms will choose to produce the same product. Therefore, each good will be produced in only one of the countries. Consumption will, however, take place in both countries. Since the quantity of each good is given by total demand, the size of the manufacturing sector in each will depend on the number of °good groups' in each. In the first country the number of products is n^1 and in the second n^2. The sum n^1+n^2 will be greater thn n^O (the amount produced in isolation), as the larger market will allow for economies of scale. Equilibrium will occur when $n^1 = n^2$ as:

1. both economies have the same-sized manufacturing sectors;
2. with identical resources they will have equal income;
3. given identical preferences, they will consume the same quantity of each good;

and trade balances will sum to zero. This being the case, all trade is of the intra-industry type. Thus intra-industry trade will arise when economies are identical in every respect.

2.5 Helpman's Model

Helpman (1981) is based on Lancaster and the latter's incorporation of product characteristics into consumer demand. However, Helpman positions his model very close to the HOS type and predicts trade on the basis of factor endowments. The other sector produces differentiated products under conditions of economies of scale. Each sector uses capital and labour which are mobile nationally. Therefore if both countries have identical technologies, produce both food and manufactures,and have symmetrical demand patterns (the meaning of this will become apparent when the concept of the unit circle is covered), then factor price equalization holds as prices should be the same in both countries. If manufactures are capital intensive, then the home country, with a greater relative endowment of capital, will be a net exporter of manufactures and a net importer of food. As factor endowments become more equal, the extent of intra-industry trade will rise. Helpman has consumers with an ideal variety making consumption choices between their ideal variety and the available variety. Producers are assumed to be monopolistically competitive and produce different varieties of a product. However, each consumer may find that a variety from a second country may be closer to his ideal variety, and same may be said for consumers in the second country. This gives rise to the possibility of intra-industry trade.

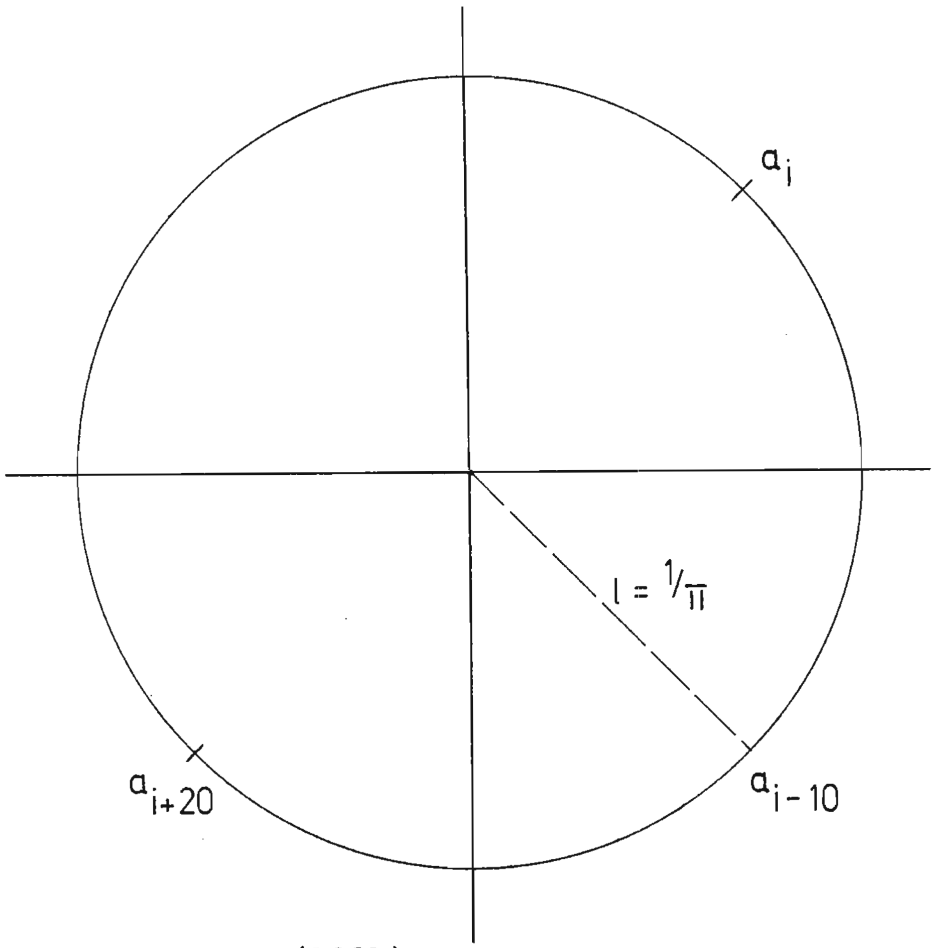
2.5.1 Consumers in Helpman's Model

In Helpman's world, the consumer consumes two goods : a manufactured good and food. Food is homogenous, that is there is only one type. Manufactured goods have many specifications. It is assumed there is a 'continuum' of the types of manufactured products that can be produced. Let each type be represented by points on the circumference of a circle. In Figure 2.3 point a_i represents a product as does a_{i-10} and a_{i+2}. Every product has a point on the circumference. Each consumer has, out of all varieties, a most preferred type. This can be explained as follows: a consumer faced with a bundle consisting of x units of manufactured goods and y units of food will always choose a particular type. This ideal is the most preferred good. Added to this, assume that any combination of factors will produce X number of units for every type of manufactured product. If U(x,y) is the utility function showing the consumer's preference for food and his most preferred type, then it is possible to obtain preferences for all manufactures not of the ideal type. To do this, assume a function h(v) with

$$o < v < \Pi \; 1 = 1 \qquad (88)$$

FIGURE 2.4

THE UNIT CIRCLE



Source: Helpman (1981)

where $l = 1/\pi$ is the radius of the circle in Figure 2.4. The function is such that any consumer is indifferent between x units of his most preferred type and h(v)x units of a good which is located on the circle such that the arc distance v is the shortest. The function h(v), the compensation function, has the following properties

$$h(o) = 1;\ h(v) > 1 \text{ when } v > o \tag{89}$$

$$h'(o) = 0; h'(v) > o \text{ when } v > o \tag{90}$$

$$h''(v) = o \quad \text{for } v > o \tag{91}$$

implying that the further away a product is located from the ideal type, the greater is the quantity required to make the consumer indifferent between it and the most preferred type. The further away the product from the most preferred type the larger is the marginal compensation required to compensate the consumer for not being able to obtain the most preferred good.

If x(v) is the quantity of the manufactured item located at the distance v from the most preferred type, then utility is

$$u = v[x(v)/h(v);y] \tag{92}$$

A consumer thus makes two decisions. First, he chooses the variety of the manufactured good he will consume. Following this, the consumer allocates his budget between this good and food. The demand functions can be shown to be

$$x(v)/h(v) = \alpha_x[p_x h(v), p_y]I \tag{93}$$

$$y = \alpha_y[p_x h(v), p_y]I \tag{94}$$

P_x = price of manufactured good
P_y = price of food
I = income
$\alpha_{x;y}$ = homogenous functions of degree -1.

The consumer will choose that variety which provides him with the lowest price in terms of his most preferred product. Further, there is a continuum of consumers with the same utility functions and income. This does not mean that all consumers have the same ideal type, but instead ideal type preferences are assumed to be uniformly distributed around the circumference of Figure 2.4. If L is population size, the density of consumers with ideal type a_i

is $\varepsilon = L/2\Pi 1 = L/2$.

2.5.2 Producers in Helpman's Model

Helpman assumes that food is produced with a linearly homogenous production function using Labour and Capital

$$Y = F_y (L_y; K_y) \qquad (95)$$

and its associated cost function

$$C_y^{(w;r;y)} \equiv C_y (w;r)Y \qquad (96)$$

where w = wage rate

r = rental on capital

$C_y(w;r)$ = increasing, linearly homogenous concave cost function.

This gives the demand functions for the factors of production

$$L_y = \alpha_{Ly} (w;r)Y \qquad (97)$$

$$K_y = \alpha_{Ky} (w;r)Y \qquad (98)$$

where α_{Ly} = labour output rate

α_{Ky} = capital output rate

The price of food is thus

$$p_y = C_y(w;r) \tag{99}$$

The manufacturing sector has the following production function

$$X = F_x(L_x;K_x) \tag{100}$$

where Lx and Kx are the factor inputs into each variety which is represented by a point on the circle of Figure 2.4. The following cost function is associated with the production function

$$C_x(w;r;X), \tag{101}$$

and the inverse of the elasticity of cost with respect to output measures economies of scale, θ,

$$\theta(w;r;X) = \frac{C_x(w;r;X)}{C_{xx}(w;r;X)X} \tag{102}$$

where the denominator of (102) represents the marginal cost of production. The demands for the factors of production are

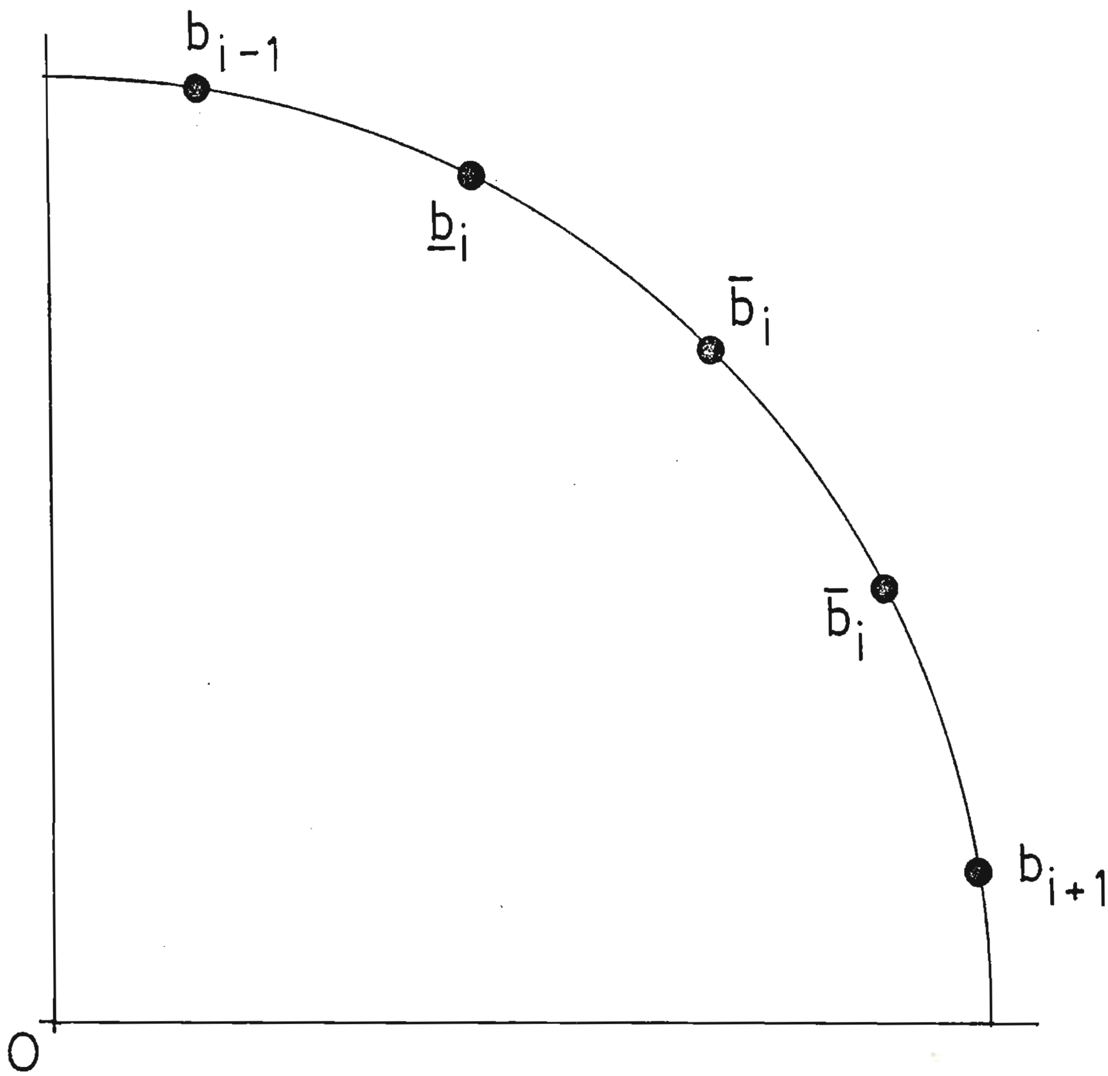
$$L_x(w;r;X) = \delta C_x(w;r;X)/\delta w \tag{103}$$

$$L_x(w;r;X) = \delta C_x(w;r;X)/\delta r \tag{104}$$

In Figure 2.5 a segment of Figure 2.4 has been reproduced.

FIGURE 2.5

A SEGMENT OF THE UNIT CIRCLE



A firm wishing to produce b_i must ensure that

$$px_i \leqslant \text{minimum } [px_{i-1} \cdot h(v_{i-1});\ px_{i+1} \cdot h(v_{i+1})] \qquad (105)$$

where

v_{i-1} = distance between b_{i-1} and b_i

v_{i+1} = distance between b_i and b_{i+1}.

It is possible to pinpoint the size of the market for b_i. Consider those consumers whose ideal product lies between b_i and v v_{i+1} such that

$$px_i h(\bar{d}) = px_{i+1} \cdot h(v_{i+1} - \bar{d}_i) \quad (106)$$

where $\bar{b}_i$ is $\bar{d}_i$ away from b_i. Equation (106) states that the consumer whose most preferred good is $\bar{b}_i$ is indifferent between b_i and v_{i+1}. Similar reasoning can be applied to type $\underline{b}_i$ in Figure 2.5. With this one can obtain the demand function:

$$Q(px_i;\ V_{i-1};\ py;\ px_{i-1};\ px_{i+1};\ D_i; \varepsilon;\ I) \quad (107)$$

where D_i is equal to

$$\frac{b_i + b_{i+1}}{2} \quad (107a)$$

The producer of b_i will maximize profits

$$\Pi_i = p_{xi}\ Q(px_i;\ etc) - C_x(w,r,\ Q(px_i;\ etc)) \quad (108)$$

and first and second order conditions can be calculated from the same equation.

2.5.3 Equilibrium in Helpman's Model

This occurs in the closed economy when N, the number of varieties consumed, equals n, the number of varieties produced. Before the conditions for equilibrium are given, it is necessary to give the degree of monopoly power faced by any one product's producer. This is the function R(px;py;N) and is the ratio of price to marginal revenue

$$R(px;py;N) = 1 + \left[\frac{1}{\tilde{E}(px;py;N)}\right]^{-1} \quad (109)$$

where É is the responsiveness of quantity to price, px. In the long run the following zero-profit conditions must be satisfied

$$py = C_y\ (w;r) \quad (110)$$

$$p_x X = C_x(w;r;x) \quad (111)$$

Marginal costs are then equated with marginal revenue

$$p_x \left[1 + \frac{1}{\tilde{E}(px;py;N)}\right] = C_{xx}\ (w;r;X) \quad (112)$$

and combining (102) and (111), the degree of monopoly power must equal the degree of economies of scale

$$R(p_x;p_y;N) = \theta(w;r;X) \quad (113)$$

The equilibrium conditions for factor markets are as follows

$$a_{Ly}\ (w;r)Y + L_x\ (w;r;X)n = L \tag{114}$$

$$a_{Ky}\ (w;r)Y + K_y\ (w;r;X)n = K \tag{115}$$

where L = the labour force

K = the capital stock

and the first term represents the agricultural demand for labour, the second, the demand for labour by the n firms in the manufacturing sector. The capital equation has a similar interpretation.

