DETERMINANTS OF INTRA-INDUSTRY TRADE: A CROSS-INDUSTRY EXAMINATION OF CANADIAN MANUFACTURING INDUSTRIES.

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ABSTRACT

The simultaneous export and import of similar commodities between two countries or group of countries (intra-industry trade) cannot be fully explained by the traditional trade theory of comparative cost. This has led to a search for alternative theoretical explanations and to further empirical investigation of the phenomenon.

Various hypotheses have been suggested as determinants of intra-industry trade in recent years. The objective of this study is then to empirically examine these hypotheses using the data of Canadian manufacturing industries. The data pertains to 67 industries at the 4-digit Standard Industrial Classification (SIC) level for the year 1981.

The study examines and tests the following hypotheses as determinants of intra-industry trade. (1) The more differentiated are the products of competing firms, the higher will be the share of intra-industry trade in total trade. (2) The more extensive are the scale economies in a given industry, the less should be the volume of intra-industry trade. (3) The larger is the firm-specific technical knowledge, the higher will be the share of intra-industry trade of the technological gap variety. And (4) the greater the degree of comparative advantage or disadvantage of an industry, the less will be the volume of intra-industry trade.

On the whole, the empirical results support the hypotheses outlined above. More specifically, the results indicate a strong support for the economies of scale hypothesis, and a modest support for the product differentiation and comparative advantage hypotheses. The empirical support for the firm-specific technical knowledge is relatively weak.

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Chapter 1

INTRODUCTION

Intra-industry trade, defined as two way trade in similar goods and services, accounts for a large and growing proportion of trade among the industrialized countries. The somewhat belated recognition of this phenomenon has led to a wide range of theoretical, empirical, and policy studies and these in turn, have formed a central part of "the new international economics".

Traditional theories of comparative advantage focus on patterns of inter-industry specialization and, as such, have little to say about intra-industry trade. In addition, most attempts to explain intra-industry trade highlight the roles of product differentiation, internal economies of scale, and the resulting market imperfections - all of which are outside the domain of the traditional theories. The result has been the emergence of a new theoretical framework which has not only provided a more adequate basis for explaining intra-industry trade, but has also led to a reappraisal of the effects of trade policy.

Although its influence on international economics has been considerable, the empirical application of the theory has been plagued by difficulties. Controversy remains over how to measure intra-industry trade and, given the limitations of available data, how one might test the new theories or use the new theories to explain observed trade flows. Since intra-industry trade is dependent, in large part, on the internal characteristics of industries, empirical studies require the use of data at a highly disaggregated level. Unfortunately most industry data is available only at the 3-digit level of the Standard Industrial (or international trade) Classification.

The objective of this study is to construct a 4-digit data series and to use it to examine the effects of product differentiation, economies of scale, firm-specific technical knowledge and comparative advantage on the cross-industry pattern of intra-industry trade in Canada. Construction of this data series was facilitated by the appearance of a book by Baldwin and Gorecki (1986) which contains previously unpublished 4-digit data on industry characteristics for Canada and also some comparative Canada - U.S. data. This study also departs from previous work by explicitly considering the effects of comparative advantage. Although the traditional theories of comparative advantage were not intended to explain intra-industry trade, it remains true that if a country has a strong comparative advantage or disadvantage in an industry, then trade in those industries will tend to be in one direction only. As a result the proportion of trade that is intra-industry trade will be smaller.

1.1 Outline

In the first section of the next chapter, the origin, development and significance of intra-industry trade will be discussed. The last two sections of the chapter contain a selective survey of the basic theoretical and empirical literature relating to the determinants of intra-industry trade.

The 3rd chapter introduces the specific hypotheses used to construct the empirical model. In order to establish the basis for the empirical model, chapters two and three follow a similar order and line of argument. In addition to presenting these propositions, attention is also paid to the way in which the hypotheses are incorporated into the model.

Chapter 4 presents the empirical results. After discussing the statistical findings of the study, these findings are briefly compared with other similar studies. The discussion mainly focuses on the statistical relevance of the results and their relationship to the respective hypotheses.

Finally, the conclusions of the study are summarized in Chapter 5. In this chapter the significance and the implications of the findings are also discussed.

Chapter 2

THE NATURE, SIGNIFICANCE AND DETERMINANTS OF INTRA-INDUSTRY TRADE (IIT).

The traditional theories of international trade do not address the issue of intra-industry trade (IIT). The recognition by trade thoerists that it accounts for a significant proportion of trade has led to a search for alternative explanations. The objective of this chapter is to review a number of alternative studies that have attempted to explain this phenomenon. After briefly examining IIT as a concept, its development and significance, the chapter focuses on the determinants of IIT. No attempt will be made to cover all studies. Attention will be limited to those works that are concerned with the determinants of IIT across industries.

2.1 The Phenomenon of Intra-Industry trade.

Intra-industry trade, as a concept, might be defined as the simultaneous export and import of "similar" commodities between two countries or among a group of countries. Similarity of commodities may mean products that have equal or similar factor contents in the Heckscher-Ohlin (H-O) sense, similar technology intensity, as Aquino (1978) preferred to emphasise, or close substitutability in consumption, as Gray (1979), Brander (1980), among others, have stressed. However it is defined, standard trade theory has not been able to fully explain its existence or to account for its increase over time.

The focus of traditional trade theories - principally the Ricardian comparative productivity theory and the Heckscher-Ohlin factor proportions theory - has been on explaining countries' specialization based on comparative costs. These theories attempt to explain why countries produce a relatively large amount of some product types and a relatively small amount of others, with trade following as a consequence of the resulting differences in production patterns. Defining an industry as consisting of a collection of similar commodities (in one or more of the senses above) these theories lead to predictions about trade between industries (inter-industry trade) and, in their original forms, have nothing to say about intra-industry trade.

Even though some economists commented on IIT as far back as the 1940s - for instance, Frankel (1943), Hilgerdt (1945) - widespread interest was not noticeable until the 1960s and the 1970s. As Grubel noted, "The idea of intra-industry trade is not new. The growing exchange of manufactures for manufactures has been recognized for some time. What is new is the realisation of the extent of this trade, its causes and an awareness of its policy implications."[1]

The phenomenon of IIT came into focus after the emergence of various empirical studies in the early 1960s regarding the pattern of international trade among developed countries. Verdoorn (1960), and Balassa (1963), on the basis of their studies on trade patterns in the Benelux (BLEU) and the EEC respectively, noted that much of the trade that took place in these countries was within and not between commodity groups. Similarly, Kojima (1964) noted that the results of his study of international trade patterns among developed countries are contrary to the traditional comparative cost theory. He suggested that the fast growth of

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[1] Grubel and Lloyd (1975), Intra-Industry Trade. Macmillan Press Ltd. P. 12.

'horizontal trade of manufactured goods among highly developed, homogeneous and industrial countries' requires an alternative explanation that would 'uncover the forces underlying this conspicuous trend'.[2]

As IIT started getting its share of attention in the international trade literature, it also attracted some critics who argued that the phenomenon is a result of an aggregation problem and thus compatible with traditional trade theories. For instance, Finger (1975) argued that IIT -overlapped trade, as he calls it - is in line with the factor proportions theory in so far as the variation in factor input requirement is greater within product groups than between them. Citing U.S. data to supports his argument he states, "Examination of United States data shows that 40% to 70% of the variation in factor input requirements among products is within 3-digit product groups - at which level of aggregation about 44% of US trade is overlapped trade. These data are consistent with the factor proportions theory".[3] Similarly, Pomfret (1976) concluded, based on his study of Israel's trade data, that this phenomenon could partly be attributed to the level of aggregation with the remainder perfectly explicable by conventional trade theory.[4]

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2 P.K.M. Tharakan. (1983), ed. Intra-Industry Trade: Empirical and Methodological Aspects, (Amsterdam:North-Holland), PP. 1-2.

3 J.M. Finger (1975), "Trade Overlap and Intra-Industry Trade", Economic Inquiry Vol. XIII, P. 581.

4 Tharakan (1983), p. 17.

2.1.1 Significance

Whether it is the case that the conventional trade theories are incapable of explaining the factors underlying trade flows, or it is the case that the problem is mainly one of inconsistency between the standard definition of an industry and the statistical classification of trade flows, as Finger and others contend, the issue cannot be ignored.

Empirically, the measures of intra-industry trade in terms of its share in the overall trade flow indicate that it is not only high but has also been increasing. According to Greenaway and Milner (1983), existing evidence suggest that the share of intra-industry trade in total trade may exceed 60 percent in most developed market economies. Over a period of 20 years (1955-1976), the current price value of world exports increased from $93 billion to $991 billion. Over 60 percent of this increase is accounted for by trade in manufactures among developed countries, a significant proportion of which could be classified as intra-industry trade. The increase in the share of manufactures in total trade, over the same period, is from 48 percent to 58 percent.

