Regional and Statistical Variation in the Commodity Structure of Canada's Intra-Industry Trade with the United States

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The volume of international trade in manufactured goods has increased significantly since the Second World War, both in absolute terms and relative to trade in resources and primary materials. Within manufactured products, cross-trade has grown even more quickly and now dominates the total as firms become more involved in the simultaneous export and import of similar goods. It is estimated that intra-industry trade, the simultaneous import and export of similar commodities, now represents more than 60 percent of the total international trade in manufactured products (MacCharles 1987). This paper examines Canadian intra-industry trade with the United States using the Grubel and Lloyd (1975) and Aquino (1978) intra-industry trade indices. The goal is to determine the importance and commodity mix of United States intra-industry trade in the Canadian economy using descriptive analysis and cross-trade statistics. Three principal questions are addressed. First, what is the level of intra-industry trade between Canada and the United States and which Canadian provinces, if any, have a majority of the cross-trade with the United States? Second, does the level of intra-industry trade between Canada and the United States differ significantly depending on the degree of technological sophistication embodied in the commodity? Finally, do the intra-industry trade indices vary significantly depending on the level of commodity aggregation analyzed?

A broader objective of the paper is to explore developing trends in intra-industry trade between Canada and the United States in order to better our understanding of evolving trade patterns between developed nations. Worldwide increases in production efficiency have led to an increase in rationalization of products and production activities. To specialize successfully, it is often necessary to contract out production to specialist suppliers, many of whom are outside the domestic economy. To achieve greater scale, moreover, it is often necessary to export. These two activities cause an increase, on a two-way basis, in the imports and exports of similar goods for many industries. Further, as trading blocs continue to emerge in the 1990s, the quantity and composition of international trade within trading groups will evolve, generating a myriad of questions concerning multilateral (for example, the General Agreement on Tariffs and Trade) versus regional (for example, the North American Free Trade Agreement and Europe 1992) trading arrangements. For example, how does the spatial allocation of production shift, if at all, within a trading bloc? Are clusters of competitive firms forming in a borderless environment (Porter 1990), taking advantage of assets of the other nations within the economic bloc? Does each member country of the agreement produce goods that are complements or substitutes to be traded within the bloc, and does the composition of intrabloc trade differ from trade outside of the bloc?

To determine the robustness of intra-industry trade as a measure of international trade intensity, it is important to determine how the statistics react to various database changes. How sensitive are the various indices to changes in the level of product aggregation? Does a change in commodity groupings follow expected trends or do the results suggest inconsistencies inherent in the structure of the statistics that skew the results of the analysis?

Theoretical Foundations and Hypotheses

The growing body of theoretical and empirical literature concerning intra-in-dustry trade (IIT) recognizes that the study of the prevalence of such trade is important in three respects. First, variations of IIT intensity exist for any given industry depending on country-specific characteristics of the trading partners. Secondly, variations of IIT intensity occur across industries depending on commodity-specific demand and supply characteristics (Hypothesis 1). Finally, the accurate quantification of international cross-trade provides a reliable indication of its relative significance in explaining international exchange by comparison with the relative factor proportions explanation (Hypothesis 2). This paper adopts an approach covering IIT between Canada and the United States across a variety of industries, thus uncovering trends in the propensity to engage in IIT in the future. The analysis also explores provincial IIT flows, trends in technology intensive commodities, and the effect of categorical aggregation on the robustness of the available statistics.

Given the relatively small size of the Canadian domestic market, manufacturers can achieve certain economies of scale by increasing exports. The freer trade environment of the 1990s has created an opportunity for Canadian manufacturers to gain improved access to international markets, especially those in the United States. Increased scale and specialization by manufacturers would increase the international cross-trade in similar goods within the same industry sector. Both imports and exports would simultaneously increase for these industries undergoing rationalization. Further, an increase should occur in the ratio of purchased material to value-added for such industries following an increased level of trade in intermediate and final goods between producers as firms out-source for internally made goods. The importance of value-added occurs when the proportion of purchased material to value-added is increasing, which shows both rationalization and specialization (Krugman 1981). Manufacturers in the supplying industries that are attempting to reduce their unit costs to internationally competitive levels by engaging in product specialization and increased scale through exports will increase the exports of these same supplying industries. The combination of increased imports through foreign sourcing by manufacturers outside the supplying industry along with increased scale and specialization through exports by manufacturers within the supplying industry will result in an increased international cross-trade for industries producing such intermediate goods (Grubel and Lloyd 1975).

The form of international economic involvement that a firm will pursue (such as, licensing, foreign direct investment, intra-industry trade, and so forth) depends on a variety of contextual factors, notably country-, industry-, and firm-specific characteristics (Dunning 1988). One extreme, from a theoretical standpoint, is typified by a Heckscher-Ohlin-Samuelson world in which all transactions are conducted in a perfectly competitive environment, which is a variant of the factor endowment explanation of trade. In this situation, all inter-country transactions will be inter-industry and based upon the distribution of location-specific assets. Alternatively, international trade may be derived from a similarity of economic factors other than those associated with the availability of factor endowments (Balassa 1986).