2.5.4 International Trade in Helpman's Model

Consider two countries with identical technologies and the same utility functions. The unit circles (Figure 2.4) have the same density and identical compensation functions. The second country's variables are shown by use of an asterisk. If no two firms produce the same variety and all goods are sold at the same price, the following model can be set up using equations (110) to (115)

$$py = C_y\ (w;r) \tag{116}$$

$$p_x X = C_x\ (w;r;X) \tag{117}$$

$$R(px;py;N) = \theta(w;r;X) \tag{118}$$

$$a_{Ly}\ (w;r)Y + L_x\ (w;r;X)n = L \tag{119}$$

$$a_{Ky}\ (w;r)Y + K_x\ (w;r;X)n = K \tag{120}$$

$$py = C_y\ (w^*;r^*) \tag{121}$$

$$pxX^* = C_x\ (w^*;r^*;X^*) \tag{122}$$

$$R(px;py;N) = \theta(w^*;r^*;X^*) \tag{123}$$

$$a_{Ly}\ (w^*;r^*)Y^* + L_x\ (w^*;r^*;X^*)n^* = L^* \tag{124}$$

$$a_{Ky}\ (w^*;r^*;)Y^* + K_y\ (w^*;r^*;X^*)n^* = K^* \tag{125}$$

Using the above it is possible to make some statements as to the existence of IIT. Using Grubel and Lloyd's (1975, p 21) B_i, one can obtain the following;

$$B_i = 1 - \frac{X_f + (M_g - X_g)}{X_f + (M_g + X_g)} \qquad (126)$$

or

$$B_i = 1 - \frac{py(Y - Ay) + px\,(n^*Ax - nA^*x)}{py(Y - Ay) + px(nA^*x + n^*Ax)} \qquad (127)$$

where Ay = consumption of food in first country
Ax = consumption of manufactures in first country
Ax* = consumption of manufactures in second country

with

$$py(Y - Ay) + pxnA^*x = pxn^*Ax \qquad (128)$$

then

$$B_i = \frac{n/Ax}{n^*/A^*x} \qquad (129)$$

Now, if labour is reallocated from the second to the first country, with factor prices (thus rewards) unaltered, B_i will fall as n^*/A^*x increases. This suggests that endowment similarly gives rise to intra-industry trade. Thus intra-industry trade will take place between countries with close factor proportions. A similar model may be found in Krugman and Helpman (1975) and has been outlined in the previous chapter.

2.6 Conclusion

In this section we have covered seven models which hypothesize about the existence of intra-industry trade. They are not without fault. Musa in Bhagwati (1982) has three criticisms against them, first, that in trading between countries there are no benefits to be had from an increase in the scale of production. In other words, there exist no benefits which might accrue from the division of labour, given the broadening of markets. Secondly, some of the models, Krugman Two and Helpman (1981) do not allow for a decrease in the monopoly power of any one firm, as the elasticity of demand is assumed a constant in the former and monopoly power is restricted to the degree of economies of scale in the latter. Therefore, the models might be of little use in determining whether the opening up of trade will encourage competitive behaviour among firms. Finally, the models assume symmetry and balanced trade. Thus they come close to assuming intra-industry trade *ab initio*. This is not a problem if one keeps in mind the purpose of such models, which is to ascertain what are the determinants of intra-industry trade. In addition, Greenaway and Milner (1986) criticize the Krugman and Dixit-Norman models for their assumption that all varieties are symmetrically included in the utility functions, product variety is as a result only of changes in supply conditions and the mechanism by which firms choose which variety to produce, is not detailed. Further adjustments from autarky appear to be costless and the models do not give the direction of trade. However, apart from these criticisms it appears that the models do convincingly point to certain determinants of intra-industry trade. Each of the models is logically consistent and the hypotheses as regards intra-industry trade are not in conflict.

To conclude, and draw out such determinants, it is useful to detail the differences between the Krugman (1979, 1980, 1981) models, and the model of Lancaster (1980). From Table 2.1 it is seen that the major determinants of intra-industry trade are

TABLE 2.1 A COMPARISON OF FIVE MODELS OF INTRA-INDUSTRY TRADE

	DIXIT-NORMAN	KRUGMAN ONE	KRUGMAN TWO	KRUGMAN THREE	LANCASTER
Nature of goods	Objects of utility	Objects of utility	Objects of utility	Objects of utility	Goods desired for characteristics
Consumers	Choose between varieties produced in differentiated industries	Choose between a large number of goods	Choose between a large number of goods	Purchases all goods	Has a most preferred good and pays for a good the closer it is to the most preferred good
Diversity of consumers	None	All consumers identical	All consumers identical	None	Extreme
Elasticity of demand (D)/ substitution (S)	Differentiated goods not perfect substitutes (S)	Derived from a utility function (D)	Derived from a utility function (D)	Constant parameter of utility function (D)	Rises as goods become more alike (D)
Production and costs	Imperfect competition	Chamberlinian Monopolistic competition	Chamberlinian Monopolistic competition	Chamberlinian Monpolistic competition	Any form possible
Decisions faced by firms	Price, quantity and entry	Price, quantity and entry	Price, quantity and entry	Price, quantity and entry	Price, quantity entry, specification
Product variety	Each firm produces a new variety	Indeterminate which goods are produced	No two firms produce the same product	Determined by industry-specific factors	Determined by marked size, preferences and output of other industries
Equilibrium output	Competitive two good economy with each good produced in two countries	Profit maximizing behaviour	Profit maximizing behaviour	Profit maximizing behaviour	Same as Krugman Three except number of products determined simultaneously
Economies of scale	Yes	Yes	Yes	Yes	No
Determinants of intra-industry trade	Similar factor endowments Economies of scale Product differentiation	Similar factor endowments Economies of scale Product differentiation	Similar factor endowments Economies of scale Product differentiation	Similar factor endowments Economies of scale Product differentiation	Similar factor endowments Product diversity

Source: Based on Lancaster (1982)

product diversity, economies of scale and similarity of factor endowments. The table does not show the models of Helpman (1981) and Ethier (1972, 1982). Helpman confirms the conclusion of the table and has similar factor endowments being the major determinant of intra-industry trade. Ethier (1979) is interesting in that product diversity gives rise to intra-industry trade and the determination of intra-industry trade is due to relative factor endowments. More specifically, the greater the similarity in relative factor endowments, the greater is the scope for intra-industry exchange. Furthermore, Lancaster (1981) shows that tariff barriers generally inhibit intra-industry trade. Therefore, it might be hypothesized, given the above analysis, that intra-industry trade is likely to be higher the smaller the difference in factor endowments between countries and the larger is the average per capita income which allows for greater product diversity. If per capita income differences are smaller, then the possibility of two trading countries being identical as envisaged in the models is greater. Thus the scope for intra-industry trade in differentiated products may be larger. Further, intra-industry trade levels are likely to be higher where there are impediments to trade such as higher transport costs and high tariff barriers. Finally, if economies of scale exist, and are substantial, higher levels of intra-industry trade are likely to be observed, as they are critical in the structure of the above models of intra-industry trade.

chapter 3.

THE EXISTENCE AND MEASUREMENT OF INTRA-INDUSTRY TRADE

3.1 Introduction

In an investigation of intra-industry trade, two important areas need to be covered; first, does the phenomenon exist (the so-called existence problem); and second, how is the level of intra-industry trade in any one country measured.

This chapter intends to discuss the existence problem and detail the methods used in calculating the level or extent of intra-industry trade. In the first section it is proposed to detail the debate surrounding the existence of intra-industry trade. Following this, the measurement of intra-industry trade will be discussed. In addition, some mention is to be made of the reliability of the data used in measuring such trade. Finally the actual levels of intra-industry trade are given for South Africa and the average level of intra-industry trade is compared to average levels in other countries.

3.2 The Existence of Intra-industry Trade

One of the major problems in the area of intra-industry trade is the question of whether it exists. The first major investigation into intra-industry trade by Grubel and Lloyd (1975) revealed high levels of intra-industry trade amongst the major industrial countries. This gave impetus to theoretical developments which attempt to explain trade between countries of similar factor endowments and the large proportion of this trade being of the intra-industry type. In the previous chapter it was shown that two of these developments were the incorporation of imperfect competition and economies of scale into international trade theory. However, Grubel and Lloyd (1975) have been interpreted as measuring a phenomenon - intra-industry trade - which is inconsistent with conventional trade theory. As a result of this so-called "inconsistency" interpretation for which Grubel and Lloyd are partly responsible. Finger (1975) was led to show that intra-industry trade was not inconsistent with conventional trade theory.

The HOS model maintains that trade between two countries, one with a higher relative endowment of capital (and the other with a higher relative endowment of labour) would result in the exchange of capital-intensive exports for labour-intensive imports. This is known as the factor proportions or factor-endowments model of trade. Thus the 'inconsistency' interpretation would maintain that high levels of intra-industry trade between countries with similar endowments of factors cannot be reconciled with the HOS prediction given above. Finger (1975) takes issue with this and attempts to show that intra-industry trade is consistent with the factor proportions model of trade.

Finger (1975) gives the following set of inequalities:

$$r_{1a} > r_{1b} > \dots > r_{2a} > r_{2b} > \dots > r_{na} > r_{nb} > \dots > r_{nx}$$

where r is the capital/labour ratio. The first subscript refers to the industry and the second subscript to the variety of the product produced by that industry. Thus product 2 is a different product from product 1, but products 2a and 2b are different varieties of the same product. In a two country world, with one country labour-abundant, the relative costs, in terms of their factor requirements, of each product in the labour-abundant country will be

$$c_{1a} > c_{1b} > \dots > c_{2a} > c_{2b} > \dots > c_{na} > c_{nb} > \dots > c_{nx}$$

The dividing line between exports and imports for that country will fall somewhere on the range of costs above. All varieties to the left of the dividing line will be imported by the labour-abundant country and all goods to the right of the dividing line will be exported by that country. Thus if the dividing line fell at the fourth inequality, as shown by the dotted line above, intra-industry trade could only take place in one commodity group. Clearly this is not sufficient as an explanation for intra-industry trade. The question that comes to mind, ignoring the single product at the dividing line, is why intra-industry trade should be observed in a country's trade statistics. The solution is a simple one. Trade data published by countries use classification systems that do not conform to the strict ranking of the inequalities as set out by Finger.

Many countries publish trade data classified according to the Standard Industrial Trade Classification (SITC) which is based on the use to which a product is put and its stage of manufacture. Therefore given the following cost structure

$$c_2 > c_3 > c_4 > c_5$$

in the labour-abundant country, if the trade classification incorporates products 2, 3, 4 and 5 into the same group then while the labour-abundant country will export 4 and 5 and import 2 and 3 the trade classification will show the existence of 'intra-industry' trade.

Finger's problem then becomes that, to show for any observed intra-industry trade in a trade classification such as the SITC, if input requirements vary substantially within the commodity or product groups of that classification, then the process of combining products into a classification with different capital intensities, as was demonstrated with products 2, 3, 4 and 5, is occurring. This Finger does in an empirical test. The implication of Finger's work, at least initially, is that high levels of observed intra-industry trade in the SITC are a statistical conception due to the inability of the trade classification to capture products with unique capital/labour ratios in one group.

Finger's criticism of the existence of intra-industry trade appears to demonstrate that an attempt to measure intra-industry trade may be futile. However, this is not the case. Davies (1975) argues that Finger had not considered the case where countries have similar factor endowments. The implication of such a situation is that the inequalities in the equations above become equalities, and thus trade that does occur cannot be explained on the basis of the factor proportions theory. A country could not produce all the products itself, as there would be no benefit from economies of scale. Clearly one country may produce some of the products and the other country the remainder. If demand conditions are such that consumers require the products produced only in the second country, this will result in intra-industry trade. Clearly the scope for intra-industry trade increases as the number of varieties of a product increases. This is the case in the Krugman models of the previous chapter.

In conclusion, therefore, because of the 'inconsistency' interpretation it has been argued by Finger that intra-industry trade (and he refuses to call it such) is a statistical novelty. Finger's objection is important and should warn trade researchers of the danger of overstating the extent of such trade. However, it was seen in previous chapters that newer trade theories incorporate the HOS or factor proportions theory, different demand conditions, and economies of scale with monopolistic competition amongst countries of similar factor endowments. Nevertheless, the factor proportions theory is still important in explaining the volume of trade flows. However, the new theories or models can explain trade between countries of similar factor endowments which was a possibility not considered by Finger. Furthermore, there have been calculations of intra-industry trade using data that is disaggregated, so that the problem of grouping products with dissimilar input features, such as the example given above, is minimized. The calculations at the disaggregated level show falling levels of intra-industry trade, but the phenomenon by no means disappears. (See Grubel and Lloyd (1975), Gray (1979), Pomfret (1979) and Greenaway and Milner (1983).)

3.3 The Measurement of Intra-industry Trade

The measurement of intra-industry trade requires a consideration of both the data to be used and the actual measure that is to be calculated.

3.3.1 The Accuracy of the Trade Data

The quality of the trade data has come into question recently. Kamarck (1983) notes that there have been insufficient investigations into the accuracy of trade data. The suspicion that trade data may be inaccurate is by no means new. Morgenstern (1970) gives enough indication that all is not well in commodity trade statistics and concludes on their accuracy "there is no doubt that the situation is not better; it is bound to be worse" (1970, p 179). Therefore, it would be imperative, before using trade data for research purposes, to investigate the accuracy (and whether the precision is improving over time) of that data.

In 1960 the world trade balance (imports minus exports) was $6 755 million. By 1980 the world trade balance had risen to $67 778 million (see Table 3.1). One would expect that the trade balance for all the countries in the world would be zero. However, because of

1. An increasing number of countries,
2. Problems of valuation,
3. Diverting trade for political or other reasons,
4. Re-exports,
5. Timing differences, and
6. Differences in classifying commodities, valuationand quality,

an exact balance of zero is unlikely (Morgenstern, 1970, p 165).

To determine the accuracy of world trade, it would be useful to ascertain the size and variability of the world trade balance through time. In Table 3.1 are presented the world trade figures for various years between 1960 and 1980. The difference between exports and imports as a proportion of exports has fallen from 5,32 per cent to 3,66 per cent. The average is 3,82 per cent. Morgenstern's (1970) average was 6,59 for fifteen select years 1938 to 1960. As the 3,82 is smaller than the 6,59 it is possible that trade statistics are improving over time.