In the face of such suggestive empirical evidence, further empirical and theoretical examination of intra-industry trade is essential for at least two reasons. First, as Greenaay and Milner recognised, appropriately measuring pure intra-industry trade will lead to the identification of determinants of international trade flows which are alternatives to those considered in the traditional theories of comparative advantage. Second, in terms of policy relevance, it is likely that adjustments to trade expansion could be more easily accommodated when the expansion is due to an increase in intra-industry trade than when it is due to inter-industry trade. Thus, examining the phenomenon of intra-industry trade is significant for both theoretical and practical purposes.

Having briefly noted the origins and the developments of the phenomenon of IIT, and its significance in the theoretical and empirical trade literature, the next section focuses on the hypotheses that have been suggested as determinants of IIT across-industries.

2.2 Survey of the Theoretical Literature.

Before reviewing the specific propositions it might be worth highlighting the underlying theory of IIT. As Tharakan (1983) noted, the theoretical literature on IIT is so diverse it defies any neat categorization. The hypotheses suggested (and in some cases tested) as determinants of IIT not only vary depending on whether one is focusing on cross-country or cross-industry propositions, but the emphasis and the coverage within each set of propositions also vary from one set of theoretical constructs to any other. Despite the diversity and the overlapping nature of these hypotheses, they might, following Tharakan, be broadly classified into three groups.

The first group of hypotheses, what Tharakan refers to as `functional hypotheses', are not new theories of IIT as such. Their relevance to the phenomenon of IIT might be described as identifying the specific circumstances in which IIT might show up in the international trade statistics without essentially affecting the (and in some cases strengthening) the standard international trade flow predictions. Among the circumstances identified as sources of IIT are: differentiation by time, border trade, entrepot-trade, trade, cross-hauling by multinational firms, and the method of compilation in the industrial classification system. For example, trade between two countries may take place owing to seasonal differences between them in a given statistical year; and thus, trade in commodities such as perishable fruits for instance, will show up as intra-industry trade. Similarly, geographic proximity will result in what is known as border trade, at least, in commodities that have high transport costs.

The second group of theories focuses on differences in demand patterns or economies of scale as sources of trade. Linder (1961), and Derez (1960, 1961), for instance, stressed the role of domestic demand, economies of scale, and product differentiation as sources of intra-industry trade. Linder (1961) argued that product improvements through research and development, technological innovation, economies of scale, etc. create export potential. But, this potential could only be realized if there is large domestic demand for the product in question. Such domestic demand will strengthen domestic commerce and international trade will follow between countries that have similar (but differentiated) demand patterns in their respective markets. However, Dereze (1960, 1961) added, similar demand patterns and product differentiation do not satisfactorily explain intra-industry trade unless the interaction of economies of scale and product differentiation is added into the picture. The identification of such sources of trade paved the way for relatively recent theoretical refinement and developments. These developments constitute a third group of theories.

The third group of theories are an addition to, or an extension of the second group of theories mentioned above. Contributions by Gray (1973), Grubel and Lloyd (1975), Brander (1980), Krugman (1979, 1981), Lancaster (1980), Helpman

(1981), and Ethier (1982), have helped in shaping both the recent theoretical and empirical scope of the IIT literature. The specific contributions of these authors will be discussed in the next section. The distinguishing feature of these authors is that in addition to their attempts to identify the main determinants of IIT, the contributors have been able (with varying degrees of success) to formalize and integrate it into the main body of trade theory.

2.2.1 Cross-Industry Propositions.

2.2.1.1 Product Differentiation

Although there are explanations for intra-industry trade in homogeneous products, most modern treatments base their arguments on product differentiation.[5] As a result of differentiation the varieties of the same good produced in different countries will have limited substitutability - some people preferring a domestic variety others preferring foreign varieties. Trade then emerges not as a consequence of comparative costs across industries but instead as a consequence of heterogeneity in the product mix within industries. The greater the degree of differentiation - the larger the number of varieties or the less substitutable they are - the greater will be the volume of intra-industry trade. Grubel and Lloyd (1975) have argued that quantitatively, differentiation is the basis for most intra-industry trade.

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5 For a discussion of intra-industry trade in homogeneous products (the cases of border trade, re-export trade, entrepot trade and seasonal trade), see Grubel and Lloyd (1975). And for IIT based on reciprocal price discrimination, see Brander (1980).

A number of ways of classifying differentiated goods have been suggested. Grubel and Lloyd (1975), Caves (1979), Greenaway (1983), among others, distinguish various supply or demand based characteristics as sources of product differentiation. According to Greenaway[6] differentiation could mean at least three things: horizontal differentiation, vertical differentiation and technological differentiation. Horizontal differentiation basically refers to the Lancastrian classification of products in accordance to their attribute mix. Vertical differentiation, on the other hand, is broadly analogous to quality differentiation. For instance, while horizontal differentiation focuses on the variety of specifications of a product within a given quality standard (`red and blue Austin Metros'), vertical differentiation focuses on the availability of alternative quality standards (`Austin Metros and Daimler Sovereigns'). Technological differentiation is usually related to the inclusion of additional attributes, with the final outcome that the present product is ultimately replaced. In principle, the distinction is relevant because different factors may be responsible for international trade flows.

Vertical and horizontal differentiation are analogous to what Grubel and Lloyd refer to as quality and style differentiation, respectively. By quality differentiation they meant commodity differences that could be measured by performance characteristics, whereas style differentiation refers to the outcome of product appearance and minor performance differences that are usually magnified by advertising. Caves' classification is similar. However, he argued that those product differences that are mainly the result of slight attribute

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6 D. Greenaway (1983), "Patterns of Intra-Industry Trade in the UK," in Intra-Industry Trade: Empirical and Methodological Aspects, ed. P.K.M. Tharakan (Amsterdam:North-Holland), p. 151.

differences promoted by advertising are biased against trade. His rationale is that advertising is by and large specific to a national culture, and therefore such a message does not easily cross national boundaries. Furthermore, designing the advertisement to suit national tastes seems complementary to designing the product itself. Consequently, other things (such as economies of scale and comparative advantage) being equal, heavily advertised goods tend to be produced and consumed in the same national territory. Such product differentiation is a positive influence more on foreign direct investment than on commodity trade.

2.2.1.2 Economies of Scale

Depending on their nature, economies of scale have two distinct effects on the volume of intra-industry trade. First, if they are external to firms but internal to national industries then the cost advantages of large industries can serve as a basis for countries specializing in particular industries. To the extent that inter-industry specialization occurs the amount of intra-industry trade will be reduced.[7]

On the other hand, if the scale economies are internal to firms , due to the length of production runs, then firms will tend to specialize in a limited range of product varieties. This will lead to greater intra-industry trade. The same will also be true of other internal economies that allow them to produce their varieties at lower cost by serving the world market rather than the domestic market in isolation.[8]

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7 For a discussion of types of scale economies and their trade impacts see Helpman (1984), and Jones and Neary (1984) in R. W. Jones and P. B. Kenen, ed. Handbook of International Economics. Vol. 1 (Amsterdam: North Holland, 1984), Chapters 1 & 7.

8 For detailed discussion of models which incorporate economies of scale see

In addition Ethier (1979) [9] argued that economies of scale may give rise to an international division of labour within multinational corporations. His central argument is that economies of scale in various stages of the production process will lead multinationals to concentrate on each stage in a single location - which, in general, will differ from stage to stage. Since component parts are often classified as belonging to the same industry as the final good, intra-industry trade will be created.

2.2.1.3 Growth of Firm-Specific Technical Knowledge.

Firms or industries may have a comparative advantage in the production of a certain product owing to their innovative capacity, or because of already available knowledge gained through learning by doing, which is specific to these firms or industries. Such a comparative advantage is usually realized through available legal protections, such as patents and copyrights against imitations, and through dynamic economies of scale due to efficient production techniques. Trade flows generated from such technological disparity are usually referred to as technological-gap trade. It was mentioned earlier (see the section on product differentiation), that goods may be differentiated in according to their attribute mix, and that one of the sources of such a difference is the addition of new attributes made possible by technological innovation. We referred to this as technological differentiation and, as with other forms of differentiation, it can give rise to intra-industry trade. Where the rate of product innovation is relatively high and production processes are less standardized, firms will introduce more

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Krugman (1979, 1980), and Helpman (1981).