The increase in global international IIT raises three noteworthy points with regard to traditional trade theory. While real growth in the international trade of manufactured goods has been substantial, both relative and total employment in manufacturing has remained static. An innovation may be a process or a product. Most product advances promote job creation, whereas most process innovations are measured by increased efficiency, often with labor replacement. A further case exists when one firm's product innovation (for example, a piece of labor saving technology) becomes another firm's process innovation (for example, cutting unskilled labor). The second point of interest is that the Heckscher-Ohlin-Samuelson (HOS) trade model predicts that international trade will occur between firms or industries if one can produce with a comparative cost advantage over the other (Samuelson 1947). This results in international trade of dissimilar goods between countries, with each country specializing in the production and exportation of outputs from industries different than those of its trading partners. The third problem relates to the fact that the HOS model explains international trade in terms of differences between countries in the relative availability of various factors of production and specialization (Aquino 1978). Relative differences in factor endowments between countries cause inter-national price variation for the factors of production. In the case of bilateral trade flows, aggregated over products and between countries, Lancaster (1980) has shown that in a two-sector model with one differentiated and one homogeneous product, equality of factor endowments in the two countries will result in pure intra-industry trade, while in the case of differing endowments, both inter- and intra-industry trade will occur (Globerman 1992). As the demand structure for the products of two nations become similar, the trade between them will increasingly become intra-industry in structure. The less the difference in factor endowments between the two countries (for example, between Canada and United States), therefore, the higher the proportion of IIT that will occur (Lundberg 1982; Globerman 1992). Thus, differences in factor endowments and prices partially explain the growth in IIT between industrial countries.

Several econometric studies of IIT have examined the determinants of the degree of this trade between pairs of countries for a particular industry (Lundberg 1982; Bergstrand 1990; Balassa and Bauwens 1987) and between numerous countries and numerous sectors (Caves 1981; Toh 1982). These cross-country, cross-sectional, studies have found systematic empirical relationships between the share of IIT between two nations and the average levels of and inequalities between their gross national products, per capita incomes, and tariff levels, thus providing partial justification for comparing the two economically similar regions in this study. The robustness of the econometric results of this genre has varied, however.

Inequality, or a negative correlation, in per capita incomes (Toh 1982) and the resultant effect of the levels of international IIT have been attributed to differences in taste (Linder 1961) and the outcome of capital-labor ratio differences (Helpman and Krugman 1985). Higher average per capita income represents a higher level of economic development, raising the extent of demand for differentiated products and increasing the share of cross-trade (Loertscher and Wolter 1980; Balassa and Bauwens 1987). Another way of expressing this is that consumers with high incomes are willing to pay for product differentiation. Bergstrand (1990) tested a model that revealed that a greater similarity in per capita incomes would be associated simultaneously with more IIT for both supply (Heckscher-Ohlin-Samuelson model) and demand (Linder) reasons.

The levels of IIT are expected to be proportionally higher between Canada and the United States because of the large North American product market, trade liberalization and economic integration, shared international border effects, and the high level of development that the two nations enjoy. In large markets, many differentiated products can be produced under conditions of economies of scale. At the same time, a voluminous demand exists for foreign differentiated goods so that the potential for IIT is high.

Trade liberalization has, in the past, primarily involved developed countries. Factor price differences are relatively small between developed nations. Competition within domestic markets reflects product differentiation that is stimulated both by higher incomes and by oligopolistic market structures. As a consequence, increased IIT is a prominent feature of trade liberalization involving industrialized countries. To the extent that trade liberalization involves developing as well as industrialized countries, the impact could involve significantly more IIT adjustments than has hitherto been the case.

Balassa and Bauwens (1987) found a negative correlation between a nation's average tariff level and the share of IIT. A bilateral removal of trade barriers will cause a nation to shift resources from import-competing industries to export-competing ones in which the country has a comparative advantage, leading to an increase in inter-industry specialization. Import-competing firms in North America should respond to the changing trade environment brought about by the Canada-United States Free Trade Agreement and the North American Free Trade Agreement by reducing unit costs through increased specialization and scale. This response would influence the domestic and international trade flows for Canada, because similar countries, with reduced barriers, have an incentive to trade, and their trade will typically be in products produced with similar factor proportions.

An increase in specialization and barrier reduction would result in more out-sourcing of minor product lines, intermediate goods, and services to efficient suppliers at home and abroad, thereby increasing imports of manufactured goods. Bellows (1987) also found that membership in regional integration in the European Common Market, the European Free Trade Association, and the Latin American Free Trade Association is positively correlated with the level of cross-trade.

Moreover, barriers to trade, including non-tariff barriers such as imperfect information and the existence of transport costs, are relatively weak between Canada and the United States because of spatial proximity, similarly high levels of economic development, and the Canada-United States Free Trade Agreement. When trade barriers exist, domestic firms are buying at non-competitive prices, which is a form of tied purchasing. Efficient information and communication linkages are a precondition for a substantial exchange of highly dif-ferentiated goods (Hepworth 1989). Geographical proximity, which often goes hand in hand with similar preference patterns and habits, further facilitates IIT.