TABLE 3.1
TOTAL WORLD TRADE
(MILLION US DOLLARS)

YEAR	IMPORTS (c.i.f.)	EXPORTS (f.o.b.)	M - X	$\frac{M - X}{X} . 100$
1960	133 739	126 984	6 755	5.32%
1965	196 583	186 400	10 183	5.46%
1970	331 953	313 979	17 974	5.72%
1973	599 643	572 650	26 993	4.71%
1974	859 895	841 163	18 732	2.23%
1975	909 002	876 225	32 777	3.74%
1976	1 018 105	991 001	27 104	2.74%
1977	1 165 493	1 126 919	38 574	3.42%
1978	1 349 509	1 298 796	50 713	3.90%
1979	1 688 943	1 642 615	46 328	2.82%
1980	2 053 327	1 993 248	60 079	3.01%
1981	2 030 760	1 973 499	57 261	2.90%
1982	1 921 640	1 853 862	67 778	3.66%
			AVERAGE	3.82%
			STANDARD DEVIATION	1.10%

Source: Yearbook of International Trade Statistics (1984)

In addition Morgenstern (1970, pp 169-174) tests for the possibility of bias in international trade data. He defined four variables as regards trade data between two countries. Morgenstern (1970), labelling them as follows

I_1 = Imports of country one according to country one's statistics.

I_2 = Imports of country two according to country two's statistics.

E_1 = Exports of country one according to country one's statistics.

E_2 = Exports of country two according to country two's statistics.

The percentage difference between country one'simports (as stated in that country's records) and the records of the exporting country (two) from which those imports were obtained is measured by $I_1 - E_2/I_1$. The ratio $E_1 - I_2/E_1$ similarly shows by how much country one's exports differ from the recorded imports of the country who purchased those exports. Table 3.2 shows the biases in the data dependent on the signs of the two statistics above

TABLE 3.2

$\frac{I_1 - E_2}{I_1}$	$\frac{E_1 - I_2}{E_2}$	SOUTH AFRICA	ANY SECOND COUNTRY
+	+	I_1 and E_1 overstated	I_2 and E_2 understated
+	-	I_1 overstated E_1 understated	I_2 overstated E_2 understated
-	+	I_1 understated E_1 overstated	I_2 understated E_2 overstated
-	-	I_1 and E_1 understated	I_2 and E_2 overstated

Source: Morgenstern (1970)

3.3.2 The Measure of Intra-industry Trade

Intra-industry trade has been defined as the value of exports of an industry which are matched by imports of a type produced by that same industry situated elsewhere. This has been designated R_i and

$$R_i = (X_i - M_i) - |X_i - M_i|$$

where X_i = exports in industry 'i'

M_i = imports of a type produced by industry 'i'

i = 1;2;3;...n.

n = number of industries.

Inter-industry trade, usually designated S_i, is merely the difference between any one industry's exports and imports. Both measures are standardized by showing them as a proportion of the sum of each industry's exports and imports. The value of S_i becomes A_i.

$$A_i = [\,|X_i - M_i|\,/(X_i + M_i)]\,.\,100$$

Further, R_i changes to B_i and is

$$B_i = \frac{[(X_i + M_i) - |X_i - M_i|\,]}{(X_i + M_i)}\,.\,100$$

This is a useful index as it ranges from zero to one, and S_i is given by $100 - B_i$. If $X_i = M_i$ then $B_i = 100$ and intra-industry trade must be at its maximum. When $B_i = 0$ all trade will be inter-industry trade.

If the data are such that the level of aggregation includes products in the same product grouping which have different factor intensities, then $|X_i - M_i|$ may be small. This implies that B_i is larger. Thus it is possible to obtain values for B_i which suggest the occurrence of intra-industry trade when, in fact, the larger portion of trade is inter-industry. Related to this problem is the "opposite sign effect" (Greenaway and Milner 1983, p.901). This occurs when one is measuring intra-industry trade at a particular classification level which comprises a number of sub-groupings, each with trade imbalances of opposite sign. At the higher level of aggregation, B_i will be overstated. This is so because the term $|X_i - M_i|$, required to calculate B_i, is smaller and therefore less is subtracted from unity. One method to prevent categorical aggregation (which is where products with dissimilar production functions are grouped together) would be to reclassify the data, a huge if not impossible task.

Two other methods are available to deal with the problem of aggregation. These are measuring intra-industry trade at a lower level of aggregation, and adjusting the measure of intra-industry trade. The former appears to be most popular, as is evidenced by studies undertaken by Grubel and Lloyd (1975), Gray (1979) and Pomfret (1979). The results indicate that intra-industry trade does not disappear as one moves to lower levels of aggregation. The second way of coping with the problem is to adjust the index, such as B_i, with which one measures intra-industry trade to nullify the effects of aggregation. One such index has been suggested by Greenaway and Milner (1983, p.904) and is

$$C_j = \left[1 - \frac{\sum |X_{ij} - M_{ij}|}{\sum (X_{ij} + M_{ij})} \right] \times 100$$

where j = jth of n industries

i = sub-categories at (j -1)th level of aggregation.

This differs from B_i in that subgroups of industry i are considered. Instead of subtracting imports from exports at the level of i, the difference between items at the lower level j are taken. If at the level of j, exports and imports are of different sign, then $C_j < B_i$. The most powerful feature of C_j is that it accommodates the "opposite sign effect". Further, C_j is the average of subgroup indices weighted by trade within those subgroups.

A problem that concerns the measurement of intra-industry trade is the overall trade imbalance. Questions have been raised as to whether it should be adjusted for and if so how should the index be adjusted? The trade imbalance induces a downward or upward bias to B_i as the term $|X_i - M_i|$ helps determine, via the formula, the level of intra-industry trade and, the average trade imbalance of a group of products making up an industry. Grubel and Lloyd (1975, p.22) proposed C_j

$$\bar{C}_j = \bar{B}_i \cdot 1 / (1 - k)$$

$$k = \frac{\left| \sum_{i}^{n} X_i - \sum_{i}^{n} M_i \right|}{\sum^{n} (X_i + M_i)}$$

$$B_i = \frac{\sum_{i}^{n} \left[(X_i + M_i) - \left| X_i - M_i \right| \right]}{\sum_{i}^{n} (X_i + M_i)}$$

which expresses intra-industry trade as a proportion of total trade minus the imbalance of trade. Aquino (1978, p.280) argues that such an adjustment is contradictory in that although, it adjusts for the trade imbalance, it maintains that the imbalance does not affect each commodity's trade flow. Aquino (1978) holds that the solution is to assume the imbalance is equiproportional in all industries. This requires estimating exports and imports, assuming total exports equal to total imports

$$X^{e}_{ij} = X_{ij} \, \frac{\tfrac{1}{2} \sum_{i} (X_{ij} + M_{ij})}{\sum_{i} X_{ij}}$$

$$M^{e}_{ij} = M_{ij} \, \frac{\tfrac{1}{2} \sum_{i} (X_{ij} + M_{ij})}{\sum_{i} X_{ij}}$$

where the "e" denotes the theoretical value of exports and imports, and intra-industry trade is given by

$$Q_j = \frac{\sum_i (X_{ij} + M_{ij}) - \sum_i \left| X^e_{ij} - M^e_{ij} \right|}{\sum_i (X_{ij} + M_{ij})} . 100$$

This measure is used by Loertscher and Wolter (1980) in their empirical study. Greenaway and Milner (1983) maintain that the above procedure "is likely to induce rather than remove distortions" (1983, p.901). The problem goes further than that, as it may not be possible to justify the equiproportional assumption, for the adjustment will remove the effect of scale economies, demand patterns for differentiated products and other effects which contribute to the explanation of intra-industry trade. Furthermore, the assumption only applies in the sterile and, as yet, unobserved world of identical price and income elasticities for exports and imports with world-wide elasticity of supply infinite. Aquino (1981, p.765) accepts this as correct. However, Greenaway and Milner (1981) maintain that that adjustment for imbalances in trade try to correct for the effects of disequilibrium conditions. Aquino (1981, p.765) counters this by holding that the adjustment does not require any statement to be made concerning equilibrium. On this score Aquino (1981, p.765) appears correct.

The discussion thus far has implications for any empirical work on intra-industry trade. Any empirical investigation must consider

1. What values of exports and imports to use,
2. The index to be calculated,
3. Whether to deal with the aggregation problem, and
4. Any adjustments to be made for the overall trade imbalance.

Empirical work for South Africa has been undertaken by the author and is reported in the section which follows. To nullify the effects of categorical aggregation the index to be used in calculating the extent of intra-industry trade is, Greenaway and Milner's (1983), C_j . Finally, considering the debate concerning adjustments for trade imbalances no attempt is made to account for them.

3.4 Evidence for South Africa

In a previous chapter it was noted that the greatest increases in world trade has been between the industrial countries and a great deal of this trade has been of the intra-industry type. Further, it was shown how conventional trade theory developed to take into consideration such trade flows and provide an explanation for them. In addition, intra-industry trade has been observed in developing countries. Therefore, because of these developments, it might be interesting to measure the extent of intra-industry trade in South Africa. Before this is done, however, it is necessary to ascertain the reliability of the available data. The analysis undertaken by Morgenstern described in Section 3.3.1 above was reperformed for South Africa and two other countries, namely the United Kingdom and the United States.

$I_1 - E_2/I_1$ measures the percentage difference between country one's imports (as stated in that country's records) and the records of the exporting country (two) from which those imports were obtained. The ratio $E_1 - I_2/E_1$ similarly shows by how much country one's exports differ from the recorded imports of the country who purchased those exports. Both ratios are included in Table 3.3 where South Africa is compared with the United Kingdom.

TABLE 3.3

YEAR	$\frac{I_1 - E_2}{I_1}$ %	$\frac{E_1 - I_2}{E_1}$ %
1975	- 2,14	- 51,52
1976	1,15	- 8,84
1977	- 6,17	- 11,06
1978	- 7,71	- 11,01
1978	- 7,73	- 36,23
1979	- 3.72	- 13,92
1980	- 4,52	- 17,96
1981	- 0,99	- 15,71

Source: Yearbook of International Trade Statistics(1979, 1981)

The table has two calculations for the year 1978, as the second Yearbook revises the earlier estimate. As can be seen the calculated statistics change by a factor of three for the second calculation of $E_1 - I_2/E_1$ in 1978. This points to some variability of the data. Comparing Table 3.2 with Table 3.3 reveals that either I_1 and E_1 are understated <u>or</u> I_2 and E_2 are overstated. The same ratios are now calculated for South Africa and the United States.

TABLE 3.4

YEAR	$\frac{I_1 - E_2}{I_1}$ %	$\frac{E_1 - I_2}{E_1}$ %
1975	2,25	- 77,15
1976	6,12	- 88,97
1977	4,04	- 46,35
1978	3.29	- 55,81
1978	3,31	- 97,63
1979	2,63	- 100,41
1980	3,08	- 113,65
1981	2,96	- 73,72

Source: Yearbook of International Trade Statistics (1979, 1981)

Comparing Table 3.2 with Table 3.4 it is seen that South African and United States trade data are overstated as regards imports and understated as regards exports. A possible reason is that import duties have been included in the figures for the United States.

It has been established there is a possible bias in the trade statistics of South Africa's major trading partners, the United States and the United Kingdom. It is now necessary to ask whether this has implications for the measurement of intra-industry trade. If both exports and imports of South Africa are incorrect in the same direction, the measure of intra-industry trade is unaffected. However, problems occur when the data are different as regards bias, for then the absolute difference between exports and imports can widen, causing, a fall in the measured amount of intra-industry trade assuming the total value of exports and imports is unchanged. This is the case with South Africa and the United States. On an exports plus imports basis, in 1983 the trade flow between South Africa and the United States was 11,18% of total exports and imports.

However the errors of Table 3.4 do not yield margins of error for the individual sets of statistics. The table therefore does not give an indication of the overall size of the error. Despite the possibility of error and ignorance as to the size of the error use will be made of South African trade data in this study , but stating at the outset that the possibility of error is a constraint on the ability to draw exact conclusions on the basis of calculations using the trade data. However, in the absence of any thing else, one is forced to use the existing published data. Therefore it must be kept in mind that the results are general indications, of the level of intra-industry trade, rather than exact magnitudes. The data for the purposes of this study is taken from Foreign Trade Statistics, Volume I and II, for the Year 1982, released by the Commissioner for Customs and Excise of the Republic of South Africa. The data is classified according to the Brussels Tariff Nomencalature of the Customs Cooperation Council usually abbreviated to CCCN. The area covered by the data includes the Republic of South Africa, Lesotho, Swaziland, Botswana and Namibia. The advantage of the CCCN is that it is based on the the input requirements of the commodities and thus helps overcome the existence problem, in that capital /labour requirements are more likely to vary more between classifications than within classifications.

Further, as regards the trade data, it is necessary to choose between the two bases that exist for calculating the value of exports and imports. Grubel and Lloyd (1975) recommend that in measuring intra-industry trade imports and exports should both be measured free on board (f.o.b.). This refers to the cost a supplier incurs in placing his product, for export or import as the case may be, on board ship. Thereafter, any further costs are the costs of the emptor. The reason why f.o.b. values are preferred is because they measures the value of trade in each industry without the effect on cost of transportation, which has been raised as a possible reason for the existence of intra-industry trade. To avoid adjustments to cost that arise from transportation, which might hide some intra-industry trade, it is felt that f.o.b. values are preferable. The alternative to f.o.b. values is a cost that includes charges for carriage, insurance and freight or the c.i.f. value. These values are only equal to f.o.b. values when the additional costs are the same for both imports and exports. The probability of this occurring is low. In the calculation of the indices of intra-industry trade for South Africa f.o.b. values will be used.

Given the features of the South African economy and trade structure, one can hypothesize about the level of intra-industry trade. It is expected that given

1. South Africa's factor dissimilarity compared to its major trading partners,
2. Relatively low per capita income not warranting the production of many varieties or allowing for economies of scale, and
3. High transport costs offsetting the possibility of economies of scale from access to large overseas markets,

South African intra-industry trade is likely to be low.

Grubel and Lloyd's (1975) B_i, the level of intra-industry trade in South Africa was calculated for the years 1970 and 1981. Further, to overcome the aggregation problem, Greenaway and Milner's (1983) C_j was calculated for South Africa for the years 1981 and 1982. From Table 3.5 it is seen that average levels of intra-industry trade are low. The average over 98 classifications (excluding arms and ammunition) is , for C_j is 28 per cent. In other words, 72 per cent of South Africa's trade is of the inter-industry type. Notice that for 1981, average B_i ¨ average C_j, which is to be expected, but is only 8 per cent greater. Over the period 1971 to 1981 average levels of intra-industry trade have not altered a great deal as the average B_i has risen from 31 per cent to 35 percent.