[9] Wilfred J. Ethier (1979), " International Decreasing costs and World Trade," Journal of International Economics, Vol. 9, pp. 1 - 3.

differentiated products using their specific technical knowledge of production; and hence the volume of intra-industry trade will increase.

2.2.1.4 Comparative advantage.

The traditional trade theories - either the Heckscher-Ohlin factor proportions theory or the Ricardian comparative productivity theory - focus on the determinants of inter-industry specialization. To the extent that such considerations lead countries to specialize in particular industries, inter-industry trade will be enhanced and intra-industry trade will be diminished.

In the case of the factor proportions theory, countries have a comparative advantage in the goods which use their relatively abundant factor(s) relatively intensively. Whatever the relative factor abundance of a country, comparative advantage will be strongest at the extremes of factor intensities and weakest for goods with intermediate intensities. For example, the relatively low labour costs in a labour abundant country will give it a greater advantage in the more labour intensive goods and its relatively high capital cost will give it a greater disadvantage in the more capital intensive goods. For either type of industry inter-industry specialization will dominate. At intermediate factor intensities comparative cost differences will be relatively small, leading to less inter-industry specialization and a greater opportunity for intra-industry trade.

Similarly, in the case of the Ricardian theory, large (favourable or unfavourable) differences in relative productivity will lead to greater industrial specialization and promote inter-industry trade whereas small differences lead to less specialization and provide more opportunity for intra-industry trade.

2.3 The measurement of Intra-Industry Trade.

Thus far the definition of an industry and the associated conceptual and measurement problems have been ignored. Among the problems that arise in any attempt to empirically estimate the volume of intra-industry trade between two or group of countries are the following. First, establishing what constitutes an industry in a way that is both conceptually and empirically consistent entails some difficulties; and second, finding an appropriate methodology to measure the share of intra-industry trade in over all trade has been controversial. Before dealing with the problems of measuring the volume of intra-industry trade, the concept of an industry and the related problem of aggregation bias will be discussed.

2.3.1 The Concept of An Industry and the Problem of Aggregation.

The concept of an 'industry' was created to describe a group of goods that are similar in their attributes, uses or methods of production. Putting aside the issue of what constitutes an ideal grouping, it is evident that at the 3-digit level of aggregation the Standard Industrial Classification (SIC), which is the level of aggregation commonly used in empirical studies, there remains considerable variability in the attributes, uses and production methods. This leads to what Gray (1980) called a categorical aggregation bias in the measurement of intra-industry trade.

This aggregation bias, according to Gray, might be caused by two conceptually distinct factors: an 'opposite sign effect' and a 'weighting effect'. The opposite sign effect is the result of sub-group trade imbalances that have opposite signs. For instance, if one is calculating the ratio of intra-industry trade for a given 3-digit group which contains two 4-digit sub-groups that have different attributes, then, the aggregation of these sub-groups will inflate the index if the imbalances have opposite signs.[10] If the imbalances of each sub-group are of the same sign, the aggregate index would be the weighted average of the sub-group indices, which is a desirable property. But when the sub-group imbalances have different signs, the weighting and the opposite sign effects work against each other.

Greenaway and Milner (1981) argued, there is enough ground to suggest that the misclassification of industrial categories would show up in opposite signed sub-group imbalances and, hence, use of 3-digit data understates the volume of intra-industry trade. It might seem obvious that the solution lies in regrouping the data such that it is consistent with the theoretical construct of an industry. But, as Greenaway and Milner (1981) noted, this entails two major difficulties. First, due to the variations in defining what constitutes an industry, no unique criteria for regrouping exists. For instance, Aquino (1978) attempted to regroup activities according to their 'technological intensity'. Balassa (1966) on the other hand, regrouped the same 3 and 4-digit SITC data in accordance with their 'substitutability in production'. Second, there is no clear way of determining how one classifies trade in parts and components in any regrouped scheme. As a result this option has not been as easy as would seem. The best one can do is to work with data at as a high a level of disaggregation as possible.

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[10] Say group j consists of sub-groups a and b, the IIT for group j is then,

$$Bj = \left\{1 - \frac{|Xa+Xb-Ma-Mb|}{(Xa+Xb+Ma+Mb)}\right\} X\ 100$$

If (Xa-Ma) > 0 but (Xb-Mb) < 0 then the imbalances will offset each other when aggregated. Thus if in the limit |Xa-Ma| = |Xb-Mb| the above index (Bj) would equal 100 indicating that all trade in the product group is intra-industry trade, (Greenaway and Milner (1981), pp. 901-902).

2.3.2 Problems of Measurement.

As is the case with the concept of an industry, the method of measuring the volume of intra-industry trade is not free of controversies either. Though part of the differences in measurement techniques is attributable to refinements of the earlier methods used and partly stems from the lack of clear definition of an industry, no agreement exists even at the technical level regarding which method best captures the level of pure intra-industry trade. By far the most widely used method in empirical work is the one suggested by Grubel and Lloyd. In the following discussion only some of these measures will be briefly outlined.[11]

Balassa's (1966) measure of intra-industry trade is defined as follows:

$$D_i = \frac{|X_i - M_i|}{(X_i + M_i)} \qquad (1)$$

$$0 < D_i < 1$$

where X_i and M_i are, respectively, exports and imports of sector i. Clearly, D_i is a measure of the proportion of total trade (X_i+M_i) which is not intra-industry trade. Therefore, if the above ratio approaches zero it would indicate a high proportion of intra-industry trade, but if it approaches unity the significant portion of trade flows would be classified as inter-industry.

The Grubel and Lloyd (1975) measure is in essence a refined version of the Balassa (1966) measure (equation 1 above). Grubel and Lloyd defined intra-industry trade as "the value of exports of an 'industry' which is exactly matched by the imports of the same industry". Therefore, their measure focuses on the value of total trade (X_i+ M_i) that is left after net exports (or net imports)

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[11] For details and a summary of these and other measures see Grubel and Lloyd (1975), Tharakan (1983), and Kol and Mennes (1983).

are removed. The index (B_i) they constructed for a single industry i is the following:

$$B_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \times 100 \qquad (2)$$

$$0 < B_i < 100$$

For convenience, the above index could be rewritten as follows:

$$B_i = [1 - \frac{|X_i - M_i|}{(X_i + M_i)}] \times 100 \qquad (2.1)$$

The above index varies between 0 and 100. When exports of an industry are exactly matched by its imports, the value of the index will be 100, indicating all trade is intra-industry. On the other extreme, if the given industry does not import commodities that are 'similar' to what it exports, the value of the index is zero, indicating all trade is inter-industry trade. (Note that the Grubel and Lloyd index is obtained by simply subtracting the Balassa index from one and converting the resulting fraction.)

Aquino (1978, p. 281) criticized Grubel and Lloyd for not controlling for the biasing effects of overall trade imbalances. Since such imbalances imply that

$$\Sigma j \ (X_j - M_j) \neq 0$$

the Grubel and Lloyd measure will be biased downwards. Aquino's own measure assumed that in all industries the imbalancing effect of the total trade deficit or surplus is equiproportional. Specifically, he proposed the following estimate of 'what the value of exports and imports of each commodity would have been if total exports had been equal to total imports':

$$X_{ie} = X_i \; \frac{1}{2} \; \frac{\sum_j (X_j + M_j)}{\sum_j X_j}; \qquad (3)$$

and

$$M_{ie} = M_i \; \frac{1}{2} \; \frac{\sum_j (X_j + M_j)}{\sum_j (M_j)} \qquad (3.1)$$

where X_{ie} and M_{ie} are the value of exports and imports respectively, if total exports had been equal to total imports. These can then be used in place of the 'uncorrected' values in (2).

Aquino's solution to the problem has attracted criticism. Greenaway and Milner (1981), for instance, criticized his assumption that a given trade imbalance is consistent with disequilibrium, and that balancing forces would prevail equiproportionally across all industries. A better approach, particularly in the case of cross section analysis they suggested, would be a careful selection of sample years in which no obvious disequilibrium between exports and imports is apparent, or taking the averages of intra-industry indices over selected years. Aquino (1981) countered such a solution by arguing that in some countries, for instance Japan, it is almost impossible to find a year in which there is an equilibrium between exports and imports. Therefore, in the absence of any other reliable criterion, he argued, his "equiproportionality rule" is the best alternative.

As noted by Kol and Mennes (1983) there is no practical solution to the problem. However, of the two (Aquino vs. Grubel and Lloyd) it is the Grubel and Lloyd index that is most widely used.