In addition, highly developed countries command a high capability to innovate and, hence, an important precondition to develop and produce differentiated goods. These countries are characterized by highly differentiated demand, which allows for the exploitation of economies of scale in the production of a wide variety of individual commodities. Highly developed countries also enjoy highly developed information and communication linkages. All of these factors enlarge the scope for realization and expansion of trade in differentiated products.

Finally, a similar level of development means similar consumer preference structures and similar factor price relations; production of only slightly differentiated goods and intense IIT are thus likely (Balassa 1986). Furthermore, the difference in levels of development must be introduced because the average level of development has a stronger impact on the extent of IIT if the high average reflects high levels of development in both countries (Caves 1981), as is the case in this study. If, however, the high average is the resulting mean of a low and a very high level of development, the potential IIT is much smaller because the respective demand patterns of the two countries and thus the goods produced are poorly matched. In regard to the level of IIT between individual Canadian provinces and the United States, it is expected that the larger provinces will have higher levels of IIT when compared to the smaller provinces for the same reasons stated above.

Hypothesis 1

A process or product innovation will give a producer a temporary monopoly position because the knowledge is not available for competitors. This position can be strengthened by legal devices such as patent laws, and by productivity and cost advantages for the innovating firms associated with internalization of product innovation (Dunning 1988). The innovator will, at least temporarily, be the sole producer and exporter of the product. This situation is the first stage of the Vernon product life cycle model in which a technological gap is created by the innovating company (Vernon 1966).

If product innovations of different kinds occur simultaneously in an industry in two countries, this will result in the production of two substitutes that differ with respect to consumer characteristics, and thus in intra-industry trade, provided that there is a demand for the new products in both countries. The production technologies known to different firms are not identical, and the firm's choice of product specification cannot be changed in the short run because it depends on acquired firm-specific knowledge.

Permanent differences may exist between industries with regard to the importance of technological gap measurement; for instance, production techniques in clothing are obviously far more standardized and internationally well-known than in the pharmaceutical industry. Assuming a diffusion of technology takes place, so that knowledge becomes freely available after a certain period of time, then only new knowledge will be firm-specific. Technological gaps will then occur in industries with a high rate of change of technical knowledge or a high rate of innovation. IIT is negatively correlated with the degree of product differentiation (Krugman 1979; Lancaster 1980; Helpman 1981) and positively correlated with the degree of product standardization.

Hypothesis 1. Over time, higher-technology commodities will have relatively lower levels of IIT when compared with industries whose products are in the mature or standardized phase of the product life cycle.

Hypothesis 2

It is evident that the measurement of IIT is based upon the available statistical classifications with both upward bias (at highly aggregated commodity classifications) and downward bias (at disaggregated classification levels). The upward bias stems from the heterogeneity of the commodities included in each statistical group, even at the finest level of disaggregation. The downward bias is related to the fact that commodities having identical technology-intensity are often included in different statistical commodity classifications (Aquino 1978). In other words, at levels of high aggregation, products may be included in a commodity grouping with products that are very different and vice versa for low levels of aggregation. Hypothesis 2 is intended to verify the statistical robustness and accuracy of the IIT statistics used in this study. The question of commodity disaggregation acts as a known control in the study. Further, this study disaggregates commodity groupings lower than most other IIT studies (Balassa 1966; Balassa and Bauwens 1987; Lundberg 1982; Siriwardana 1990; and Toh 1982). The products of like industries should be determined regardless of government product classification so that similar and dissimilar products are identified. This is accomplished in the study by disaggregating the commodity listings down to their 6-digit harmonized code.

The 2- or 4-digit harmonized tariff classification makes no distinction between final products and intermediate inputs. In some cases, IIT will occur because the country imports parts and exports the final product. Such vertical specialization may take place between independent firms or between plants in different countries owned by multinational firms. Such trade may well be explained by the traditional theory of comparative costs, if the successive stages of production (such as, production of parts and the assembly of the final product) are characterized by differing factor requirements. The apparent two-way trade of the "same" product is then caused by improper aggregation, this time a vertical aggregation over production processes, the output of which is tradeable. By disaggregating down to 6-digits, this study aims to control for aggregation bias that may result from over aggregation. It is expected that as the analysis approaches individual industrial product lines, the IIT statistic will represent a more accurate measure of cross-trade, disproving that two-way trade is a consequence of aggregation of industries and products with widely varying factor requirements.

Hypothesis 2 serves two specific purposes in this study. First, if the hypothesis is verified, it will lend empirical verification to the rest of study by validating the significance or robustness of intra-industry measures used as a basis throughout the study. Throughout the literature, it is assumed that disaggregation of commodity groupings will lower intra-industry levels and, therefore, the hypothesis acts as a control in the analysis. Secondly, the purpose of this exercise is to examine Canadian IIT flows. The importance of the United States in the Canadian economy as a whole and with individual provinces is well documented. If this is true, then the logical progression is to ask in what commodities and/or industry groupings (Hypothesis 1) does this form of trade occur. To accomplish this goal the study needs to disaggregate the data into industry-level commodity mixes.

Hypothesis 2. The more disaggregated the commodity grouping, the lower the level of IIT.