TABLE 3.5

SOUTH AFRICAN INTRA-INDUSTRY TRADE

	CCCN Class	1982 C_j	1981 C_j	1981 B_i	1970 B_i
1	Live animals	49	43	97	70
2	Meat and edible offals	7	20	22	84
3	Fish	32	55	45	54
4	Dairy produce, eggs and honey	38	52	53	65
5	Non-edible animal substances	21	22	87	60
6	Trees, plants, flowers and foliage	35	29	32	40
7	Vegetables	35	47	78	70
8	Fruit and nuts	38	6	9	12
9	Coffee and tea	15	18	18	2
10	Cereals	2	3	34	57
11	Milling industry products	46	67	83	76
12	Oil seeds	76	23	48	34
13	Lacs, gums and resins	48	46	30	65
14	Vegetable plaiting material	67	31	31	32
15	Animal and vegetable fats and oils	61	53	97	80
16	Prepared meat and fish	75	87	45	72
17	Sugar	9	14	16	11
18	Cocoa	9	7	9	20
19	Prepared cereals, flour and starch	55	66	70	71
20	Prepared fruit or vegetables	10	9	12	10
21	Miscellaneous edible preparations	74	87	86	85
22	Beverages, spirits and vinegar	25	21	59	80

23	Food industry waste	44	30	49	8
24	Tobacco	33	50	50	70
25	Salt, sulphur, earth and stone, lime and cement	13	16	65	29
26	Metallic ores	16	17	17	13
27	Coal	5	5	9	77
28	Chemicals - inorganic	45	45	98	89
29	Organic chemicals	12	11	11	9
30	Pharmaceutical products	39	41	44	56
31	Fertilisers	17	36	42	98
32	Tanning and dyeing extracts	69	65	65	81
33	Essential oils and resinoids	20	19	19	25
34	Soaps and detergents	52	47	49	18
35	Alluminoil substances, glues and enzymes	29	33	42	98
36	Explosives	4	5	12	14
37	Photographic goods	10	7	7	26
38	Miscellaneous chemical products	24	24	24	34
39	Artificial resins and plastics	27	23	23	19
40	Rubber	18	17	17	27
41	Raw hides and leather	52	30	70	65
42	Articles of leather	23	13	13	8
43	Articles of fur	9	6	11	9
44	Wood	27	27	57	10
45	Cork	14	8	8	2
46	Manufactures of straw	10	5	5	3
47	Paper-making material	51	68	68	45
48	Paper	47	51	55	27
49	Printed books etc	7	8	8	2
50	Silk	2	2	2	2
51	Man-made fibres	6	6	6	23
52	Metalliside textiles	3	2	2	0
53	Wool	5	8	15	33
54	Flax	2	1	1	2
55	Cotton	13	20	28	20
56	Discontinuous man-made fibres	15	15	16	9
57	Other vegetable textiles	17	9	9	1

58	Carpets, mats, etc	13	10	10	6
59	Wadding and felt	23	23	33	18
60	Knitted and crocheted goods	21	13	13	7
61	Articles of clothing	57	53	53	5
62	Other textile articles	15	18	18	25
63	Old clothes	3	4	4	13
64	Footwear	12	19	18	15
65	Headgear	62	65	59	15
66	Umbrella, etc	40	46	83	5
67	Feathers, etc	0	1	1	2
68	Articles of stone, plaster, cement, etc	35	42	46	51
69	Ceramics	17	11	39	63
70	Glass and glassware	0	0	38	33
71	Pearls, precious metals and stones	30	38	16	15
72	Coins	22	20	0	0
73	Iron and steel	25	25	62	95
74	Copper	11	14	35	12
75	Nickel	7	16	8	31
76	Aluminium	20	27	27	16
77	Magnesium and beryllium	32	34	34	12
78	Lead	94	96	99	48
79	Zinc	65	44	46	3
80	Tin	10	48	55	19
81	Other base metals	48	47	55	66
82	Tools and cutlery	23	21	21	27
83	Miscellaneous articles of base metals	27	31	32	25
84	Boilers and machinery	12	11	1	22
85	Electrical machinery	9	10	10	18
86	Railway locomotives, etc	13	10	71	4
87	Vehicles	9	6	6	9
88	Aircraft	24	13	13	32
89	Ships	20	23	61	11
90	Precision instruments	14	10	10	18
91	Clocks and watches	2	2	2	1
92	Musical instruments	4	4	5	5
93	Arms and ammunition	-	-	-	-

94	Furniture	84	31	80	7
95	Carving and moulded articles	70	31	31	17
96	Brooms and brushes	7	9	9	10
97	Toys, etc	4	7	52	10
98	Manufactures miscellaneous	10	10	10	13
99	Works of art	99	99	35	30
	Average	28	27	35	31

Source: Foreign Trade Statistics, (1982, 1970)

Finally, in Table 3.6 an international comparison is made showing that South Africa's intra-industry trade is low when compared to the rest of the world. This and the low levels of measured intra-industry trade confirm the expectation of measured intra-industry trade levels.

TABLE 3.6

INTERNATIONAL COMPARISON

United Kingdom	69
France	65
Belgium/Luxembourg	63
Netherlands	56
United States	49
Canada	48
Germany	46
Italy	42
South Africa (1981-B_j)	35
Japan	21
Australia	17

Source: Grubel and Lloyd (1975)

3.5 Summary and Conclusion

This chapter endeavoured to deal with the problem of the existence of intra-industry trade. It was concluded that, while cognizance must be taken of Finger's objection, one cannot dismiss all intra-industry trade as a statistical novelty. Following this, measures of intra-industry trade were considered and two were chosen for the calculation of South African intra-industry trade. Then the accuracy of the trade was investigated data before a hypothesis about the level of intra-industry trade in South Africa was formulated. The measured level of intra-industry trade in South Africa as compared with other countries was found to be low, indicating that there is substantial scope for the growth of intra-industry trade. This does not mean that there is not a significant relationship between the measured levels of intra-industry trade and its major determinants. This aspect of intra-industry trade will be the subject of the next chapter. A possible area of further research would be to study in detail those classifications with high levels of intra-industry trade.

chapter 4.

AN EMPIRICAL TEST OF THE DETERMINANTS OF INTRA-INDUSTRY TRADE

4.1 Introduction

The previous chapter gives the levels of South African intra-industry trade. This chapter seeks to explain the variability of the measures of intra-industry trade across industries, with the major determinants of such trade. In Chapter 2 it was established that intra-industry trade would be related to the degree of product differentiation, the extent of economies of scale and relative factor endowments. This chapter seeks to confirm the precise nature of that relationship. This is done by giving a brief summary of possible hypotheses concerning intra-industry trade and how these might be tested in the South African economy. Section 4.3.1 and 4.3.2 gives other empirical work in the area of intra-industry trade. A structural equation is set up to capture those hypotheses.

After discussing the structural equation, four statistical techniques were applied to test the validity of the linkages referred to above. The results of the separate tests are presented in this chapter and discussed in a conclusion.

4.2 Sources of Intra-industry Trade

This section attempts to summarize the major sources of intra-industry trade and give the respective variables that theory suggests should be included in the analysis.

Table 4.1 presents the major sources of intra-industry trade. It is interesting to note that product differentiation (items 2 and 5) was singled out as being an important determinant of intra-industry trade in an earlier chapter. Further economies of scale were seen as critical for the existence of intra-industry trade, and this chapter seeks to test the relationship between intra-industry trade and economies of scale.

TABLE 4.1

A SUMMARY OF THE POSSIBLE SOURCES OF INTRA-INDUSTRY TRADE

1. Taste similarity : Greater IIT will be associated with countries that have taste overlap.

2. Attribute differentiation : Greater IIT will be associated with greater attribute differentiation of products.

3. Scale economies : Greater IIT will be associated with greater scope for scale economies.

4. Market Structure : IIT will be greater in those industries that are monopolistically competitive.

5. Technological factors : IIT will be greater when there exists the possibility of technological or vertical product differentiation.

6. Distance : IIT will tend to be greater when trading partners are geographically close.

7. Tariff and other barriers : IIT will be greater, the lower such barriers.

Source : Greenaway and Milner (1986)

As regards the taste similarity and distance factors, in Table 4.1 it is not possible to include such items in the empirical test envisaged in this chapter. Trade data broken down by country on an export and import basis cannot be obtained for all the commodities for the classification systems used. Further, some data is available on the market structure of industries, but not nearly of the detail required for the number of industries used in this study. Finally, published date does not exist on the height of effective tariff barriers in South Africa. Therefore, only product differentiation and economies of scale (items 2, 3 and 5) were able to be subjected to an empirical test in the South African context. One shortcoming of the previous studies has been the exclusion of a capital and labour requirements variable. This study seeks to rectify that deficiency, especially as the literature (Helpman and Krugman, 1985) do show the linkage between intra-industry trade and factor endowments.

4.3 The Structural Equation

The purpose of this chapter is to use various techniques to test the fcllowing structural equation for South African manufacturing data. A number of techniques are used to obtain a complete picture of the variation in the data. The features peculiar to each technique are given at the begining of the respective analyses.

$$B_i = a + b_1 PROD + b_2 EOS + b_3 K/L$$

and

$$B_i = a + b_1 PROD1 + b_2 EOS + b_3 K/L$$

where

B_i = an index of intra-industry trade in manufactures, proposed in Grubel and Lloyd (1975) and discussed in chapter 3.

PROD = a proxy for product differentiation

PROD1 = a second proxy for product differentiation

EOS = a proxy for economies of scale

K/L = capital/labour ratio.

The expected signs of the estimated co-efficients are:

$$\hat{b}_1 > 0$$

$$\hat{b}_2 > \text{ or } < 0$$

$$\hat{b}_3 < 0$$

4.3.1 Product Differentiation

In Chapter 2 one of the main features of the models that explain intra-industry trade was shown to be the existence of product differentiation. The problem is to define product differentiation so that the concept can be used in empirical analysis. Greenaway and Milner (1986) distinguish between three forms of product differentiation, namely:

1. Horizontal differentiation : Products in a commodity group have certain characteristics in common. These characteristics determine the specification of the product. However, two products having the same core characteristics may be distinguished from another; for example, colours of paint. The basic constituents of the paint, aside from the colouring, is exactly the same.

2. Vertical differentiation : Unlike horizontal differentiation, this occurs where there are differences in the core characteristics in a group of products. Returning to the paint example, oil-based versus water-based paints would be an example of vertical differentiation.

3. Technological differentiation. This again refers to differences in the core characteristics of a group of products. These differences may arise from technical differences or products produced by technically

different processes. A non-drip paint would be an example of technical product differentiation.

It must be noted that intra-industry trade in the Krugman-Lancaster-Helpman models would arise from horizontal product differentiation.

Product differentiation may be proxied in three ways. These are the Hufbauer index, a measure of advertising intensity, census classification methods and hedonic price indices (Greenaway and Milner 1986). Two of these methods cannot be used in the empirical test envisaged in this chapter. There is insufficient published data on advertising expenditures in manufacturing to calculate any measure of advertising intensity. Further, the hedonic price indices cannot be used in regression analysis. Therefore, one is forced to use either the Hufbauer index or a proxy calculated from the trade classification. This implies that one also has to accept the limitations of each proxy. Of the two remaining methods, the Hufbauer index may be better, as the United States is South Africa's major trading partner and this index has been used in other studies seeking to to explain intra-industry trade. The Hufbauer index (1970) is the co-efficient of variation in unit export values. The index is a proxy for product differentiation, as it is assumed that the index measures the variation in export prices. Greenaway and Milner (1976) note that it can proxy vertical differentiation, which refers to the absolute difference in the quality of core characteristics in a commodity. Thus the index may be inappropriate in the Helpman and Krugman sense of product differentiation, which relies, more specifically, on horizontal differentiation defined above.

It is not possible to obtain published South African data in order to calculate the Hufbauer index. It is for this reason that the present study had to resort to using Hufbauer's actual values. This assumes that the conditions that prevailed in the

United States 1965 trade data are the same as those that existed in the 1979 South African trade data. An indication of the realism of this assumption will be how well the variable performs in the actual empirical test, or regression analysis. However, to overcome the inability of the Hufbauer index to capture horizontal product diferentiation, use will be made of a proxy calculated from the trade classification system. Greenaway and Milner (1986) note that others question whether the Hufbauer index properly proxies export prices. This is because the index can change if the composition of trade, between nations change. The underlying assumption of the Hufbauer index is each variety of a differentiated goods is exported to a different market. This need not be true at all of trade flows. Further change in export unit values may come about as a result of effects that have very little to do with product differentiation.

In order to place an econometric study of intra-industry trade in perspective, it is useful to see what other empirical work has been done in the area. Some studies are presented in Table 4.2 and are obtained from Greenaway (1986). The first common variable of this chapter with those in the table is the proxy for product differentiation, the Hufbauer index, or PD2 in Table 4.2. In this study PD2 is named PROD. In the statistical tests that follow it will be seen that, unlike the other studies that have used PD2 (four studies obtaining the correct (positive) sign for the estimated co-efficient), this study obtains a negative sign for the estimated co-efficient. However, the regression analysis showed that the estimated co-efficient of PROD was not statistically significant, but a weighted regression and logit analysis did reveal that the co-efficient was statistically significant but still exhibiting the incorrect sign. Furthermore, as PD2 may be inappropriate in the Krugman-Lancaster-Helpman sense PD1 was also used to proxy product differentiation. This may better capture horizontal differentiation. The significant negative co-efficient otained in this chapter is very similar to that obtained by study 9.

TABLE 4.2
ECONOMETRIC STUDIES OF INTRA-INDUSTRY TRADE

Study	1 ,	2 ,	3 ,	4 ,	5 ,	6 ,	7 ,	8 ,	9 ,	10 ,	11 ,
Country	USA	USA	OECD	OECD	SWEDEN	USA	OECD	UK	INDUSTRIAL	DEVELOPED	DEVELOPING
Year(s)	1965 1967	1963,1967 1972,1975	1971 1972	1970	1970 1977	1970 1971	1976	1977	1972 1973 1974	1979	1979
Size of Sample	102	75	59	94	77	112	3	68	102	167	167
R^2	0,40	0,12	0,07	0,27	0,25	0,32	-	0,50	0,60	0,94	0,67
Independent Variables											
Taste Overlap											
(+) To1	+		+			+		+	+	+	+
(+) To2							+				
Product Differentiation											
(+) PD1	+		+	+				+	-		
(+) PD2	+	+		+		+					
(-/+) PD3				-		-					
(-/+) PD4				-				+	+		
Scale Economies											
(-/+) SE1			-	-				-			
(+) SE2					+	+					
(+) SE3		-					+				
Market Structure											
(-) MS1								-			
(-) MS2						-					
(-) MS3						-					
Technological Factors											
(+) TF1				+	+			+			
(+) TF2					+						
(+) TF3		-				+					
Distance											
(-) D1							-			-	-
(+) D2	+		-	-		-			-		
(+) D3							-			+	+
Trade Barriers											
(-) TB1	-			+		+	-				
(-) TB2	-										

Source : Greenaway and Milner (1986)
NOTE : Expected signs of co-efficients in brackets.

The values of the Hufbauer index are classified according to the SITC (Standard Industrial Trade Classification) three-digit groups. This means that any other variable, no matter its classification, would have to be re-classfied according to the SITC. The first difficulty was to obtain South African trade data compatible with the variables to be used in attempting to explain intra-industry trade. The Department of Customs and Excise compiles South Africa's foreign trade statistics annually and classifies exports and imports according to the CCCN (Customs Co-operation Council Nomenclature). The first task was to re-classify the the CCCN trade data to agree with the SITC. This was done using the SITC, Revision 2 (United Nations, 1975) which gives for every SITC group, the corresponding CCCN classification. This is no easy task as there are 165 footnotes to take into consideration, each requiring a large number of adjustments.

The expected sign of $\hat{b}_1$, is positive because, the greater the degree of product differentiation, the greater the possibility of intra-industry trade.