2.3.3 Empirical Studies

A number of empirical studies that analyse the flow of intra-industry trade have been undertaken over the years. Though some variations exist in their analytical formulation, most have used some index of intra-industry trade as their dependent variable. Most recent studies - Toh (1982), Lundberg (1982), Gavelin and Lundberg (1983) and Greenaway (1983) for instance - used the Grubel and Lloyd measure (equation 5.1) to calculate this index. A few others, Caves (1981) for instance, used some weighted indices of trade flows among developed countries as a measure of intra-industry flow. For reasons cited elsewhere, the common level of industry aggregation used to calculate this index is the 3-digit Standard Industrial Classification (SIC) or its equivalent the Standard International Trade Classification (SITC).

To explain this share of intra-industry trade in total trade, the postulated hypotheses and the exogenous variables used in various studies differed depending on the focus of each study. That is, whether the study focuses only on cross-industry hypotheses, cross-country hypotheses or a combination of both. In the case of cross-industry studies, most of the authors included some measure of product differentiation and economies of scale as sources of intra-industry trade. Other theoretical postulates included in one or more studies are firm-specific technical knowledge, transaction costs, extent of trade barriers, and costs of transportation, the latter three being related primarily to intra-industry trade in homogeneous products.

The variables used most frequently to measure product differentiation are: number of product groups in each statistical classification (Greenaway (1983), Caves (1979), for instance), the ratio of advertising expenditure to total sales, the Hufbauer index (the coefficient of variation of unit values of a given country's exports among various destination countries), and some measure of product standardization - energy intensity, or machinery per employee. The economies of scale variables are: share of employment in big plants, or the average production or employment in each plant as a measure of plant size.

Clearly, most of these variables are proxy measures which were used due to the unavailability of data which would allow more direct measures. This has imposed limitations on all empirical studies. Tharakn (1983, p. 26) stated, "A common and striking feature of the econometric results is the failure of the theoretically relevant product differentiation - scale economies variables to satisfactorily 'explain' the commodity composition of intra-industry trade. Part of the problem could be the inadequacy of the methods used to quantify these variables which are notoriously difficult to get an empirical grip on." He also noted that, because of the abstract nature of the theory, it did not offer a clear indication of how it should be implemented empirically.

As will be discussed below, an effort has been made in this study to obtain variables which are somewhat better as direct measures of scale economies and product differentiation. In addition, the previous work has been expanded to include consideration of the effect of comparative advantage on intra-industry trade.

Chapter 3

THE MODEL AND HYPOTHESES

Having examined the broad theoretical background of intra-industry trade, the main focus of this chapter is to present testable propositions, which are derived directly from the theoretical discussion in the previous chapter. The specific propositions will be presented in the form and order of the group of arguments introduced earlier.

The organization of this chapter is as follows. After presenting the model in the first section, the specific propositions and the variables used to measure these propositions are discussed in the second section of the chapter. The variables used are only briefly discussed in the text and more details regarding the definition and data source of the variables are found in Appendix A.

3.1 The Model.

In line with the earlier discussion, the model contains four general hypotheses concerning the determinants of intra-industry trade across industries: product differentiation (PD), economies of scale (ES), firm-specific technical knowledge (FTK), and comparative advantage (CA). Broadly, the functional form of the model is as follows:

$IIT_i = f (PD_i, ES_i, FTK_i, CA_i)$ (7)

where $i = 1,2 \ldots\ldots.67$ index of industries,

IIT_i = the level of intra-industry trade in industry i,

and

PD_i, ES_i, FTK_i, and CA_i are the respective determinants of IIT_i as discussed above.

3.2 Testable Propositions and Variables.

1. Product Differentiation

Hypothesis: The more differentiated products of competing firms are, either in terms of product attributes (quality) or brand image (style), and the higher will be the share of intra-industry trade in total trade.

It was noted earlier that the theoretical literature identifies various forms of differentiation - broadly supply and demand side approaches, and specifically as vertical, horizontal and technological differentiation. Of these, product attributes and style are the usual subjects of empirical investigation. The presumption is that the lower the substitutability of products in consumption, i.e. the lower the price elasticity and the cross-price elasticities of demand for the given products of a given firm, the higher the potential for charging different prices. Consequently, given taste differences that would make it possible to charge a price that would at least cover the incremental cost of producing and exporting it, higher differentiation leads to more IIT.

Ideally, product differentiation of this nature could be measured by price elasticity or the elasticity of substitution for the product of a given firm or industry. But due to unavailability of such data, most empirical studies, including this one, rely on proxy variables. One obvious measure of product differences is based on the statistical classification itself. The presumption is that the greater the number of product groups listed under a given statistical category, the more prevalent is product differentiation, and hence the higher is the share of intra-industry trade in total trade. Consequently, the number of product groups in each 4-digit category (defined here as SIC1), is expected to directly vary with the share of intra-industry trade in total trade.

The second proxy variable used to measure product differentiation is advertising expenditure. With a premise that the need to advertise a product is a positive function of product differences within a given product group, then the higher the sale promotion costs of an industry the more differentiated the products are likely to be. As Greenaway (1983) noted, this variable (defined here as AP2) is most likely to capture the brand image (the apparent rather than the real) differences between products. However, this argument is only true to the extent that there are no significant quality differences between products. Where quality differences between products exist, it seems reasonable that firms will engage in advertising in order to make their specifications known. Thus, to the extent that advertising intensity picks up one or both types of product differences, one would expect it to be positively related to the level of IIT.

As postulated earlier, on the basis of the product cycle theory, a product tends to be standardized both in terms of style and methods of production at some stages of the cycle. It was further noted that production methods are more mechanized at a later stage of the cycle than at the early stage. The degree of mechanization is more likely to be reflected in the increasing ratio of physical capital to labour. On the basis of these observations Gavelin and Lundberg (1983, p. 176) argued, 'a precondition for mechanization is a certain degree of standardization'. Therefore it follows, to the extent that standardization presupposes mechanization, highly mechanized industries are likely to produce less differentiated products. Hence, the degree of mechanization will be inversely related to the level of intra-industry trade. Some of the proxy variables for degree of mechanization are capital and consumption of energy per employee. The latter measure, which is used in this study, (defined as EI) assumes a positive relationship between energy intensity and degree of mechanization. And, therefore, EI is expected to be inversely related to the share of IIT. In addition, a labour intensity variable, defined either as FI (labor/capital) or AV1 (labor's share in value added) is used as an inverse measure of capital intensity and is expected to vary directly with intra-industry trade.

Finally, the existence of differences in production methods across countries can be used to indicate that firms belonging to the same industry are producing different goods. The variable used for this purpose is KL2 which is calculated as capital stock per man hour in Canadian manufacturing industries relative to capital stock per man hour in the corresponding U.S. industry. Since high or low values of this variable indicate differences in production methods, with intermediate values indicating similarity in production methods, it is expected that intra-industry trade will be least for intermediate values and increase towards the extremes - yielding the U-shaped relationship shown in Figure 1. To allow for such a shape not only KL2 but also its square (PKL2) is included. The expectation is then that the coefficient of KL2 will be negative and that of PKL2 will be positive.

2. Economies of Scale

Hypothesis: The more extensive are the scale economies in a given industry, either due to size of plants or size of firms, the less should be the share of intra-industry trade in total trade.

The existence of such economies of scale lead to a geographical concentration of production and result in reduction of unit costs. This concentration also re-enforces such scale economies. This is because the scale of operation of firms or industries to some extent determines the type of capital equipment and human skill they use as factor inputs. This necessity arises due to the possible lack of divisibility of such factors to suit a given scale of operation. Thus, the higher the scale of operation, the more plants or firms will be able to employ more efficient capital equipment and hire more skilled labour, and hence the more likely they will enjoy a relative cost advantage.