Disaggregation of Industrial Sectors

The principal complication with the measurement of international cross-trade is the influence of categorical aggregation (Greenaway and Milner 1983). As Finger (1975) suggests, trade overlap may be consistent with the factor proportions theory so long as factor inputs vary more within product groups than between, thus making a case for disaggregated comparisons. A product group or industry sector may contain subgroups of products with widely varying factor requirements. If this is the case, expectations would be that the share of trade overlap or IIT in total trade is substantially reduced by disaggregation (Vona 1991). To illustrate this point, the extreme case of disaggregation would show very little, if any trade. A precondition for IIT to exist (Grubel and Lloyd 1985) seems to be that the products of individual firms in an industry are heterogeneous on the demand and/or supply side. The products of different producers, while belonging to the same product category, are not identical. The greater the scope for product differentiation in a statistical classification, therefore, the greater the amount of IIT that is likely to occur. Economies of scale in production will lead a country to produce only a subset of the products within each group, so that IIT will also take place (Krugman 1981). Countries with similar factor endowments will still trade because of scale economies if their trade is largely intra-industry in character.

Methodology

Balassa (1966), while assessing the effects of the formation of the common market on the level of international specialization of European Economic Community countries, developed one of the earliest intra-industry indices in order to explore the question of whether the EEC led to inter- or intra-industry trade specialization:

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

where X_i and M_i indicate the exports and imports of a certain country in industry *i*. If exports and imports tend to match each other in industry *i*, the index approaches zero and signifies, according to Balassa, a high degree of intra-industry specialization. Grubel and Lloyd (1975) criticize Balassa's index both because it is a simple arithmetic mean of each industry's index (and thus fails to reflect the different weights of each industry), and because it does not take account of the need to correct for aggregate trade imbalances.

A variety of measures of intra-industry trade are available, such as Balassa's; but, perhaps the best known and most widely used is that proposed by Grubel and Lloyd (1975). The weighted-average, basic trade overlap index measuring intra-industry trade in country *j*'s foreign trade in commodity *i* is the following:

$$B_{ij} = \frac{[(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{(X_{ij} + M_{ij})} \times 100 \qquad (2)$$

generally presented in its contracted form as

$$B_{ij} = [1 - \frac{|X_{ij} - M_{ij}|}{(X_{ij} + M_{ij})}] \times 100 \qquad (Grubel\ and\ Lloyd) \qquad (3)$$

where X_{ij} and M_{ij} stand for the values of country *j*'s exports and imports, respectively, of commodity *i*. B_{ij} measures intra-industry trade (the numerator of the fraction) as a percentage of *j*'s total trade in commodity *i*. Its value ranges between zero (when either X_{ij} or M_{ij} is zero so that there is no intra-industry trade in commodity *i*) and 100 (when $X_{ij} = M_{ij}$, so that all trade in commodity *i* is intra-industry trade).

A measure of the share of intra-industry trade of total trade in all products with the world can be obtained as a weighted average of the B_{ij}'s for the product groups (Grubel and Lloyd 1975):

$$B = 1 - \frac{[\Sigma|X_i - M_i|]}{(\Sigma X_i + \Sigma M_i)} \quad (Weighted\ Grubel\ and\ Lloyd) \quad (4)$$

where *B* ranges from 0 to 1. However, the intra-industry share of a country's total trade with a country will be affected (for example, the mean is biased downward) by the size of the overall trade deficit or surplus. The greater the imbalance, the greater will be the share of net trade and the smaller the share of cross-trade. The Aquino (1978) adjusted intra-industry trade measure weights the X_i and M_i values by a factor representing the aggregate imbalance of trade and is equivalent to:

$$F = 1 - \frac{1}{2} \sum \left| \frac{X_i}{\Sigma X_i} - \frac{M_i}{\Sigma M_i} \right| \quad (Aquino\ Adjusted\ Index) \quad (5)$$

The Aquino index varies between zero and two. It is higher when all the industries or commodities considered have the same weights in total exports as in total imports, because in this case $X_{ij}/\Sigma X_{ij} - M_{ij}/\Sigma M_{ij}$ is 0 for every *i*. The index reaches zero when imports and exports are concentrated in different industries or commodities (Vona 1991). This measure is based on the degree of similarity between a country's export and import structures. The more similar the share of total exports and imports for individual product groups is, the higher is the share of intra-industry trade. The complete set of the intra-industry trade measures calculated for the sample of commodities used in the study can be obtained from the author upon request.

According to Greenaway and Milner (1983), at least three ways exist to establish a measure, or correct for, the influence of aggregation bias: measurement at a lower statistical aggregation; measurement according to alternative classification or regrouping of commodity categories (Balassa 1987); and computation of an adjusted B_{ij} index. The expectation in this study is that average levels of cross-trade will fall as the sectors are disaggregated along more specific product lines. If average levels of IIT fall substantially from one level to another, then this would be an indication of the presence of categorical aggregation misrepresentation.

Organization of the Inquiry

Each harmonized commodity under consideration was randomly selected and subsequently divided into 6 two-digit, 142 four-digit, and 825 six-digit classifications. The sample represents a diverse commodity mix of manufactured goods. For the hypotheses, a descriptive analysis of the percentage of import/export trade at all the levels of disaggregation between Canada and the United is compared with the Grubel and Lloyd

IIT statistic. Finally, the Grubel and Lloyd statistic is compared to Balassa's index and Aquino's statistic.