4.3.2 Economies of Scale

The second variable to be included in an empirical test of intra-industry trade is a proxy for economies of scale. Caves (1981) uses 1963 United States data and Hufbauer's estimate of α in

$$V = kn^{\alpha}$$

where V = ratio between value added per man for a given plant size and the average value added per man for all establishments

k = a constant

n =average number of men employed in the given plant size.

as a proxy to capture the effects of scale economies. This study assumes that conditions that prevailed in the 1963 United States data applied in South Africa in 1979. A value of 0,08, for instance, would indicate that a doubling of plant size increases output per man by eight per cent, indicating the effect of changing the size of the plant. The values of United States data were classified according to the SITC. However, the SITC data had been matched to the CCCN classification for the product differentiation variable. Thus it was not difficult to match the EOS variable to the intra-industry trade variable.

If economies of scale are small, then the industry can support a large number of firms producing different varieties and thus increase the number of products available or the scope for intra-industry trade. It was noted in Chapter 2 that economies of scale are crucial for the existence of intra-industry trade. Therefore, if EOS is low, then nearly all varieties would be produced in separate countries with very little trade taking place and thus intra-industry trade would be low. Low economies of scale would therefore be associated with low intra-industry trade and the expected relationship would be positive. However, a low EOS may mean the industry can support a large number of firms. This would increase the scope for product differentiation, allowing for greater intra-industry trade and the expected relationship would be negative. Therefore, the expected sign of $\hat{b}_2$ could be positive or negative.

The proxy for economies of scale, EOS, in this study is the SE1 in table 4.2. A negative sign was obtained in all three studies that used SE1. From table 4.4 it is seen that the estimated co-efficient is positive, but not significant. The logit estimation did yield a negative sign, but the estimated co-efficient was not significant. In addition, the weighted regression analysis produced negative co-efficients one of which was significant. This appears to be similar to the result obtained for study 4 in table 4.2. As discussed above, data problems prevent the inclusion of any other of the above variables in empirical analysis, although the inclusion of a variable that captures factor endowments attempts to improve on the above studies.

4.3.3 The Capital Labour Ratio

In the Helpman and Krugman (1975) model intra-industry trade has a factor-endowment basis. A labour-abundant country producing capital-intensive manufactures would have a higher relative price of manufactures and thus would be an importer of manufactures. Thus the relationship between capital intensity (given by the capital to labour ratio) and intra-industry trade would be negative, as the higher the capital to labour ratio the greater the imports of manufactures without corresponding exports and therefore the the lower level of intra-industry trade. The measure B_i would be negatively related to the capital to labour ratio.

The critical problem is that data on the factor requirements of industries can only be obtained from the Census of Manufacturing (Department of Statistics, 1976). However the census uses the SIC (Standard Industrial Classification). It is therefore necessary to reclassify the data to make it compatible with the SITC. It is possible to do this via the CCCN, for which you can identify the SIC classification to which a particular export or import belongs. One further problem is that, even though the SIC values can be matched to the SITC via the CCCN, a SITC group may include a SIC classification common to another SITC group. It was necessary to make the assumption that the SIC classification that appeared most often characterized the SITC group. Finally, where it was not possible to obtain the capital labour ratio for a SITC group but only a collection of groups, or division, the group capital-labour ratios were calculated on a proportional basis using United States 1963 data. This assumes the production functions of each SITC group, which collectively provide the division production function, are homothetic.

All the data generated is presented in Table 4.3. The table presents for each SITC group the data for each of the three variables of the first structural equation. In any statistical analysis the mean of all the other values for a variable was substituted for the missing values. This procedure allowed for the creation of 93 usable observations which compares favourably with the studies in Table 4.2.

TABLE 4.3

DATA OF VARIABLES INCLUDED IN THE ANALYSIS

SITC THREE DIGIT GROUP	INTRA-INDUSTRY B_i	CAPITAL/ LABOUR RATIO K/L	ECONOMIES OF SCALE EOS	PRODUCT DIFFEREN-TIATION PROD
512	13	16	0,09	0,92
513	11	10	-0,07	0,77
514	52	11	-0,06	1,12
515	16	11	0,0	2,44
531	9	5	0,09	0,95
532		4	0,05	0,49
533	77	2	0,05	0,91
541	32	4	0,08	1,47
551		7	0,19	0,75
552		2	0,24	0,30
553	24	1	0,16	0,76
554	32			
561	5	10	0,08	0,48
581	32	8	-0,08	0,91
599	24	12	0,06	0,75

611	77	1	-0,06	0,59
612	7	1	0,06	0,59
613	79	1	0,40	0,59
612	19	4	0,01	0,88
629	44	4	0,01	0,71
631	24	0,3	0,03	0,68
632	42	0,3	0,01	0,95
633	3	0,3	0,01	0,83
641	41	5	0,10	0,83
642	43	2	0,02	0,99
651	21	2	0,07	0,46
652	17	2	-0,05	0,48
653	13	2	-0,03	0,60
654	23	1	0,0	0,61
655	27	2	0,01	0,62
656	30	1	-0,01	0,59
657	53	4	0,05	0,51
661	78	16	-0,05	0,67
662	69	3	0,02	0,77
663	32	3	0,05	0,77
664	29	8	0,04	0,91
665		4	0,11	0,63
666	14	1	0,03	0,60
667	4	1	0,03	0,84
671	9	17	0,08	0,69
672	82	19	0,03	0,55
673	5	20	0,06	0,69
674	3	21	0,12	0,52
675	49	21	0,12	0,61
676	17	20	0,06	0,55
677		20	0,02	0,69
678	28	17	0,04	0,87
679		14	0,0	0,33
681	10	17	-0,3	0,34
682	38	11	-0,07	0,56
683	5	17	-0,1	0,67

684	17	12	-0,03	0,75
685	2	12	-0,02	0,60
686	12	12	-0,02	0,74
687	15	14	-0,07	0,34
688	37	17	-0,30	0,26
689	23	17	-0,30	0,95
691	62	2	0	0,81
692	41	2	0,04	1,33
693	46	3	-0,01	0,90
694	36	3	-0,02	2,09
695	48	2	0,07	1,28
696	9	4	9,17	0,59
697	85	3	0,01	0,59
698	65	3	0,01	1,03
711	13	24	0,08	0,99
712	18	3	0,06	0,57
714	7	2	0,03	0,60
715	20	2	0,03	0,32
717	5	2	0,0	1,20
718	25	2	0,3	1,22
719	19	2	0,04	1,21
722	13	3	0,08	1,75
723	22	2	0,03	0,88
724	15	2	0,03	0,96
725	8	3	0,10	0,96
726	13	3	0,07	0,53
729	18	3	0,06	1,52
731	22	3	0,01	0,85
732	14	4	0,06	0,55
733	86	1	0,11	0,51
734	11	2	0,30	1,02
735	13	2	0,01	1,31
821	60	1	0,03	0,96
831	35			
841	51	0,1	-0,10	0,53
842	60			

851	49	1	0,05	0,61
861	14	3	0,03	1,22
862	12	6	0,06	1,44
863	34	6	0,06	1,03
864	2	3	-0,01	1,19
899	51	2	0,05	0,74

The above structural equations were estimated using the data of Table 4.3. The results of the regression analysis are presented in Table 4.4.

4.3.4 Regression Analysis

This section uses the details shown in Table 4.4 The t-statistics are presented in brackets below the estimated co-efficients. The only significant (at the 90% level of confidence) co-efficient is that of the capital labour ratio which is of the correct sign. The R^2 is disappointing, indicating nearly 96 per cent of the change in intra-industry trade may be due to factors not included in the analysis. The product differentiation and economies of scale variables appear to have a limited effect on the level of intra-industry trade.

TABLE 4.4

DETERMINANTS OF SOUTH AFRICAN INTRA-INDUSTRY TRADE (B_i) IN MANUFACTURES

FIRST REGRESSION INTERCEPT	PRODUCT DIFFERENTIATION	ECONOMIES OF SCALE	CAPITAL TO LABOUR RATIO
	PROD	EOS	K/L
0,3919	-0,0734	0,0297	-5,6691
t - Statistic	(-1,999)	(0,122)	(-1,525)
R^2 = 0,0378			
WEIGHTED REGRESSION			
- 5,1139	-105,3746	-79,5497	-4,51186
t-Statistic	(-8,797)	(-1,088)	(-5,746)
R^2 = 0,64			
WEIGHTED REGRESSION WITH PROD1	PROD1	EOS	K/L
	-5,3844	-228,5984	-5,3886
	(-3,1370)	(-2,1)	(-5,138)
R^2 = 0,37			

A plot of the residuals revealed that heteroscedasticity was likely to be a problem as the variance of the error term appeared not to be constant. Using a technique suggested by Caves (1981) a weighted regression was performed. Two variables, namely the product differentiation proxy and the capital to labour ratio were significant. However the former was of the incorrect sign. The R^2 rose to 0,64 indicating that 64 per cent of the variation in B_i can be explained by changes in the independent variables. This comparse very well with the results of Table 4.2 where only studies 10 and 11 have higher values of R^2. Two of the variables were statistically significant at acceptable levels, namely product differentiation and the capital to labour ratio. The incorrect sign of the proxy for product differentiation would seem to indicate that the assumption that the estimate of the Hufbauer index using United States data is representative of the South African economy is inappropriate. Thus, a weighted regression was conducted using a proxy, PROD1, which hopefully would capture horizontal product differentiation. It is interesting to note that the sign is still negative, but now the co-efficients of all the variables are significant. Ethier (1982) maintains that product differentiation plays a strange role in intra-industry trade. Product differentiation is required to set up Ethier's trade model, but changes in the amount of product differentiation may have no effect on intra-industry trade levels. This may be a reason for the incorrect sign on the product differentiation variable. Bergstrand (1983) maintains that empirical results are likely to be biased if regressions include proxies for product differentiation and economies of scale, especially if these variables are positively related (as is the case) with each other.

In order to confirm the above results of the regression analysis, a number of other statistical techniques were used to analyze the data, namely factor, logit and discriminant analyses.

4.4 Factor Analysis

Factor analysis is one of a number of methods used for analyzing data. The data in this case are the variables of intra-industry trade, capital to labour ratio, proxies for economies of scale and product differentiation for the SITC classifications as indicated in Table 4.3. Factor analysis is useful because, although there may be very little variation in the data, that variation can be analyzed and hopefully understood in an economically meaningful manner. Factor analysis looks for meaningful variation in the data. The interpretation of the analysis depends upon the theoretical framework in which the research is conducted.

It has been hypothesized that intra-industry trade is related to factor endowments, economies of scale and product differentiation. Therefore, factor analysis will show how much of thepatterned variation which exists in the data set of Table 4.3, can be attributed to the variables listed above. The following interpretation will assume that the factors extracted from the data will be meaningful in an economic sense.

4.4.1 The Correlation Matrix

Table 4.3 gives the data for the SITC comprising capital/labour ratios, proxies for economies of scale and product differentiation. The correlation matrix for the variables is presented in Table 4.5.

The three largest correlations (in descending order) are between

1. Economies of scale and the capital/labour ratio,
2. Product differentiation and economies of scale,and
3. The capital/labour ratio and the measure of intra-industry trade.

From Table 4.5 the correlation between the measure of economies of scale and the capital/labour ratio is -0,26 and 6,76 ($(-0,26)^2$ x 100) per cent of the variation of the SITC data is common to both these variables. In other words, if one knows the capital/labour ratio, it is possible to produce nearly seven per cent of the linear variation in the measure of economies of scale.

The diagonal of the correlation matrix gives the correlation of a variable with itself and is unity. When a correlation matrix is used in factor analysis, estimates of the common variance, or the variance which the variables share with each other are substituted for the unities in the matrix diagonal. The estimate used is the squared multiple correlation co-efficient (SMC) of one variable with all the other variables. The value SMC x 100 measures the percentage of linear variation that can be produced in one variable, given the others. In Table 4.5 the SMC values are placed in the diagonal. For intra-industry trade the SMC is 0,69, which means that 69 per cent of the linear variation in intra-industry trade can be produced from a knowledge of the other three variables.

TABLE 4.5

SITC DATA CORRELATION MATRIX

	VARIABLE	1	2	3	4
1	Capital/Labour ratio	(0,64)			
2	Economies of Scale	-0,26	(0,47)		
3	Intra-Industry trade	-0,15	0,05	(0,69)	
4	Product Differentiation	-0,16	(0,06)	(0,10)	(0,66)

Elements in the diagonal are the squared multiple correlation coefficients of the variables with all the others.

4.4.2 Unrotated Factor Matrix

Usually two factor matrices are given, namely the unrotated factor matrix and the rotated factor matrix. The method used here is principal components analysis, where a set of variables such as is given in Table 4.3 is transformed into a new set of variables known as principal components that are uncorrelated with each other. The first component may be viewed as the single best summary of a linear relationship in the data. The second component is defined as the second best linear relationship in the data, but is uncorrelated to the first. That is, the second component is the combination of variables that account for the greatest residual variance after the effect of the first component is removed from the data. Table 4.6 displays the unrotated factor matrix. These are the actual factors for a principal components analysis of the data shown in Table 4.3.

TABLE 4.6

SITC DATA - UNROTATED FACTOR MATRIX

	VARIABLES	FACTORS	
		ONE	TWO
1	Capital/labour ratio	-0,80	-0,02
2	Economies of Scale	0,68	0,02
3	Intra-Industry Trade	0,32	0,77
4	Product Differentiation	0,39	-0,71

The columns of the matrix give the factors in the data and the rows contain the respective loadings or regression co-efficients of factors used to explain any variable. Thus the row/column intersection gives the loading for a particular variable for each of the extracted factors. The number of common factors are the patterns of relationships between the four variables, and there are two such statistically independent patterns within the data. Thus there are two influences or theoretical constructs with an empirical counterpart influencing or describing the trade data. The loadings measure the degree to which the variables and the factors are related and are the correlation co-efficients between the variables and the factors. If the loading is squared and multiplied by 100, one obtains the percentage variation in the variable that can be obtained with the unrotated factor. Thus this percentage is the variation in a variable that can be obtained from a knowledge of a SITC trade classification on the factor or the variables included in the factor. Thus it is possible to see, not only what important variables are included in a factor, but also which are the most important. With reference to the unrotated factor loadings, it is usual to consider those variables with a 16 per cent (a loading of $0,40^2 \times 100$) or more of the variation attributed to the factor.

The common factor equations are :

Capital/labour ratio	$= 0,81\ F_1$	
Economies of scale	$= 0,68\ F_1$	
Intra-industry trade	=	$0,77F_2$
Product Differentiation	=	$-0,71F_2$

One interesting feature that can be obtained from Table 4.6 is the reproduced correlation between any two variables which is obtained from the loadings on the extracted factors. The reproduced correlation between economies of scale and the capital/labour ratio is

$$(-0,80 \times 0,68) + (-0,02 \times 0,02)$$
$$= - 0,5440 - 0,00004$$
$$= - 0,5440$$

However, from table 4.5 the actual correlation is -0,26, while the residual correlation is -0,28.

The difference between the squared reproduced and squared actual correlation is used to obtain the residual variance not accounted for by the two factors for the economies of scale and capital/labour ratio, this is

$$(-0,54)^2 - (-0,26)^2 = 0,22.$$

Thus 22 per cent of the variance in common between the two variables is due to residual factors. The same has been done for the remainder of the variables as shown in table 4.7. The third figure of the row and column gives the residual variance. Looking at intra-industry trade and the other three variables the residual variance for the capital/labour ratio, economies of scale and product differentiation is 5, 5 and 17 per cent respectively.