The variables used in this study are returns to scale (RS) and relative plant scale (PS). Needless to say, returns to scale is a direct measure of economies of scale. This variable is an estimate of manufacturing industry production functions with labour and capital as factor inputs. Theory predicts that the scale of operation influences factor returns which determine a given firm's competitive position. More specifically, industries with increasing returns will have a lower

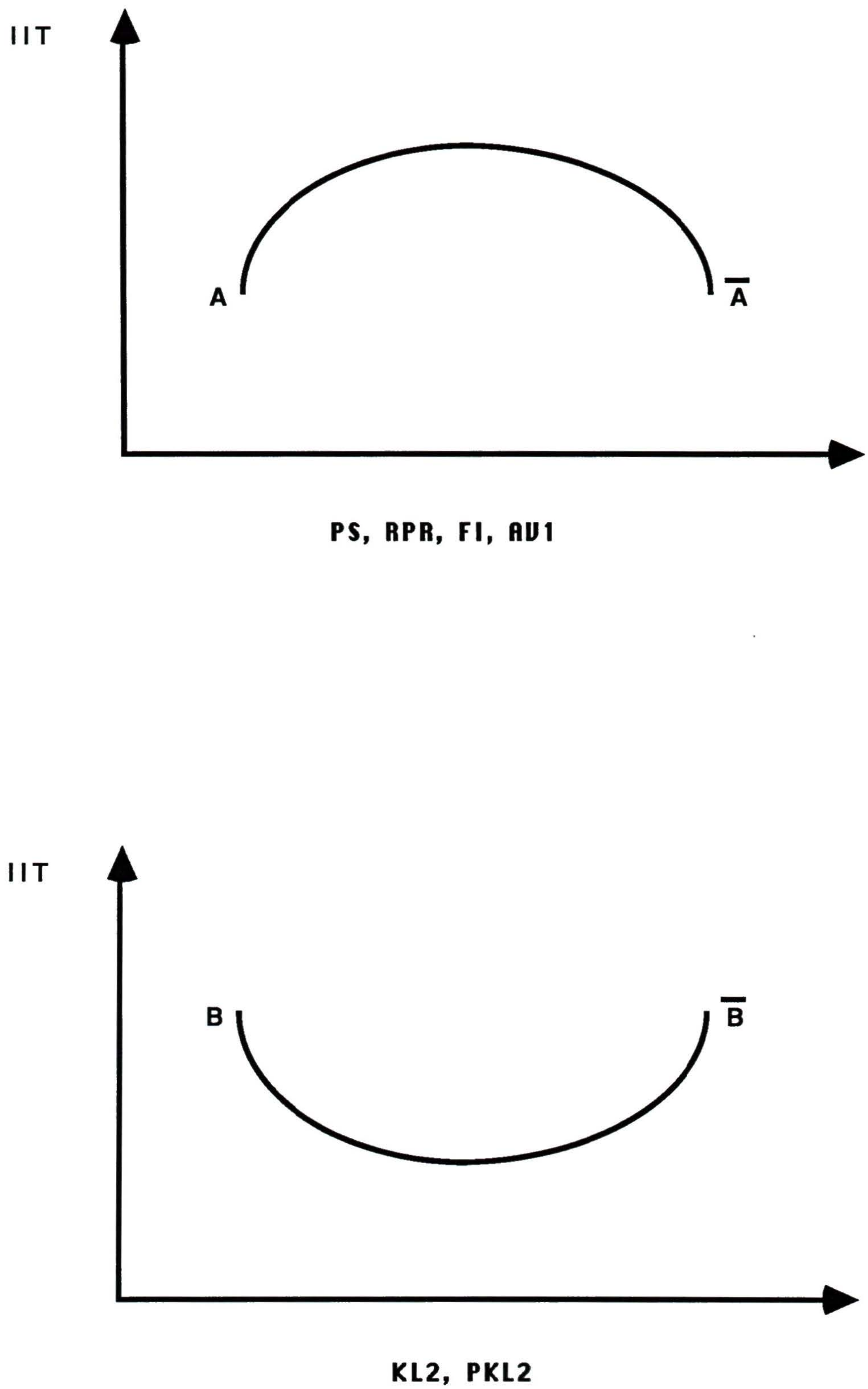

FIGURE 1

cost per unit than industries with either constant or diminishing returns. In such a case, increasing returns will lead to more inter- and less intra-industry trade when such returns do not prevail in similar industries. Therefore, the share of intra-industry trade will be lower in industries which exhibit increasing returns to scale, at least in the case of identical commodities. This measure is intended to capture the efficiency aspect of scale in the sense of transforming a given input to output. And if that is the case, RS will be inversely related to the volume of IIT.

In addition to returns to scale (as defined above), plant scale advantage (disadvantage) may generate economies (diseconomies) either by influencing the scale of optimal operation which determines efficiency, or product diversity which reduces cost per unit, by at least drastically cutting the fixed component of total cost. To the extent that plant or firm size influences scale economies by either directly reducing cost or indirectly via increased efficiency, plant size will influence both the trade volume and the direction of trade between two industries or countries. Industries with such a scale advantage due to their size will also have a cost advantage and therefore, other things being equal, will have a greater market share. The extent of this share is directly related to the extent of the cost advantage, thus determining the volume of trade. To capture this scale advantage or disadvantage, the measure used here is the relative plant scale (PS) between Canada and the U.S. (Canada/U.S.). It is hypothesised that the higher the similarity of plant (firm) size (the closer the ratio is to unity) between two similar industries of the two countries, the higher will be the share of intra-industry trade. This suggests a humped shape relation which is allowed for by including both PS and its square PPS. The expected hump shape will arise if intra-industry trade is positively related to PS but negatively related to PPS.

3. Firm-Specific Technical Knowledge

Hypothesis: Industries with a larger stock of firm-specific technical knowledge will have more innovative ability and hence a higher share of intra-indutry trade of the technological gap variety.

This type of technological gap usually enables a firm(s) to enjoy a monopoly position at least until other firms are able to adapt to the new technology (in a technical sense) and /or until the legal monopoly (patents, copyrights) of the inventing firm expires. Whichever the case, this technological advantage is usually embodied in the labour force. Thus, the level of firm-specific technical knowledge might be expected to be reflected in the average wage rate, the share of technical employees in the labour force and the ratio of research and development expenditure to total sales.

The average wage per man hour (AW) is a measure of skill level assuming that returns to human capital indicate the level of skill embodied in the labour force. If this measure captures the level of skill, then, it is predicted to be directly related to the volume of IIT.

The share of technical employees in the labour force (TL) is similarly a measure of firm-specific relative advantage as reflected in the skill level of its employees. However, the relationship of this variable to the volume of IIT might be complicated by what job categories are defined as technical. That is, if the category of technical employees is composed of workers which operate standardized machines, other unskilled workers engaged in the production process etc., it is to be expected that this variable will be inversely related to the volume of IIT. On the other hand, if technical employees mainly include the highly skilled group of the labor force, for instance engineers and scientists, then one would expect a positive relationship between such level of skill and the volume of IIT due to the embodied high level of skill in such workers. Since the skill categories included in TL are mainly composed of the former category, this variable is expected to be inversely related to the volume of IIT.

Finally, the ratio of research and development expenditure to total sales (RD) is expected to capture firms' relative advantage with respect to technical improvements. With the premise that the higher the level of a firm's research and development expenditure the greater will be its innovative ability, one would expect this variable to be directly related to the share of IIT.

4. Comparative Advantage

Hypothesis: The greater the degree of comparative advantage or disadvantage of an industry, the less will be the volume of intra-industry trade.

There are two principal theories of comparative advantage - the Ricardian theory and the factor proportions theory. The former suggests that a country's comparative advantage will vary directly with the relative productivity of its labour compared to that of other countries. The expectation is that comparative costs will matter most if RPR (the productivity of Canadian labour relative to that of U.S. labour in the corresponding industry) takes on either high or low values, thus suggesting a humped shape relation to intra-industry trade.

In the case of factor proportions theory, the expectation is that a country's comparative advantage will be greatest for those goods which use its relatively abundant factor relatively intensively and least for those goods which use its relatively scarce factor relatively intensively. Whatever the factor abundance of a country, comparative advantage will matter most for industries at the extremes of factor intensities and least for industries at intermediate values. In the present instance FI and AV1, introduced earlier, are used as measures of labour intensity with the expectation that their relation to intra-industry trade will be humped shape. Consequently, the coefficient of either is expected to be positive and that of their squares (PFI, PAV1) are expected to be negative. Since both variables measure the same thing, only one of them was used in any particular equation. For an easy reference, the above variables and their expected signs are summarized in the following table.

Table 1: Summary of Varibles and Expected Signs

HYPOTHESIS	VARIABLE	COEFF.	SIGN
PRODUCT DIFFERENTIATION	SIC1	B1	+
" "	EI	B2	-
" "	AP2	B3	+
" "	KL2	b4	-
" "	PKL2	b5	+
ECONOMIES OF SCALE	RS	B6	-
" "	PS	B7	+
" "	PPS	B8	-
FIRM-SPECIFIC TECH. KNOWLEDGE	RD2	B9	+
" " " "	TL	B10	-
" " " "	AW	B11	+
COMPARATIVE ADVANTAGE	RPR	B12	+
" "	PRPR	B13	-
" "	FI	B14	+
" "	PFI	B15	-
" "	AV1	b16	+
" "	PAV1	B17	-

Chapter 4

EMPIRICAL RESULTS

On the basis of the theoretical discussion outlined in the previous two chapters, the following equation is used to estimate the determinants of intra-industry trade.

$$
\begin{aligned}
IIT = {} & a + b_1SIC1 + b_2EI + b_3AP2 - b_4KL2 + b_5PKL2 \\
& - b_6RS + b_7PS - b_8PPS + b_9RD2 - b_{10}TL \\
& + b_{11}AW + b_{12}RPR - b_{13}PRPR + b_{14}FI \\
& - b_{15}PFI + b_{16}AV1 - b_{17}PAV1 + u
\end{aligned}
$$

Where a and u are the constant and the error term respectively, and the bs are the coefficients of the variables. As discussed above, the variables 1 to 5 represent Product Differentiation, 6 to 8 Scale Economies, 9 to 11 Firm-Specific Technical Knowledge, and 12 to 17 Comparative advantage. The measure used to calculate the index of intra-industry trade (IIT) is that of Grubel and Lloyd which is discussed in Chapter 2 (equation 5.1).