The commodities in certain categories will be considered higher technology products in comparison to others for Hypothesis 1. Based on studies by Malecki (1978, 1985) and Markusen, Hall, and Glasmeier (1986), industries selected as representing high technology industries (Table 1) are compared to relatively low, standardized product lines (Table 2) such as ploughs (H.S. 8432.10) and drilling machines (H.S. 8459.21).

TABLE 1 High Technology Sectors

TABLE 2 Lower Technology Sectors

Canada's Trade Position with the United States

The importance of the trading relationship between Canada and the United States is evident by the magnitude of the flows between the two nations (Figure 1). Canada runs a trade surplus that increases substantially from 1989 to 1990, which is a possible result of the Canada-United States Free Trade Agreement (FTA). Figure 2 presents the percentage of imports and exports with the United States.

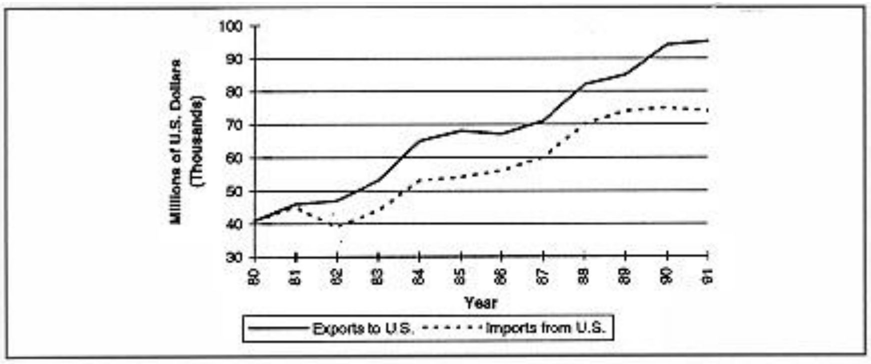

FIGURE 1 Canadian Imports and Exports 1980-1991

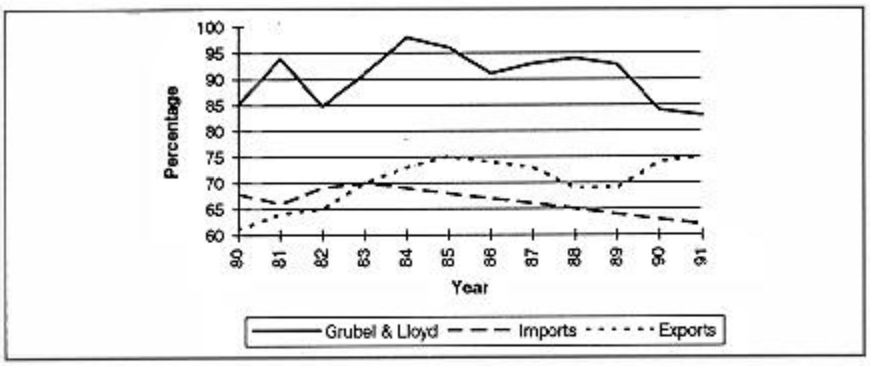

FIGURE 2 Canadian-United States Total Trade 1980-1991

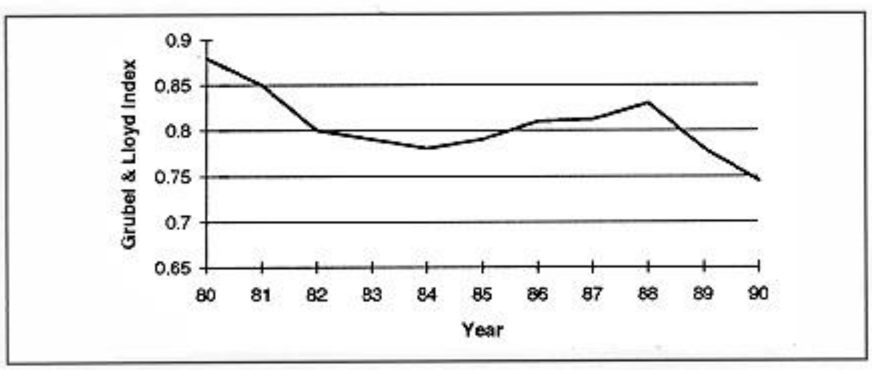

FIGURE 3 Intra-Industry Trade with the United States 1980-1990

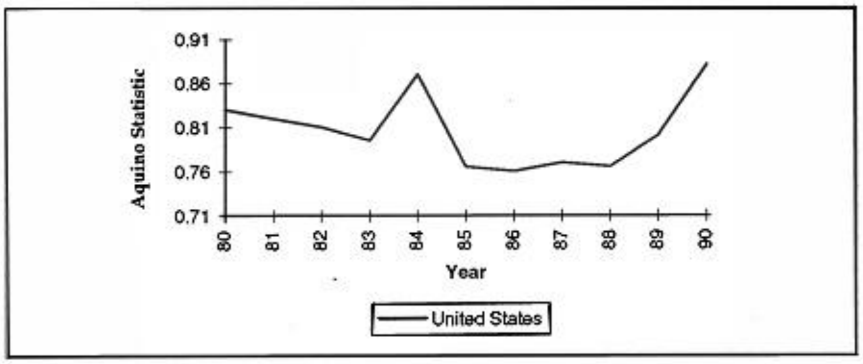

FIGURE 4 Intra-Industry Trade with the United States 1980-1990

Figure 2 shows that the level of IIT is decreasing steadily from 1988 to 1991, the last year of available data used in this study, while Canadian exports increase steadily. It should be noted that the Grubel and Lloyd IIT index is a relative measure of the trends, not to be confused with the percentage of trade which is also reported.