TABLE 4.7

RESIDUAL VARIANCES

		1		2	3	
1 Capital/labour						
2 Economies of Scale	-0,54	0,22				
	-0,26					
3 Intra-Industry trade	-0,27		0,23			
		0,05		0,05		
	-0,15		0,05			
4 ProductDifferentiation	-0,29		0,25		-0,42	
		0,06		0,06		0,17
	-0,16		0,06		-0,10	

The communality of any variable is the proportion of a variable's total variance that is accounted for by the factors. In Table 4.5 intra-industry trade has a communality of 0,69 which shows that roughly 69 per cent of the total variance in intra-industry trade can be obtained from a knowledge of the SITC data values on the two factors. The capital/labour ratio has a communality of 0,64 indicating that 64 per cent of the variation in the ratio can be predicted if the SITC data values are known for the two factors.

The sum of the communalities multiplied by 100 gives the percent of total variation in the data that is patterned, accounted for by the two factors. Thus for the SITC data the two factors contribute 39 percent of the data's variance. It would be possible to obtain 39 percent of the total variance of the SITC data set from these two factors. This is a measure of order in the data and it appears that approximately 40 per cent of the data exhibits some regularity. The strength of a factor is given by the percent of total variance amongst the variables related to a factor. The two factors together account for nearly 61 per cent of the total variance in the SITC data. An orthogonal rotation does not change the loadings on the factors for the variables in any significant manner.

4.4.3 Factor Analysis - Summary and Conclusion

In order to confirm the results of the regression analysis above an alternative method of analyzing the data was sought. Factor analysis, it was thought, might be applicable as the extraction of economically meaningful factors may reveal some pattern in the data and provide confirmation of the hypothesis that intra-industry trade is linked to factor endowments, economies of scale and product differentiation. The computations extracted two factors that explained 39 percent of the patterned variance and grouped the variables capital/labour ratio and economies of scale in one factor and product differentiation in another. This grouping would seem to indicate a familiar division, namely supply, as regards factors (of production) and changes in the scale of operation and demand relating to product differentiation.

4.5 Logit Analysis

Caves (1981) does suggest a procedure for overcoming the problem that regression techniques will give estimated values of B_i that lie outside the range 0 to 1. To overcome this problem B_i is divided by 100 (and the new variable is called B1). B1 is expressed in the form ln(B1/1-B1). The dependent variables are then weighted to correct for heteroscedasticity. A plot of the residuals revealed that this might be a problem so each observation is weighted by $x^{1/2}$, x = VALADD x (B1/1 - B1) and VALADD = total value added in manufacturing in 1976.

The structural equation was then estimated with the new variables using logit regression techniques. It was necessary to recode the variables to carry out the logit analysis. This was done using the means of the new variables. All values above the means were given a value of 2. The remainder were given a value of unity.

Table 4.8 presents the data for high intra-industry trade values coded according to high and low values for each variable. It can be seen that the large number of observations for high intra-industry trade, low capital/labour ratio, high economies of scale and low product differentiation confirms the result of the regression analysis which showed the poor performance of the product differentiation variable in explaining intra-industry trade. The same can be said of the poor performance of the economies of scale variable.

TABLE 4.8

LOGIT ANALYSIS OF THE SITC DATA

	Number of Observations	Adjusted Residuals
High Intra-industry Trade		
Low capital/labour ratio		
Low economies of scale		
Low product differentiation	7	0,5126
High " "	1	-2,0117
High economies of scale		
Low product differentiation	24	0,0872
High " "	3	-0,6021
High capital/labour ratio		
Low economies of scale		
Low product differentiation	3	0,9391
High " "	1	0,5639
High economies of scale		
Low product differentiation	4	1,4032
High product differentiation	0	-1,0101

In Table 4.8 are shown the adjusted residuals. The higher the adjusted residual, the less important is the effect shown. It would appear, given the adjusted residuals greater than, or close to, unity, that the residuals are significant This is borne out by the analysis of dispersion presented in Table 4.9 where the major portion of the variation is in the residuals. The measures of association are also given in Table 4.9 and are very similar to the R^2 statistic in regression analysis, although Haberman (1982, p 575) maintains that care must be taken not to give them the same interpretation as one would give an R^2.

Therefore, given this and other statistical methods used to analyze the data, the values of 0,30 and 0,38 must be seen as fairly low.

TABLE 4.9
ANALYSIS OF DISPERSION

SOURCE OF VARIATION	DISPERSION	
	ENTROPY	CONCENTRATION
Due to Model	18	16
Due to Residual	40	26
Total	58	42

Table 4.10 presents the logit estimates of the structural equation co-efficients. The results tend to confirm those of the unweighted regressions of Table 4.4 as the economies of scale variable is still insignificant. The capital/labour ratio exhibits the correct sign but is not significant. However, what is interesting is that the co-efficient of the product differentiation variable is the only one that does not span zero at the 90 percent level of confidence. This shows that product differentiation is highly negatively related to intra-industry trade in the South African context, which to some extent bears out the regression analysis and the results of the factor analysis.

TABLE 4.10

DETERMINANTS OF SOUTH AFRICAN

INTRA-INDUSTRY TRADE (B_i) IN

MANUFACTURES - LOGIT ANALYSIS

INTERCEPT	PROD	EOS	K/L
0,4566	-1,3974	-0,0740	-0,5018
Z-Value	(-4,65175)	(-0,2175)	(-1,52632)

4.6 Discriminant Analysis

In order to try and confirm the results above, use was made of discriminant analysis. The objective of discriminant analysis (Dillion and Goldstein, 1984) is to obtain a linear grouping of the independent variables that minimizes the probability of misclassifying SITC industries according to the trade characteristics as represented by the three independent variables. The discriminant function is

$$B_i = 0{,}8132\ K/L + 0{,}3335\ EOS - 0{,}2108\ PROD$$

The intra-industry trade variable was broken down in high and low values using the mean as a cut-off value. The above function was evaluated for the high intra-industry trade values, IIT_1 and the low intra-industry trade values IIT_2. The discriminant scores were 0,1314 for IIT_1 and - 0,25003 for IIT_2. The highest absolute score is associated with the higher intra-industry trade values. However the relationship is a negative one. Thus the larger any one of the independent variables, the smaller the amount of intra-industry trade in the group of SITC industries, with intra-industry trade greater than the sample mean. This confirms the results of the other statistical procedures and a chi-squared test revealed that the discriminant analysis was not significant beyond the 0,4140 level.

4.7 Overall Conclusions

The theoretical analysis of chapter 2 indicated that intra-industry trade was likely to be related to product differentiation, economies of scale and relative factor endowments. These relationships were subjected to an empirical test for South Africa in the form of regression analysis. Very little variation was found in the data by this method, although the factor endowments variable was of some significance and worked in the direction expected. This confirmed the HOS model's applicability in South Africa and that, given South Africa's endowment of capital and labour, very little trade is of the intra-industry type. Weighted regression techniques did improve the percentage variation explained to levels comparable with other studies. With an additional proxy for product differentiation, all the variables were statistically significant and only the product differentiation proxy was of the incorrect sign. Three other statistical techniques were used to analyze the data, namely factor, logit and discriminant analyses. The factor analysis extracted two factors which might be meaningful in an economic sense, although, the relationship between the variables was not as expected. This confirms the results of the other statistical techniques. Discriminant analysis revealed that high intra-industry trade was negatively related to the variables, although the analysis was not statistically significant. Finally, logit analysis revealed that some variation in intra-industry trade is due to the included variables. Therefore, it would appear that due to the inappropriateness of product differentiation proxies, regression analysis of intra-industry trade has reached its limits. The future of research is likely to see better proxies for product differentiation being sought and detailed analyses of industries which exhibit high levels of intra-industry trade being undertaken.

chapter 5.
WELFARE AND COMMERCIAL POLICY ASPECTS OF INTRA-INDUSTRY TRADE

5.1 Introduction

It may not be intuitively obvious that commercial policy, intra-industry trade, and welfare gains are linked. However, economic integration, for example, usually implies the reduction of tariff barriers and this, in turn, can be shown to promote intra-industry trade. One factor preventing the existence of economic integration is the existence of political differences. Therefore, the existence of gains from the possibility of integration may serve as a theoretical justification for considering overlooking political differences, as the potential gains offset the cost of association with countries, which might, if such gains did not exist, be considered repugnant. This chapter examines the theory underlying the links between intra-industry trade, commercial policy and economic welfare. Even though theoretical developments considering intra-industry trade are new, the literature on the welfare aspects of such trade is fairly extensive.

5.2 Commercial Policy and the Welfare Effects of Intra-industry Trade

Falvey's model of intra-industry trade has been dealt with in an earlier chapter and is reproduced here to facilitate the analysis. An industry is assumed to possess a given stock of capital (K) and can obtain labour (W). With these factors the industry can produce a range of products designated "α". The difference between each depends on the capital to labour ratio in production. Commodities are measured in units such that to produce "α" producers need "α" units of capital and one unit of labour. Higher quality products are more expensive as they require techniques of greater capital intensity. Demand is a function of relative prices.

Moving to a two-country world where the foreign country's industry has capital K* and labour W*, it is possible to see the effects of commercial policy on intra-industry trade. Capital is assumed to be industry-specific and immobile internationally but not nationally. R and R*, the return to capital in each country, adjust so as to maintain full-employment. Perfect competition is assumed, in the foreign country has the lower wage rate. The costs of producing a quality "α" are

$$\Pi(\alpha) = W + \alpha R$$

$$\Pi^{*}(\alpha) = W^{*} + \alpha R^{*}$$

With $R^{*} > R$ there will be a continuum of qualities produced by the home country at lower costs than abroad. There will exist some marginal quality where

$$\alpha 1 = \frac{W - W^{*}}{R^{*} - R}$$

and the home country will export those qualities where $\alpha > \alpha_1$ and import those where $\alpha < \alpha_1$. The existence of industry-specific capital coupled with product variety results in intra-industry trade.

The imposition of an ad valorem tariff on imports competing with the home industry increases the price of imported goods and leads to an increase in demand for lower cost home-produced goods. This raises the demand for domestic capital and reduces the demand for foreign capital. The foreign return on capital (R*) falls. However, the effect on the return on domestic capital (R) is ambiguous (Falvey 1981, p.504). The home industry could lose some of its export markets as foreign capital costs fall. Therefore, a reduction in tariff barriers, to the extent that more varieties are traded, leads to an increase in intra-industry trade. Thus, without increasing returns to scale or imperfect markets, intra-industry trade is shown to vary inversely with trade barriers. Empirical support for this hypothesis has been provided by Pagoulatos and Sorensen (1975, p.462), where it was found that tariff and non-tariff barriers adversely affect trade. Thus the formation of a trading area that may comprise any number of countries may result in increased intra-industry trade. Indeed Balassa (1979), in an analysis of the Latin American Free Trade Association (LAFTA) and the Central American Common Market (CACM), has shown that tariff reductions have led to greater levels of intra-industry trade. Whether this is welfare improving is the subject of the next section.

5.3 Welfare Effects of Intra-Industry Trade

5.3.1 Introduction

With increasing returns, international trade may result in gains arising from a greater variety of products. It is important to determine, as regards commercial policy and economic integration, whether intra-industry trade has any positive welfare effects. To this end this chapter intends to present an overview of the welfare effects of intra-industry trade. In addition to some general literature, several models of intra-industry trade are examined for welfare effects. In fact, there may be an additional gain from trade allowing for both factors in a two factor model to gain from trade. In the HOS trade model it was seen that the factors of production which are relatively scarce in one country are likely to lose from entering into trading relationships. The real return to the scarce factors will fall if trade takes place. Thus, even though there are overall gains to be had from trade, the owners of the scarce factor will lose. If theoretical developments that include increasing returns to scale can show that all factors gain from trade, then there will exist an additional welfare gain from trade not given by conventional HOS trade theory. There is, of course, no general model that shows that countries gain from trade in the presence of product differentiation and economies of scale, as it is usually assumed there are a finite number of products, each of which comprise many varieties.

The welfare effects of intra-industry trade will be dealt with, initially, at a superficial level. A consideration of the 'extra' welfare gain does require greater analysis. However, it is proposed to deal with this gain last. Gray (1979) showed foresight when he wrote;

> The gains from international trade in differentiated goods are to be found in the wider choice offered to consumers in different nations, in the possibility of an exchange of scale economies among nations, and perhaps the most important, is the exposure to foreign competition of domestic industries.

It is interesting to note that the theoretical developments have been concerned with the welfare effects of greater product diversity and the exploitation of economies of scale, rather than with gains from exposure to foreign competition.

Willmore (1979) maintains that intra-industry trade, in commodities that are close substitutes in production, is likely to lead to a welfare gain. If commodities are close substitutes in production, then the adjustment costs of changing production from one commodity to another may be low. As a result of trade, fewer goods may be produced in each country, but as long as the world production of varieties does not change (and it will not if the production is undertaken by the same multinational corporation), the consumer will not be worse off, but with increased variety will, in fact, be in a better position. With some form of competition, there may be a better allocation of resources which may lead to lower prices. A dissenting view is provided by Franko (1979), who maintains that if intra-industry trade is as a result of oligopolistic firms 'carving' up markets at a sub-optimal level, then there is a welfare loss.

Balassa (1979) discusses the welfare implications of intra-industry trade. The gains from intra-industry trade are two-fold. The first gain is that consumers are likely to gain because of the wider choice available with intra-industry trade of differentiated consumer goods. Further, if markets are characteristically oligopolistic or monopolistic, then the exposure of those markets, via trading links, to markets in other countries may promote competition. Balassa maintains that intra-industry trade may come from two sources, horizontal and vertical specialization. In the former, industries may have firms producing a relatively large number of varieties. The reason for this may be the existence of high tariff barriers preventing the importation of certain varieties. A reduction in those tariffs may result in certain of those varieties becoming unprofitable and firms may cease production of them. However, for the remaining varieties, there will be increased demand due to foreigners wanting the locally produced varieties. The longer production runs that are thus possible may imply economies of scale and greater efficiency. Vertical specialization, which refers to the production of 'parts, components and accessories', may be assembled in any country. Again, the reduction of tariffs may lead to specialization and gains through the exploitation of economies of scale. A further benefit for countries at roughly the same stage of development is that the above specializations, especially if due to intra-industry exchanges, may have smaller adjustment costs than would have been the case with greater inter-industry trade.

Krugman and Helpman (1985) see the gains from trade in a world of imperfect competition and economies of scale being one or more of the following :

1. Production Effect. If trade causes industries characterized by increasing returns to expand output, then cost reductions are likely. Further, the opening up of trade links may promote

competition amongst the countries imperfectly competitive firms.

2. Production Concentration. Trade will result in the concentration of each increasing-returns industry in one country, if there is factor-price equalization and country- and industry-specific external economies of scale. The larger scale of production that results from concentration may lead to cost reductions.

3. Rationalization. Trade is likely to reduce the number of firms and increase output per firm and this may result in gains from trade.

4. Diversity. After trade, the number of varieties of a commodity may be greater. If consumers value variety, or a greater number of intermediate inputs can be produced, there are welfare gains.