The above equation is estimated for a sample of 67 Canadian manufacturing industries (at the level of 4-digit SIC) for the year 1981. Even though most of the data applies for the year in question, in some case the data for some variables was pooled either for the year 1980 or 1979. These sources are indicated in the discussion of each of the variables concerned. The reasons for opting for this 'second best' alternative are: first, some of the data were not available at the desired level of aggregation, and second, the data for some of the variables (the economies of scale variables in particular) were otherwise unavailable at any level of aggregation.

The regression equation was estimated using Ordinary Least Square (OLS) with a linear specification, though a log-linear equation is also estimated as an experiment to examine possible changes. The results of the two equations are reported in the following table. For alternative regression results see Appendix C.

4.1 Description of Statistical Results.

In general, the following observations can be made regarding the regression results. First, despite the unreliability of the data (in some cases taken from other years) for some of the variables, the overall result of the test is very satisfactory. That is, almost all the variables are both correctly signed as hypothesised in the previous theoretical discussion, and are also statistically significant. Second, the statistical results are reasonably stable in terms of sign and significance, with few exceptions, irrespective of changes in specification or combination of variables. Third, as is expected in any cross-section analysis, a multicollinearity problem was detected among a few of the independent variables which resulted in a corresponding sign changes depending on the combination of variables and the specification of the regression equation. This was detected by the correlation matrix of the variables and by estimating a Ridge regression equation to examine the stability of the variables.

We now focus on the specific results from the linear specification.

Table 2: Regression Coefficients for Determinants of Intra-Industry Trade for Canadian Manufacturing Industries.

LINEAR			LOG.	
VARIBLE	COEFFICIENT	T-RATIO	COEFFICIENT	T-RATIO
SIC1	0.035	1.017	0.332	1.577*
EI	-0.947	-2.223***	-0.144	-0.864
AP2	-25.81	-0.110	0.255	1.395*
KL2	-13.15	-1.450*	-0.124	-0.520
PKL2+	1.903	1.196	-0.007	-0.228
RS	-66.85	-2.729***	-4.410	-3.909***
PS	21.49	1.937**	0.556	2.350***
PPS+	-5.321	-2.309***	-0.122	-2.487***
RD2	1509.9	0.967	0.183	1.546*
TL	-2.692	-0.062	-0.133	-0.110
AW	6.643	2.655***	3.291	4.347***
RPR	407.97	1.283	0.598	1.434*
PRPR+	-2288.1	-1.623*	-39.66	-2.471***
FI	5.458	2.017***	======	======
PFI	-0.120	-1.591*	=====	======
AV1	======	=====	4.915	2.044***
PAV1+	=======	======	-8.808	-1.812**
constant	37.31	0.674	5.919	1.518*
R^2 (adjust.)	.3612			.3961

* Indicates significance at level of 90%, ** at 95% and *** at 99% (one tail test).

'+' indicates that the specification of the variable is the same in both the linear and the logarithmic equations.

4.1.1 Product Differentiation.

All the product differentiation variables (except AP2) have correct signs as theoretically predicted though significance is mixed. While the measure of energy intensity (EI) is highly significant, the measure of categorical aggregation (SIC1) and advertising expenditure (AP2) are statistically insignificant. The variable AP2 also has an unexpected sign. However, it is highly correlated with many of the independent variables and hence both its sign and significance differ depending on what variables are included in (or excluded from) the regression equations. To a lesser extent this also applies to SIC1 although its sign is consistently positive.

The explanations for the inconsistency of SIC1 in terms of significance probably lies in its crude nature as a measure of product differentiation. In essence it is determined by what product lines are included in a given industry classification whose basis is, as noted earlier, an unsettled issue. Further, the data used for computation is simply based on the number of product lines listed under a given statistical classification. But the fact that more product lines are listed under a given classification may not necessarily indicate to what extent the products of that industry are more differentiated than that of other industries.

The possible reasons why advertising expenditure (AP2) is not significant are less obvious from a theoretical stand point if one takes previous empirical studies as a measure of consensus. An exception to this is Caves (1979) who argued that while the 'complexity' (product attribute) aspect of product differentiation favors intra-industry trade, the 'information' aspect promoted through advertising discourages it. This is because, Caves argued, advertising is usually specific to a given culture and therefore does not travel smoothly across national boundaries. In such a case the absence of cultural similarity discourages trade flow that could have occurred due to sales promotion. Even if this line of argument is accepted it is not very likely to be applicable to this study simply because; (a) Canada's main trade is with the U.S. with which cultural differences are minimal, and (b) most of the variables are weighted in terms of respective U.S. values. Thus, the explanation must lie elsewhere.

4.1.2 Economies of Scale.

The hypothesis regarding economies of scale is confirmed by the statistical results. All the variables are correctly signed and almost all significant especially when entered in logarithmic form. Returns to scale (RS) is highly significant with its negative sign indicating that the higher the returns to scale the greater the relative cost advantage which results in more inter- and therefore in less intra-industry trade as theoretically predicted. The plant scale variable (PS) and its squared value (PPS) are also both correctly signed and consistently significant.

4.1.3 Firm-Specific Technical Knowledge.

The variables used to test the hypothesis of firm-specific technical knowledge showed mixed results. The average wage per worker (AW) is highly significant and positive as predicted . The ratio of production related workers to total labour force (TL) and the ratio of R & D to total sales both have the predicted signs, but are statistically insignificant .

The results are not surprising given the data set used to estimate these variables. The problem with TL is that the results will depend on how correctly job categories are defined. If the ratio of production and related workers includes both highly skilled and unskilled workers, the result will depend on the effect of each skill category. TL is computed from published employment data in which the distinction is hardly clear. However, many of the job descriptions in the "production and related workers" category do not seem to require any special skills.[12] On the other hand the data for RD2 only includes expenditures on labouratory equipment which is not a sufficient measure of research and development expenditure. Thus, given the data, the results are not disappointing.

4.1.4 Comparative Advantage.

Among the variables used to test the comparative advantage hypothesis, the measure of relative productivity (RPR) has the predicted sign, though its significance is limited to its squared value (PRPR) in the linear specification. As mentioned elsewhere, the squared value of RPR (PRPR) is used to measure (as is the case with all the variables whose squared value is used in the regression) the extreme productivity differences between two industries which lead to more inter- and less intra-industry trade. The labour/capital ratio - FI (and its squared value PFI)- and the ratio of wage costs to value added - AV1 (and its squared value PAV1) - were entered alternatively since both are measures of factor intensity. As could be seen from Table 2 both variables (including their squared values) are correctly signed as predicted and statistically significant.

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[12] The Statistics Canada definition of production and related workers in manufacturing activity include,"those employees at the establishment engaged in processing, assembling, storing, inspecting, handling, packing, maintenance, repair, janitorial and watchmen services and working foremen.

4.2 Comparison of the Results with Other Similar Studies.

Strictly speaking, statistical results are hardly comparable unless identical equations (with identical variables and specification) are used in a given empirical investigation. Hence, any attempt to compare statistical results must be made with at least the following limitations in mind. First, some variations may exist in how the hypothesis to be tested is formulated and hence the variables chosen. Second, Even if the hypotheses are identical the proxy variables chosen may differ and lead to different set of results. Third, the prevalence of multicollinearity in a group of variables may limit the statistical significance of some variables in one study but not necessarily in some other similar studies which use different combination of variables. Therefore, the following brief comparison should be viewed in light of these limitations. To minimize these problems the comparison will focus on those studies which used identical or similar variables, though specifications differ widely from one study to the next. The main specifications used by the various authors are logit, loglinear and ordinary least square. The results of these other studies that used similar and in many cases identical variables are summarized in Table 3.