Figure 3 illustrates the Canadian trade surplus and decrease in cross-trade with America. Nevertheless, since the signing of the FTA, Canada's highest level of IIT is with the United States. The relative index of Canadian cross-trade, however, has declined steadily since 1988 with the United States.

Figure 4 utilizes the Aquino statistic to gauge the accuracy of the Grubel and Lloyd results. The Aquino adjusted IIT statistic measures the degree of similarity between a country's export and import structures by weighting the trade values by a factor representing the aggregate imbalance of trade. The more similar the share of total exports and imports, the higher the level of IIT. The graph illustrates the recent increase in IIT for the United States indicating a close demand and supply structure among developed nations. Finally, both figures suggest, once again, that the reduction of trade barriers is positively correlated with the relative IIT levels.

The results from the study strongly support the proposition that the level of Canadian IIT is relatively high with the United States. The statistics also support that larger provinces will have higher levels of IIT with the United States. Figure 5 illustrates the percentage of total trade and IIT. The Grubel and Lloyd Index is highest for Ontario, British Columbia, and Quebec. This suggests that close economic ties exist between the three largest Canadian provinces and the United States. A reason for the lower Grubel and Lloyd measure for the smaller provinces may lie in the fact that the larger provinces are the transhipment and break-in-bulk points for goods both entering and exiting the country. The ensuing trade flows may be inaccurately credited to the larger province. The final assembly or processing of the product before distribution may be different than the province of manufacture, thus creating data misrepresentation.

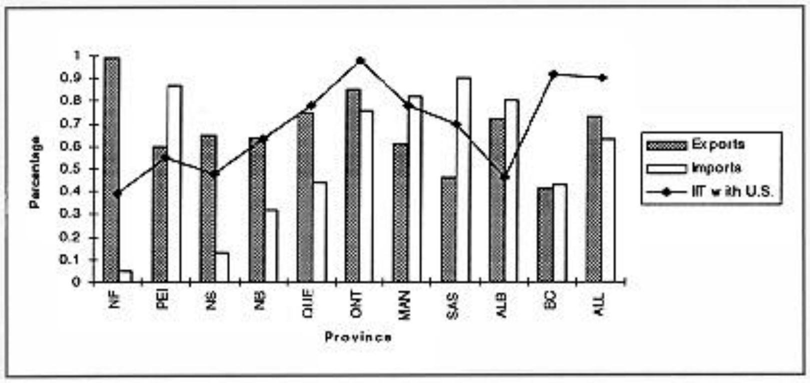

FIGURE 5 Trade with the United States, 1990

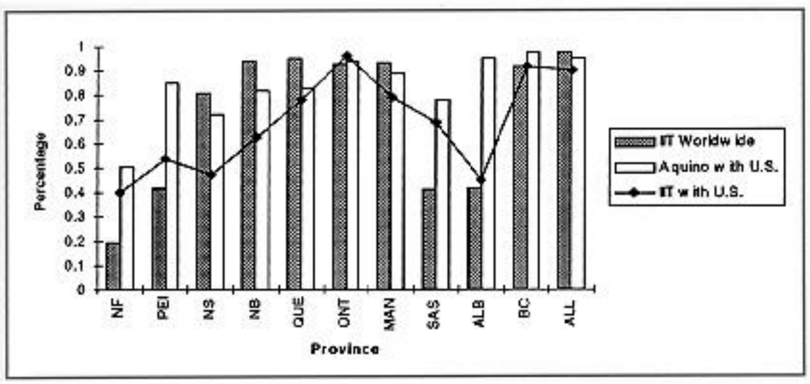

FIGURE 6 Provincial Intra-Industry Trade, 1990

Figure 6 illustrates that the IIT measure follows the Aquino statistic trend for each province. For the majority of the provinces (seven out of eleven), the United States has relatively more IIT when compared to the worldwide flows. Ontario and British Columbia have slightly more cross-trade with the United States, while Quebec has more worldwide IIT flows. The smaller provinces demonstrate strong ties with the United States. The results suggest that Canadian IIT is not driven by one province but by a combination of all the provinces.