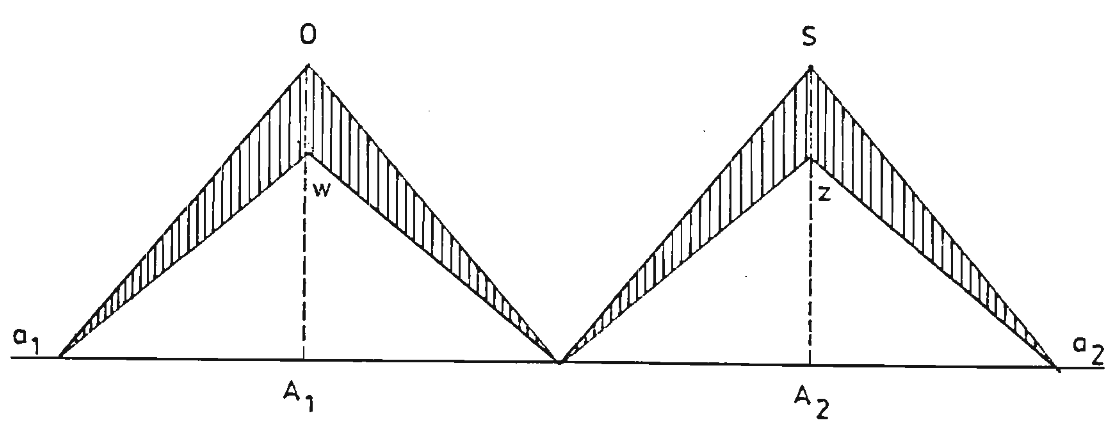
Krugman and Helpman feel that, except for the production effect, gains from the other effects are likely. In fact, with trade, production in monopolistic industries under increasing returns may decrease. However, the other three effects may predominate, leading to gains from trade.

Now the welfare implications of intra-industry and inter-industry trade will be considered. Aquino (1978) maintains that the gains are likely to be larger for inter-industry trade than intra-industry trade. This underlying logic is that the greater the difference in factor endowments, the greater will be the difference in pre-trade relative prices. Once trading takes place, gains arise from obtaining goods relatively cheaply that were dear before. Greenaway (1983) has argued that intra-industry trade provides gains through greater product differentiation. Gains are also to be had from the exploitation of scale economies and a reduction in X-inefficiency. The latter arises from increased competition among trading firms. Greenaway assumes that it is impossible to make unambiguous statements about where the greater gains lies in intra-industry or inter-industry trade. However, it is possible to show that both countries (in a two-country model) gain from intra-industry trade. In addition, in the final section of this chapter, it will be shown that intra-industry trade also provides an extra gain in that both factors gain from trade.

Greenaway (1983) adapts Lancaster's (1966) analysis to show that gains can be had from scale economies and product diversity. Referring to Figure 5.1, characteristic proportions are plotted along the horizontal plane, namely a_1 and a_2. With diverse but uniformly distributed (in a_1 and a_2 space) preference, there will be a demand for each combination of a_1 and a_2. With decreasing costs, a limited number of varieties of product A, will be produced. Given two varieties, A_1 and A_2, it is obvious that consumers who prefer the characteristic mix of A_1 and A_2 will buy more of A_1 and A_2 than any other mix of a_1 and a_2. Thus A_1 and A_2 will have associated with them higher levels of consumer and producer surplus.

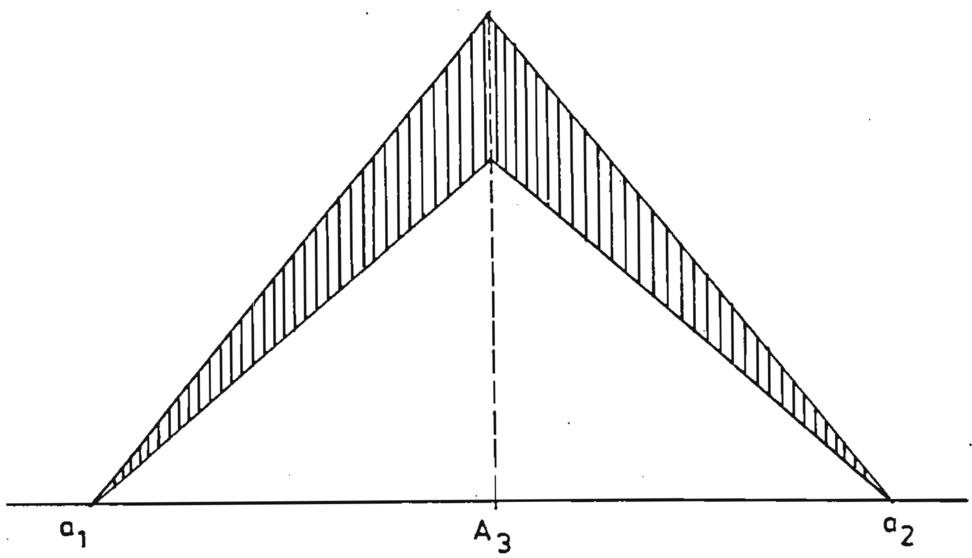
FIGURE 5.1

GOODS AND CHARACTERISTICS



Assuming equal preference intensities for A_1 and A_2 surpluses, both producer and consumer, will be at a maximum above A_1 and A_2 (Fig. 5.1). Maximum producer surplus is given by w and z and for consumers is o and s. In Figure 5.2 a second industry is shown which produces variety A of this product.

FIGURE 5.2
A THIRD VARIETY

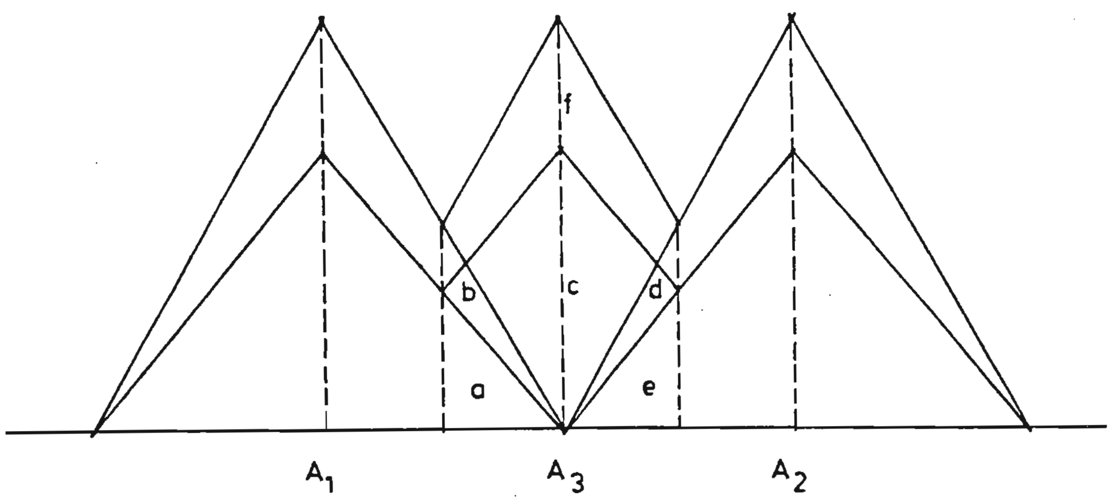


Allowing for trade will enable the first country to consume A_3. This is shown in Figure 5.3. Consumers gain area f and producers the sum (a+b+c+d+e). However, only c is a net gain. In the second country varieties A_1 and A_2 are introduced, resulting in similar gains. The overall result is that both countries gain from intra-industry trade. This does not require the assumption that new varieties sell for the same prices as existing ones. Exactly the same reasoning can be applied to reductions in unit costs as a result of longer production runs. Greenaway therefore shows that, from a welfare point of view, neither intra-industry trade nor inter-industry trade provide the larger gain. What is certain is that with intra-industry trade both countries gain from trade. Furthermore, it follows that costs associated with tariffs imposed on predominantly intra-industry trade are not necessarily less than if tariffs were to be applied to inter-industry trade.

The welfare gains for intra-industry trade are likely to equal those that arise from inter-industry specialization (Greenaway 1983). Therefore there is no basis for applying a tariff on the premise that, being an intra-industry trade industry, welfare would not be reduced as much as with a tariff on an inter-industry trade industry. Rather a reduction in trade barriers allows for greater intra-industry trade and a welfare gain.

FIGURE 5.3

TRADE EFFECTS



5.3.2 Increasing Returns and Differentiated Products

In a previous chapter it was seen how international trade theory has become modified to include production with internal economies of scale with firms producing differentiated products and consumers demanding a wide variety of those products. The market structure of many these models was monopolistically competitive and a fixed number of varieties were produced in equilibrium. In a two-country model, as each variety is only produced in one country, the assumptions with respect to conditions of demand for a number of varieties ensure intra-industry trade. In a consideration of the conditions in which there might be positive welfare effects, it is necessary to consider the nature of consumer demand. However, prior to this, and assuming the absence of product differentiation, it is necessary to discuss the autarky and free trade conditions for positive welfare effects. There would exist a welfare improvement if, after trade, prices are less and consumers could purchase pre-trade quantities. Further, if the autarky use of the factors is inefficient, then free trade output may be higher if these inefficiencies are removed. Thus the value of autarky production must be lower than free trade production valued at free trade prices. Now, to consider the welfare effects of product differentiation, it is necessary to introduce the possibility of variety. If free trade implies that the number of varieties is reduced and thus consumer choice is reduced, then, even if the consumer can, in free trade, purchase autarkic levels, there may be a clear welfare loss. Thus it is necessary to expand on the manner in which consumer demand is dealt with in the models of intra-industry trade.

The first is that of Dixit and Stiglitz (1977) where consumers like to obtain a great number of varieties. Another method is that of Lancaster (1979) which has consumers with an ideal variety making choices between varieties that are close to their ideal variety. These alternative assumptions about demand have different implications for production. The first implies that a firm may not produce an already available variety. For Lancaster, however, the firm engages in both variety and price competition. With internal economies of scale, each producer maximizes profits where marginal revenue equals marginal cost, given prices and varieties. With no factor intensity reversals and a greater number of goods than factors, each country in a symmetrical model produces different varieties of a product. However, each consumer consumes a portion of every variety produced and this means that there is intra-industry trade in differentiated products, with internal economies of scale, - resulting in the specialization of varieties. In order for there to be gains from trade with differentiated products in the Dixit-Stiglitz world, trade must result in an increase in the amount of varieties available. This is because consumers place a high value on variety in the model. The gain is likely to be larger, the greater is the increase in output of industries with huge economies of scale and if there is a possibility of substitution between varieties. In the Lancaster world consumers will be better off if varieties are produced that are closer to consumer's ideal types. Trade may result in higher output levels, reducing input requirements (with economies of scale) and thus reducing the price of varieties. The gains are likely to be larger for a country if its trading partner is large. In the Dixit-Stiglitz world there will be a welfare gain if average productivity and variety do not decline with trade. However, with Lancaster type preferences, trade must result in greater output and more varieties for there to be a welfare gain.

5.4 An 'Extra Gain' from Trade

The Stolper-Samuelson theorem maintains that the price of the scarce factor falls after trade. Thus conventional theory, with constant returns to scale showing gains from trade, may be cold comfort for the owners of the scarce factor. However, in a world of increasing returns, the Stolper-Samuelson theorem may not apply. If commodities produced in two different countries are not perfect substitutes, trade may mean a greater range of consumer choice. If this induces consumers to spend a greater fraction of their income on any one industry's products, the return to the industry's specific factor may rise. This is demonstrated by Krugman (1982).

This work is very close to developments in international trade theory that treat factors as specific to a sector. In Krugman (1982) each commodity is produced with a specific type of labour.

In Jones (1971) the consequences for the HOS model, with specific factors, demonstrates, as is done in this section, that the return to a scare factor may rise as a result of trade.

To show that producers with a comparative disadvantage will also benefit from trade liberalization, Krugman assumes, where the industry is referred to as i :

1. Two countries and two industries with industry i to be so small as not to affect national income or prices of other industries if trade takes place.

2. Once trade is allowed, no barriers are placed on any industry trading.

3. The two countries have identical incomes.

4. Consumers assemble a final commodity C_i from components C_{ij}.

Using the above Krugman shows that the output of industry i can be written as

$$Q_i = \tilde{n}_i^{1/\theta_i} . q_i$$

where $\tilde{n}_i$ is the number of commodities and q_i is the output of a representative commodity and θ is an index of product differentiation. The smaller is θ, the greater the value placed on diversity by consumers. The price of i will be

$$P_i = \tilde{n}_i^{(\theta_i - 1)/\theta_i} . p_i$$

where p_i is the price of a representative commodity and $\tilde{n}_i$ is the number of commodities of which are domestically produced. After trade $\tilde{n}_i$ will include not only n_i but n_i^*, those commodities of foreign origin. Using

$$p_i = \theta_i^{-1} \beta_i w_i$$

$$q_i = \frac{\alpha_i \theta_i}{\beta_i (1-\theta_i)}$$

$$n_i = \frac{L_i (1-\theta_i)}{\alpha_i}$$

and writing the outcome in logarithmic form, we have

$$\ln Q_i = \ln \frac{\alpha_i \theta_i}{\beta_i (1-\theta_i)} + \theta i \ln \frac{L_i (1-\theta_i)}{\alpha_i}$$

and

$$\ln P_i - \ln \theta_i \beta_i w_i - \frac{1-\theta}{\theta} \ln \frac{L_i (1-\theta_i)}{\alpha_i}$$

Withan income elasticity of unity and price elasticity equal to the demand function is

$$\ln Q_i = A + \ln Y - \frac{1}{1-y} \ln P_i$$

where A is a constant.