Caves (1979), Greenaway (1983) and Loertscher and Wolter (1980), among others, used the number of products in a given statistical category (similar to SIC1 in this study) to test the product differentiation hypothesis. All their results indicate that the variable has the appropriate positive sign and (unlike in this study) highly significant. And the measure of energy intensity (EI) is consistently negative and highly significant in many similar studies (Lundberg (1982), Gavelin and Lundberg (1983), for instance) as is the case in this study.

Table 3: Statistical Results of Similar studies

Author	SIC1	AP2	RD2	EI	AW	TL
G. & Lund.	----	-	(+)	(-)**	(+)**	(+)*
R. Caves	(+)**	-	(+)	---	---	---
L. Lundberg	---	-	(+)	(-)**	(+)***	(+)
D. Greenaway	(+)***	(+)**	(+)	---	---	---
B. Balassa	---	-	---	---	---	---

--- implies inapplicable.
*** = significance at 99%
** = " " 95%
* = " " 90%
The signs in parenthesis are the predicted and obtained ones, if not the sign is contrary to what is predicted.

However, the statistical results for advertising expenditure (AP2) as a measure of product differentiation are mixed. While Greenaway (1983) reported that the share of salesmen in the labour force is positively related to the volume of intra-industry trade and is statistically significant, all the above studies which used the ratio of advertising expenditure to total sales obtained a negative sign and statistically insignificant relationship. It is to be recalled that the variable in this study is also negative and insignificant though it varied depending on what other variables are included or excluded and on the specification of the equation. In this study research and development expenditure is used as a proxy for firm-specific technical knowledge but other studies used it to explain technological differentiation. In either case despite its predicted positive sign it is insignificant in the cited studies as is the case in this study.

Various authors used different measures to explain the role of scale economies in determining the volume of intra-industry trade. Hence due to the variation in the construction of the variables it is not possible to directly compare one with any other. However, the common attribute of all the variables used to test this hypothesis might be characterized as measures of an industry's relative cost advantage either due to plant size or longer production runs. And most of the studies cited above indicate that their results confirm the hypothesis that scale economies determine the share of intra- industry trade in total trade. Gavelin and Lundberg (1983) used a relative productivity measure similar to RPR in this study, but the coefficient was insignificant though the sign was positive as predicted.

With regard to the firm-specific technical knowledge hypothesis, the reported results for the share of production workers to total labour force are significant according to Gavelin and Lundberg (1983) but insignificant according to Lundberg's (1982) although both studies reported a positive sign confirming their predictions. These same studies also indicate that the average wage per worker is both consistently significant and with a positive sign as predicted. This is also confirmed by this study.

The comparative advantage hypothesis is an indirect approach in the sense that the share of intra-industry trade is expected to be higher the less is the comparative advantage. And since this has been the conventionally accepted determinant of inter-industry trade, not many empirical studies include it as an intra-industry trade hypothesis. As mentioned in Chapter One, the recognition that intra-industry trade has a factor endowment basis is of recent origin even at a theoretical level. But the variables used here confirm that between the extreme cases where comparative advantage leads to specialization and hence more inter-industry trade, the share of intra-industry trade could be predicted from the relative comparative advantage of industries.

On the whole, the results of this study are consistent at least with the studies discussed above. That is, the earlier mentioned comparability problem aside, the results obtained by the various authors are similar with this study both in terms of sign and the statistical significance of of the variables.

Chapter 5

SUMMARY AND CONCLUSIONS

This study was set out to test the empirical relevance of the phenomenon of intra-industry trade by examining the case of Canadian manufacturing industries. Despite the various attempts to provide a theoretical explanation and an empirical evidence to verify its genuine existence, no general consensus has yet emerged. Consequently, the controversy regarding its theoretical importance in the international trade literature and its practical trade policy implications has not been settled.

The purpose of this and other similar studies is then to strengthen the available evidence to date by (a) examining a different set of data pertaining to different set of countries or industries; and (b) by extending the level of enquiry in order to identify the determinants of such trade. This study aimed at carrying out both tasks by concentrating on Canadian manufacturing industries, and by including a different set of measures. To that an extent, it is hoped the study will contribute to resolving the on going controversy regarding the phenomenon.

The study identified four main determinants of intra-industry trade: the degree of product differentiation, economies of scale, firm-specific technical knowledge, and comparative advantage. On the whole, the hypotheses can not be rejected and the statistical results are robust. The basic arguments, findings and implications of the study could be summarized as follows:

1. With respect to the determinants of intra-industry trade, the following conclusions could be reached.

a. The higher the degree of product differentiation, the greater will be the volume of intra-industry trade. The statistical results provide a reasonable support for the hypothesis.

b. More extensive scale economies lead to more inter-industry and, therefore, to less intra-industry trade. The results are particularly significant because the variables used to measure this hypothesis are more direct than the usually used proxy variables.

c. The larger the stock of firm-specific technical knowledge, the greater will be the volume of intra-industry trade of the technological gap variety. The statistical evidence is not very solid in terms of the significance of the variables (only AW is consistently significant) used to measure the hypothesis, but the predicted signs all indicate the relevance of the hypothesis as a determinant of intra-industry trade.

d. The greater the degree of comparative advantage of an industry, the less will be the share of intra-industry trade in total trade. This hypothesis is also statistically confirmed.

2. The argument that the phenomenon of intra-industry trade is a statistical artifact reflecting the heterogeneity of products within a statistical category of

trade is not supported by the above statistical results. The measure of heterogeneity (SIC1) could only explain, if at all, a small portion of the phenomenon. Further, even using a relatively disaggregated data (4-digit SIC), the level of intra-industry is quite high, a mean of 47% and the reported significance of the explanatory variables support this conclusion. Thus, categorical aggregation does not seem to be the main source of the observed levels of intra-industry trade.

3. This study, as a departure from other studies, used more direct measures of economies of scale and established its significance as a determinant of intra-industry trade. It is to be noted that many such studies have failed to empirically establish the significance of economies of scale as a determinant of intra-industry trade despite its strong theoretical appeal.[13] It is to be hoped that this study will be of some help in filling this gap by indicating the direction and the extent to which economies of scale influences intra-industry trade.

4. Another departure from other similar studies is the inclusion of a comparative advantage hypothesis which is usually used to predict inter-industry trade. By distinguishing between the intermediate and the extreme cases of comparative advantage (using a given variable and its square), this study established that the intermediate cases of comparative advantage lead to more intra-industry trade.

5. Finally, it was argued that the variables used to measure an industry or a country's advantage or disadvantage (factor intensity, productivity, plant size etc.) should be weighted in terms of an appropriate industry or country as opposed to using the absolute values of such variables. The demonstration of this argument

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13 For a summary of statistical results see Tharakan (1983), and for the theoretical significance of economies of scale see Krugman (1979, 1980) Ethier (1982), and Helpman (1981).

by weighting the above variables in terms of corresponding U.S. industries is, one could argue, an important way of establishing the true relative advantage or disadvantage of a given industry or country.

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APPENDIX A

DEFINITION OF VARIABLES AND DATA SOURCE.

1. IIT = The Volume of Intra-Industry Trade Index. It is calculated using the Grubel and Lloyd Index discussed in Chapter Two (Equation 5.1).

   Source: Manufacturing Trade and Measures 1966 - 1981. Economic Intelligence Directorate Office of Policy Analysis, Department of Industry, Trade and Commerce/ Regional Economic Expansion. Ottawa, July 1981.

2. EI = Energy Intensity.

$$= \frac{\text{Energy consumption}}{\text{Number of Employes,}}$$

   Where energy includes fuel and electricity and employees are those classified as Production and related workers.

3. SIC1 = Indicator of Product Diversity. Measured as the number of products listed under each 4-digit SIC Classification.

4. AP2 = Ratio of Advertising Expenditure to to total Sales for each industry.

   Source: Special tabulation by the Input/Output Division of Statistics Canada.

5. KL2 = Relative Capital Stock.

   = A ratio of capital stock per man-hour in Canadian manufacturing industries to similar U.S. industries.

   Source: Baldwin and Gorecki (1986), The Role of Scale in Canada-U.S. Productivity Differences in the Manufacturing

<u>Sector, 1970-1979.</u> Supply and Services Canada, University of Toronto Press. PP. 294-296, Table D-5, Column 4.

6. $PKL2 = (KL2)^2$

7. RS = Returns to Scale.
Based on Baldwin and Gorecki's Production function estimates with labour and capital as factor inputs, for the year (1979).
Source: See RS, Table D-3, Column 4, (PP. 288 - 291).

8. PS = Relative Plant Scale.
Plant scale of Canadian manufacturing industries relative to that of U.S. (Canada / U.S.).
Source: See RS, PP.291 - 293, Column 5.