TABLE 3 Technological Intensity and Intra-Industry Trade

IIT in High-Technology Commodities

Hypothesis 1 suggests that as the level of technological sophistication increases, the level of IIT will correspondingly decrease. High-technology products, often protected through patents, trademarks, and firm internalization of knowledge, create a monopoly situation for the innovating firm. In phase one of the Vernon (1966) product life cycle model, a new invention or innovation will be sold domestically and exported to countries with similar demand structures. Although for each product the imitation lag differs, a period of monopolization in the export market will occur, and IIT will be low. As the product line expands, a certain degree of standardization will occur and product differentiation will increase as will the level of trade-overlap (Vernon 1966).

Analyzing a sample of twenty commodities, ten of which are technologically intensive and the other ten are low-technology, (Table 3) the IIT statistics suggest that more cross-trade occurs in the latter rather than the former. Six high-technology commodities have indices less than 50 while only two of the less technologically intensive commodities have indices less than 50. The highest levels of commodity cross-trade are in printed circuits (8401), aircraft (8801), and integrated circuits (8542) -- a possible result of product differentiation in the case of circuits and the large aircraft industry in Quebec. The technologically intensive commodities with the lowest level of cross-trade are medical equipment (9018), physical and chemical analysis equipment (9027), and optical fibers (9002). These product lines have a high level of product differentiation and research and development expenditures. Pleasure water craft and fishing vessels (8903), mountings and fittings of base metal (8302), and watertube or vapor generating boilers (8402) have large levels of IIT as expected, and ploughs, discs, and other farm equipment (8432), thermostats, monostats, and other controlling instruments (9032), and drilling, boring, and milling machines have low levels of cross-trade.

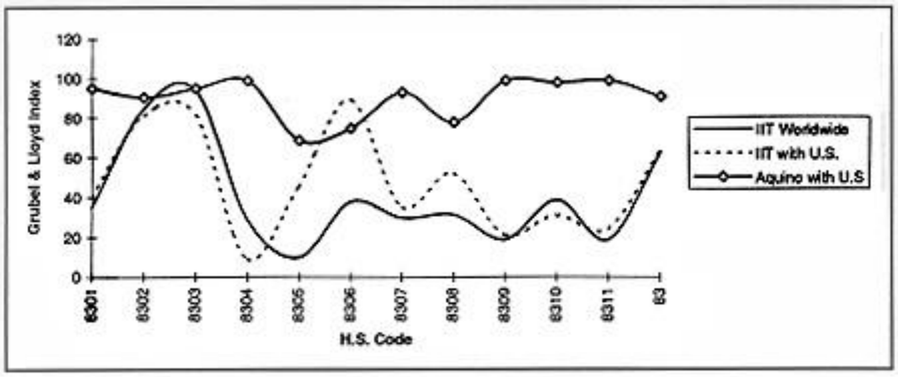

FIGURE 7 Intra-Industry Trade, 4-Digit H.S. 8300

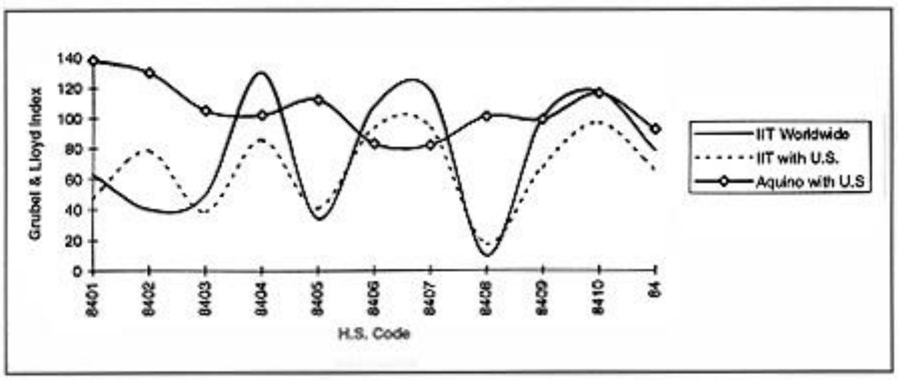

FIGURE 8 Intra-Industry Trade, 4-Digit H.S. 8400

Figures 7 and 8 represent the percentage of total trade and IIT levels for the sample of ten low-technology and ten high-technology commodities, between Canada and the United States analyzed for this hypothesis. Canada has a trade surplus in three of the ten high-technology products (H.S. 8542, 8802, 9012), each of which has an IIT statistic of over 50 (three of the top four). The low-technology commodities that have a trade surplus with America are H.S. 8302, 8432, 8441, 8459, 8467, 8903, 9029. IIT with the United States and the rest of the world follows each other closely in high-technology industries but not in the low-technology industries, which suggests that the geographical proximity of the nations may affect the level of trade-overlap.

TABLE 4 Technological Intensity and Intra-Industry Trade, 1975-1990

Table 4 shows the levels of IIT in the sample of high- and low-technology commodities between Canada and the United States over the past fifteen years. As products move through the product life cycle, becoming increasingly standardized, the level of IIT should increase because the technological innovation has spread to other nations who are able to produce the commodity. On the other hand, low-technology products that have been standardized for the past fifteen years are expected to have fairly constant levels of IIT and follow the overall cross-trade trends that have been decreasing over time.