Since a liberalizing of trade in industry i cannot affect income or prices and using the output of all other industries as a numeraire we can derive an expression for wages in industry i

$$\ln w_i = K_i + (1-y) \text{ h } Y - \frac{\theta_i - y}{\theta_i} \ln L_i$$

where K_i includes all those items which do not change if trade takes place with two economies and trade income is $Y + Y^* = 2Y$ and the labour employed is $L_i + L_i^*$. The first country's share of $L_i + L_i^*$ is

$$\sigma_i = \frac{L_i}{L_i + L_i^*}$$

If $\sigma_i < \frac{1}{2}$, L_i is scarce in the first country, the return paid to that factor will be high, commodity prices will be higher and thus σ_i is an index of comparative advantage. With $\sigma_i < \frac{1}{2}$ the industry's commodity will be at a comparative disadvantage. The Stolper-Samuelson theorem indicated there is likely to be a fall in the return to the scarce factor. The change in the return to that scarce factor under the assumptions above is

$$\Delta \ln w_i = (1 - y) \ln 2 + \frac{\theta_i - y}{\theta_i} \ln \sigma_i$$

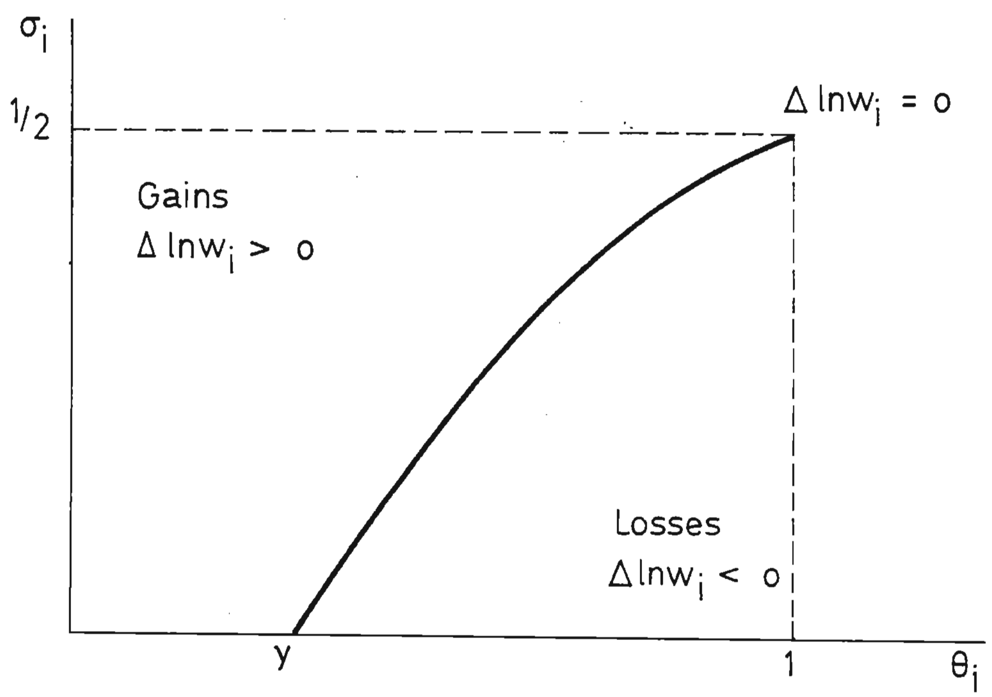
Now let us examine the relationship between σ_i and θ_i. The following shows for θ_i, y and σ the relationship between gains to the scarce factor and θ_i and σ are

	$\Delta \ln w_i$
$\theta_i \leq y$	positive
$\theta_i > y$	increases in σ decreases in θ_i
$\theta_i = 1$; $\sigma_i = \frac{1}{2}$	zero

These imply the following relationship between σ_i and θ_i which can be graphed as has been done in Figure 5.4. θ is shown on the horizontal axis and as θ falls, product differentiation increases. Comparative advantage is shown on the vertical axis and as σ increases, domestic producers have a greater comparative advantage in that industry. As σ increases , θ will fall, thus giving the line yB, which divides industries into two groups, its slope. Those industries in the first group are in the area of losses, where there is strong comparative advantage but weak product differentiation and those in the second, the area OyBC, are those where comparative advantage is weak and product differentiation is strong. It is in this latter area that the scarce factor gains from trade. Thus if trading takes place between countries of similar relative factor endowments, trade will take place in industries with weak comparative advantage and product differentiation. The trade flows are, therefore, more likely to be of the intra-industry type. It follows that it is possible for both factors to gain from trade, and, therefore, in addition to the welfare gains of the previous section, intra-industry trade has associated with it an extra gain from trade.

FIGURE 5.4

GAINS FROM TRADE



5.5 Conclusion

It has been shown that under certain assumptions the gains from intra-industry trade are not necessarily smaller than those associated with inter-industry exchange. Further, it might be that there is an 'extra' gain from intra-industry exchange. The implications of this are that economic integration amongst countries producing differentiated products may not be accompanied by major structural upheavals. Further, tariff protection of intra-industry products may be as welfare, losing as tariff protection of inter-industry products. Thus tariff reductions as a result of economic integration may result in gains without any distributional changes. This could serve as a theoretical justification for reducing political differences to allow for closer economic co-operation between countries of similar factor endowments.

chapter 6.
SUMMARY AND CONCLUSIONS

6. Summary and Conclusions

This thesis attempts to examine some aspects of intra-industry trade. The first chapter defines intra-industry trade, and places it in a theoretical framework. Conventional trade models, such as the Ricardian and Heckscher-Ohlin-Samuelson models, cannot adequately deal with the phenomenon of intra-industry trade. Both the above models assume perfect competition and constant returns to scale. International trade theory, seeking to explain intra-industry trade, relaxes these two assumptions by allowing Chamberlinian monopolistic competition and increasing returns to scale. With these new models, incorporating these alternative assumptions, international trade theory is able to allow for the possibility of intra-industry trade. These new models, however retain strong links with conventional trade theory.

In order to obtain the determinants of intra-industry trade, the second chapter examines, in detail, seven trade models that allow for intra-industry trade. Apparent from a discussion and comparison of the models were the major determinants of intra-industry trade, namely, the degree of product differentiation, economies of scale and similarity in factor endowments.

Chapter 3 tackles the difficult "existence problem". Critics note that intra-industry trade is a statistical quirk and thus that any attempts to deal with it theoretically are meaningless. This study concludes that even at fairly low levels of aggregation in trade data, the phenomenon persists. Before measuring the extent to which intra-industry trade occurs in South Africa, the study discusses the various measures of intra-industry trade and investigates the accuracy of the trade data. Undoubtedly some error exists in the trade data, although the thesis still makes use of the data because general indications, rather than exact magnitudes, are sought.

As expected, the average level of intra-industry trade in South Africa is half that of levels in the major industrial countries, with approximately one third of total South African trade being of the intra-industry type. An obvious area of further research would be to investigate those product classifications that exhibit high levels of intra-industry trade.

Having placed intra-industry trade in a theoretical context, ascertained its major determinants and estimated levels of infra-industry trade for South Africa, it is necessary to bring the above analyses together in an empirical test of the determinants of intra-industry trade. Using several assumptions, it is possible for a number of proxy variables to generate South African manufacturing data which can be subjected to statistical analysis. Various statistical techniques are used to analyse the data. Regression results compare favourably with those of other studies. The product differentiation variable does not perform as expected. Rather than concluding that this does not confirm the relationship between intra-industry trade and product differentiation, it could be argued that the proxies do not capture product differentiation in the South African context. Further research must concern itself with the formulation of better proxies to capture product differentiation, given the poor performance of the usual proxies in an empirical test using South African data.

Chapter 5 discusses the commercial policy and welfare aspects of intra-industry trade. The chapter shows that a lowering of tariff barriers encourages intra-industry trade and that there exists a gain from intra-industry trade, under certain conditions, over and above gains associated with conventional trade theory. Given the low levels of intra-industry trade and thus substantial scope for increases in such trade, it makes sense to bring about social and political changes, within South Africa, to allow for greater economic integration and co-operation in the Southern African context.

BIBLIOGRAPHY

Aquino, A. 1978. Intra-Industry trade and inter-industry specialization as concurrent sources in international trade in manufacturers. Weltwirtschaftliches Archiv. 114 2, 275-96.

________. 1981. The measurement of intra-industry trade when overall trade is imbalanced. Weltwirtschaftliches Archiv. 117 4, 763-66.

Balassa, B. 1963. An empirical demonstration of classical comparative cost theory, Review of Economics and Statistics, 45, 231-238.

________. 1979. Intra-industry trade and the integration of developing countries in the world economy. The World Bank Staff Working Paper No. 312, Washington.

Bergstrand, J. 1983. Measurement and determinants of intra-industry international trade. In Tharakan (1983).

Bhagwati, J. 1964. The pure theory of international trade. The Economic Journal, 74, 1-84.

Bhagwati, J. 1982. Import Competition and Response. University of Chicago Press.

Bhagwati, J.N. and Srinivasan, T.N. 1983. Lectures on International Trade, London, The MIT Press.

Blaug, M. 1978. Economic Theory in Retrospect. Illinois, Richard Irwin.

Caves, R.E. 1981. Intra-Industry trade and market structure in the industrial countries. Oxford Economic Papers, 33 2, 202-223.

Caves, R.E. 1984 In Spiegel, H.W. and Samuels, W.J. Contemporary Economists in Perspective. London, Jai Press.

Chiang, A.C. 1974. Fundamental Methods of Mathematical Economics. Second edition, Tokyo, Japan.

Chipman, J.S. 1982. Trade in differentiated products and political economy of trade liberalization. In Bhagwati (1982).

Corden, W.M. 1978. Intra-Industry trade and factor proportions theory. In Giersch (1978).

Davies, R. 1978. Trade overlap and intra-industry trade : Comment. Economic Inquiry, 16 3, 470-73.

Dillion, R. and Goldstein, M. 1984 Multivariate Analysis. United States, John Wiley and Sons.

Dixit, A. and Norman, V. 1980. Theory of International Trade. Cambridge University Press.

Dixit, A.K. and Stiglitz, J.E. 1977. Monopolistic competition and optimum product diversity. American Economic Review, 67 3, 297-308.

Ethier, W.J. 1982. National and international returns to scale in the in the modern theory of international trade. The American Economic Review, 72 3, 389-405.

Ethier, W. 1983. Modern International Economics, London, W.W. Norton.

Falvey, R.E. 1981. Commercial policy and intra-industry trade. Journal of International Economics. 11 4, 495-511.

Feenstra, R. 1982. Appendix. In Bhagwati (1982).

Finger, J.M. 1975. Trade overlap and intra-industry trade. Economic Inquiry, December 1975, 13 4, 589-89.

__________. 1978. Trade overlap and intra-industry trade: reply. Economic Inquiry. 16 3, 474-75.

Franko, L.G. 1978. Comment. In Giersch (1978).

Giersch, H. (ed) 1978, On the Economics of Intra-industry Trade. Tubingen, J.C.B. Mohr.

Gray, H.P. 1973. Two-way international trade in manufacturers : a theoretical underpinning. Weltwirtschaftliches Archiv, 10 9, 19-39.

__________. 1978. Intra-industry trade : the effects of different levels of data aggregation. In On the Economics of Intra-industry Trade, ed. H. Giersch, Tubingen.

Greenaway, D. 1977. International Trade Policy. London, The Macmillan Press.

Greenaway, D. 1982. Identifying the gains from pure intra-industry exchange. Journal of Economic Studies, 9, 40-54.

Greenaway, D. 1983. Inter-industry trade and intra-industry trade in Switzerland. Weltwirtschaftliches Archiv. 119, 109-21.

Greenaway, D. and Milner, C.R. 1983. On the measurement of intra-industry trade. Economic Journal, 93, 900-908.

Greenaway, D. and Milner, C. 1984. A Cross-Section Analysis of Intra-Industry Trade in the U.K. European Economic Review, 25, 319-344.

Greenaway, D. and Milner, C. 1986. The Economics of Intra-industry Trade. Oxford, Basil Blackwell.

Grubel, H.G. and Lloyd, P.J. 1975. Intra-Industry Trade. London, MacMillan Press.

Haberman, S. J. 1982. Analysis of dispersion of multinomial responses. Journal of the American Statistical Association, 77 379, 568.

Helpman, E. 1981. International trade in the presence of product differentiation, economies of scale and monopolistic competition : a Chamberlin-Heckscher-Ohlin approach. Journal of International Economics, 11 , 305-40.

Helpman, E. and Krugman, P.R. 1985. Market Structure and Foreign Trade, London, MIT Press.

Hufbauer, G.C. 1970. In The Technology Factor in International Trade. (ed) R. Vernon, New York, NBER.

Jones, R.W. 1971. A three factor model in theory, trade and history. In Trade, Balance of Payments and Growth. (ed). J.N. Bhagwati, Amsterdam, North-Holland.

Karmack, A. 1983. Economics and the Real World. Oxford, Basil Blackwell.

Krugman, P.R. 1979. Increasing returns, monopolistic competition, and international trade. Journal of International Economics, 9, 469-79.

Krugman, P.R. 1980. Scale economies, product differentiation and the pattern of trade. American Economic Review, 70, 950-59.

Krugman, P.R. 1981. Intra-industry specialization and the gains from trade. Journal of Political Economy, 89, 959-73.

Krugman, P.R. 1982. Trade in differentiated products and the political economy of trade liberalization. In Import Competition and Response, (ed) J.N. Bhagwati, University of Chicago Press.

Lancaster, K.J. 1966. A new approach to consumer theory. Journal of Political Economy, 74 2, 132-57.

Lancaster, K.J. 1980. A theory of intra-industry trade under perfect monopolistic competition. Journal of International Economics, 10 2, 151-75.

Lancaster, K.J. 1966. A new approach to consumer theory. Journal of Political Economy, 74 2, 132-157.

Lancaster, K. 1979. Variety, Equity and Efficiency. New York, Columbia University Press.

Lancaster, K.J. 1980. A theory of intra-industry trade under perfect monopolistic competition. Journal of International Economics, 10 2, 151-75.

Lancaster, K.J. 1982. Comment. In Bhagwati (1982).

Loertscher, R. and Wolter, F. 1980. Determinants of intra-industry trade : among countries and across industries. Weltwirtschaftliches Archiv, 116, 280-93.

Lundberg, L. 1982. Intra-industry trade : the case of Sweden. Weltwirtschaftliches Archiv, 118 2, 302-16.

MacDougall, G.D.A. 1951. British and American exports: A study suggested by the theory of comparative costs. Economic Journal, 61, 697-724.

Morgenstern, O. 1970. On the Accuracy of Economic Observations. Princeton, Princeton University Press.

Mussa, M. 1982. Comment. In Bhagwati (1982).

Myint, H. 1977. Adam Smith's theory of international trade in the perspective of economic development. Economica, 44, 231-248.

Pagoulatos, E. and Sorensen, R. 1975. Two-way international trade : an econometric analysis. Weltwirtschaftliches Archiv, 111, 454-465.

Pomfret, R. 1978. Intra-industry trade in intraregional and international trade. In On the economics of intra-industry trade. ed. H. Giersch, Symposium 1978, Tubingen.

Rummel, R. J. 1970 Applied Factor Analysis Evanston, Northwestern University Press.

Rybczynski, T.M. 1955. Factor endowments and relative commodity prices. Economica, 22, 336-341.

Samuelson, P.A. 1948. International trade and the equalization of factor prices. Economic Journal, 58, 163-84.

Samuelson, P.A. 1949. International factor-Price equalization once again. Economic Journal, 59, 181-197.

Smith, A. 1776(1961) The Wealth of Nations Vol 1 (ed) Cannan, E. London, Methuen.

Stern, R. M. 1962 British and American productivity and comparative costs in international trade, Oxford Economic Papers, 14, 275-296.

Stolper, W. F. and Samuelson, P.A. 1941. Protection and real wages. Review of Economic Studies, 9, 58-73.

Tharakan, P. K. M. 1983. Ed. Intra-Industry Trade. Amsterdam, North-Holland

Toh, K. 1982. A cross-section analysis of intra-industry trade in U.S. manufacturing industries. Weltwirtschaftliches Archiv, 118 2, 281-301.

Travis, W.P. 1984. The Theory of Trade and Protection. Cambridge, Harvard University Press.

Verdoorn, P.J. 1954. A Customs Union for Western Europe. World Politics, July.

Willmore, L. 1978. The industrial economics of intra-industry trade and specialization. In Giersch (1978).

Thärakan, P. K. M. 1983. Ed. Intra-Industry Trade. Amsterdam, North-Holland

Toh, K. 1982. A cross-section analysis of intra-industry trade in U.S. manufacturing industries. Weltwirtschaftliches Archiv, 118 2, 281-301.

Travis, W.P. 1984. The Theory of Trade and Protection. Cambridge, Harvard University Press.

Verdoorn, P.J. 1954. A Customs Union for Western Europe. World Politics, July.

Willmore, L. 1978. The industrial economics of intra-industry trade and specialization. In Giersch (1978).