9. $PPS = (PS)^2$

10. RD = Ratio of research and development expenditure to total sales value.
Source: See, AP2.

11. TL = The ratio of technical workers to total employees for each industry.

12. AW = Average wage per man-hour.
This is calculated for the employees only engaged in the manufacturing activity of the industry.

13. RPR = Relative Productivity.

$$= \frac{\text{Value Added for Canada}}{\text{Value Added for the U.S.}}$$

This is estimated after adjusting

for price differences in the two countries.
Source: See RS, PP. 296 - 299, Column 3.

14. PRPR $= (RPR)^2$

15. FI = Measure of Factor intensity.

$$= \frac{\text{Returns to Labor}}{\text{Returns to Capital}}$$

Source: See RS, Columns 2 and 3.

16. PFI $= (FI)^2$

17. AV1 = Relative industry cost advantage.

$$= \frac{\text{Average Wage per worker (wages/No.employ's)}}{\text{Average Value Added (V.Added/No.employees)}}$$

18. PAV1 $= (AV1)^2$

Note:

Unless indicated the data used to calculate the variables is based on Statistics Canada Publication (Catalogue no. 31-203) at the 4-digit SIC of manufacturing industries for the year 1981.

APPENDIX B

MATCHING OF 4-DIGIT SIC CODE AND INPUT/OUTPUT CLASSIFICATIONS.

INDUSTRIES	I/O	70 SIC	80 SIC	
Slaughtering and Meat Processors	016	1011	1011	
Poultry Processors	017	1012	1012	
Fish Products Indst.	019	1020	1021	
Fruit and Vegetable Canners and Preservers	020	1031	1031	
Frozen Fruit & Vegt. Processors	020	1032	1032	
Diary Products Ind.	018	1040	1041	1049
Biscuit Manufacturers	023	1071	1071	
Bakeries	024	1072	1072	6012
Confectionery Manf.	025	1081	1082	1083
Soft Drink Manf.	029	1091	1111*	
Distilleries	030	1092	1121	
Breweries	031	1093	1131	
Wineries	032	1094	1141	
Cotton Yarn & Cloth Mills	043	1810	1820*	1829
Wool Yarn & " "	044	1820	1820*	1821
Fibre and Filament Yarn Manufacturers	045	1831	1811*	
Fibre Process. Mills	046	1851	1911*	
Carpet, Mat and Rug Ind.	051	1860	1920*	1921
Canvas Products Manfs.	053	1872	1931	
Hosiery Mills	056	2310	2490*	2494
Knitted Fabric Manfs.	057	2391	1831	

Children's Clothing Ind.	058	2450	2451	
Foundation Garment Ind.	058	2480	2490*	2496
Manufacturers of pre-fabricated Buildings	061	2543	2549*	
Wooden Box Factories	062	2560	2561	
Coffin and Casket Ind.	063	2580	2581	
Manuf. of Particle Board	064	2593	2592	2593
Office Furniture Manufs.	066	2640	2641*	2649
Electric Lamp & Shade Manufacturers	068	2680	3332	
Pulp and Paper Mills	069	2710	2711	2712 2713 2714 2719
Asphalt Roofing Manufs.	070	2720	2721	
Folding Carton and Set-up Box Manufs.	071	2731	2731	
Corrugated Box Manufs.	071	2732	2732	
Paper & Plastic Manufs.	071	2733	2733	1691
Commercial Printing	073	2860	2811	2819
Iron and Steel Mills	075	2910	2911	2912 2919
Steel Pipe & Tube Mills	076	2920	2921	
Iron Foundries	077	2940	2941	
Boiler & Plate Works	083	3010	3011	3021* 3022
Fabricated Structural Metal Ind.	084	3020	3021*	3023 3029
Metal Door & Window				

Manufacturers	085	3031	3031	
Heating Equip. Manufs.	089	3070	3071	3121* 3199*
Agricultural Implement Industries	092	3110	3111*	
Commercial Refrigeration & Air conditioning Equipment	094	3160	3121*	
Aircraft & Aircraft Parts Manufacturers	096	3210	3211	
Motor Vehicle Manufs.	097	3230	3231	
Motor Vehicle Parts and Accessories Manufs.	099	3250	3251 3252 3253 3254 3255 3259	
Railroad Rolling Stock Industries	100	3260	3261	
ShipBuilding & Repair	101	3270	3271	
Manufacturers of Small Electrical Appliances	103	3310	3311	
Manufacturers of Major Appliances	104	3320	3321	
Manufacturers of Lighting Fixtures	110	3330	3331	
Manufacturers of Household Radio and Television Receivers	105	3340	3341	
Clay Products Manufs. (from domestic clay)	115	3511	3511	
Clay Products Manufs. (from imported clay)	115	3512	3512	
Stone Products Manufs.	117	3530	3599*	

Manufacturers of Structural Concretes Products	113	3542	3542
Glass Manufacturers	119	3561	3561
Glass Products Manfs.	119	3562	3562
Abrasives Manufacturers	120	3570	3571
Lime Manufacturers	112	3580	3581
Manufacturers of Mixed Fertilizers	123	3720	3722
Paint and Varnish Manufacturers	126	3750	3751
Manufacturers of Soap and Cleaning Compounds	127	3760	3761
Manufacturers of Toilet Preparations	128	3770	3771
Jewellery & Silverware Industries	132	3920	3921
Sporting Goods Manufs.	134	3931	3931
Signs and Display Ind.	136	3970	3971

* = Indicates partial inclusions.

Source: Statistics Canada
1970 SIC Classification Handbook
1980 SIC Classification Handbook
Input/Outpt Classification Handbook

APPENDIX C

ALTERNATIVE REGRESSION RESULTS.

Note: the letter 'L' infront of any variable indicates that the logarithim of the variable is used in the equation.

The following are alternative set of egression results among those experimented by varying the combination of the variables and/or the specifica-ation of the equations.

ALTERNATIVE RESULTS OF ALL THE HYPOTHESES.

1. IIT = 44.46 - 1.077 EI - 13.72 KL2 + 1.973 PKL2
(1.347)* (-2.65)*** (-1.55)* (1.284)

- 70.92 RS + 17.89 PS - 4.764 PPS + 7.027 LAW
(-2.996)*** (1.711)** (-2.165)*** (3.239)***

+ 437.7 RPR - 2443.5 PRPR + 5.138 FI - 0.095 PFI
(1.424)* (-1.800)** (1.966)** (-1.327)*

$\bar{R}^2 = .3852$ $F = 4.760$

2. IIT = 19.96 + 0.035 SIC1 - 1.09 EI + 7.64 AP2
(0.623) (1.062) (-2.645)*** (0.043)

- 63.96 RS + 17.73 PS - 4.834 PPS
(-2.685)*** (1.664)* (-2.167)***

+ 6.931 AW + 443.6 RPR - 2471.5 PRPR
(3.245)*** (1.4213)* (-1.792)**

+ 5.441 FI - 0.110 PFI
(2.097)*** (-1.500)*

$\bar{R}^2 = .3697$ $F = 4.520$

3. LIIT = 5.005 + 0.167 SIC1 - 0.043 EI + 0.220 LAP2
(1.539)* (0.809) (-2.613)*** (1.440)*

- 5.064 LRS + 0.477 LPS - 0.127 PPS + 3.544 LAW
(-4.643)*** (2.237)*** (-2.824)*** (5.658)***

+ 0.729 LRPR - 37.87 PRPR + 4.538 Lavl
(1.906)** (-2.523)*** (2.123)***

- 8.694 PAV1 $\bar{R}^2 = .4600$ $F = 6.111$
(-2.016)***

4. $$LIIT = \underset{(1.377)^{*}}{4.702} + \underset{(1.806)^{**}}{0.365\ LSIC1} + \underset{(1.419)^{*}}{0.228\ LAP2}$$

$$- \underset{(-3.789)^{***}}{4.070\ LRS} + \underset{(2.032)^{***}}{0.455\ LPS} - \underset{(-2.323)^{***}}{0.109\ PPS}$$

$$+ \underset{(4.839)^{***}}{3.013\ LAW} + \underset{(1.787)^{**}}{0.718\ LPRPR} - \underset{(-2.764)^{***}}{43.20\ PRPR}$$

$$+ \underset{(1.962)^{**}}{4.405\ LAV1} - \underset{(-1.810)^{**}}{8.191\ PAV1}$$

$\bar{R}^2 = .4038 \quad F = 5.470$

* = Significance at 90%
** = " " 95%
***= " " 99%

t-values are in parenthesis.

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Title of Thesis

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