Of the ten high-technology products in the sample, IIT levels of seven of the commodities increased steadily over time, supporting Hypothesis 2. Harmonized tariff codes 8802 (aircraft), 9018 (medical equipment), and 9027 (physical or chemical analysis equipment) either fell or remained constant over the study period. The IIT index for the sample of low-technology commodities remained constant between 1975 and 1990 with four commodities increasing their levels of IIT and six with decreasing Grubel and Lloyd indices. Over the fifteen year time interval, four of the commodities remained within five units of the original level and eight within ten units of the original level. The above results support Hypothesis 2, which proposes that the level of IIT increases as products become more standardized.

Disaggregation and Commodity Cross-Trade

In examining different levels of aggregation (Table 5) at the 2-digit level, 57 percent of commodity listings used in the sample are found to be higher with America, 65 percent at the 4-digit level, and 71 percent at the 6-digit grouping.

TABLE 5 Percent of Intra-Industry Trade by Aggregation Level

TABLE 6 Commodity Aggregation Comparison:2-digit

Hypothesis 2 posits that as commodity groupings increase in specificity, the level of trade overlap will correspondingly decrease. As the aggregation level decreases, the level of cross-trade decreases in both the 2- to 4-digit and the 4- to 6-digit comparisons. The data for the four-digit, industry level grouping are found in Table 6. The first column represents the figure where the data is represented graphically, the second is the harmonized, 2-digit listing, the next is the number of 4-digit divisions in each category, the next two list the number of observations that are higher or lower than the corresponding 2-digit IIT measure, and the final column is the percent of 4-digit observations less than the 2-digit calculation. In each of the seven cases, the Grubel and Lloyd IIT index is lower as aggregation decreases from the 2- to 4-digit measurement. The same trend appears in the 4- to 6-digit trade-overlap comparisons. The sample in this study supports the hypothesis that at finer levels of aggregation, product lines become more defined and have relatively lower levels of IIT. Of the 672 6-digit commodities in the study, 460 (68.5 percent) have lower Grubel and Lloyd levels in comparison to the 4-digit observations. In sum, as the level of aggregation decreases, the corresponding IIT index decreases, supporting Hypothesis 2.

Summary and Research Extensions

The above results support the hypotheses presented earlier. Hypothesis 1, which states that Canadian high-technology products will have lower levels of IIT overtime than standardized commodities, is accepted based on the sample of products used in the study. The results suggest that as the product moves through the Vernon product life cycle the level of IIT is positively correlated or increasing overtime. Finally, the evidence suggests that as commodity classifications are disaggregated, the level of IIT correspondingly decreases.

IIT involves cross-border transactions in different goods, and is primarily based on the unequal distribution of immobile factor endowments. Intra-industry transactions incorporate those in identical or closely related goods, and are based on the extent to which different nations or industries utilize the gains of concentration and specialization. This study has examined the importance and the commodity mix of United States IIT in the Canadian economy using descriptive analysis and cross-trade statistics.

The empirical results suggest that the level of IIT between Canada and the United States has been steadily increasing since the implementation of the FTA and that cross-trade is a significant proportion of the total international trade volume of the two nations. The results also imply that trade between regional partners may be of more significance than trade with other partners that are outside of the economic agreement. Finally, the Grubel and Lloyd index of IIT concentration is highest for the provinces of Ontario, British Columbia, and to a lesser extent, Quebec; suggesting that close economic ties exist between the three largest Canadian provinces and the United States.

The results for Hypothesis 1 suggest that as the level of technological sophistication increases, the level of IIT correspondingly decreases. Grubel and Lloyd indices were calculated for a sample of twenty commodities over a fifteen year time period. Of the ten high-technology products, IIT levels of seven of the commodities increased steadily over the time period.

The empirical evidence in support of Hypothesis 2 suggests that IIT indices provide a robust, valid measurement of commodity flows in similar products if the groupings are disaggregated enough so that homogeneous product lines are investigated. The importance of this type of study lies in its attempt to explain the significance of for a country participating in a regional trading bloc, and to determine if the indices provide expected, accurate, and reasonable results based on current international trade theory.

One of the most important pressures facing nations today is growing international competition and the formation of trading blocs. Once a measure of IIT is established and verified through repeated testing, as in the case here, then the statistic may be used to compare trading blocs and the effects of changing commodity flow patterns over time. Porter (1991) suggests that industrial competitiveness is based upon firm and locational advantages developed in an environment of interconnectedness with like industries that invest in specialized but related technologies, information, infrastructure, and human resources. If a statistic, such as an intra-industry trade index, can be used to measure the level of industrial interconnectedness, then policy initiatives may be developed that utilize the strategies of the successful or internationally competitive industry clusters across international borders such as Detroit, Michigan and Windsor, Ontario. Development policies should focus on enhancing clusters by building increased depth within the clusters.

This study has established that Canada has high levels of IIT with the United States and should take advantage of this economic closeness by developing clusters of like firms with its southern neighbor. The regional trading agreement represents an opportunity for Canada to strengthen its competitive position, especially in high-technology commodities, through increased IIT with the United States. Regions within Canada should strive to build cross-border clusters where they have established strength, taking advantage of the FTA and NAFTA, rather than placing priority on economic diversity. The indices of IIT levels in this study suggest the existence of strong north/south economic ties within a North American trading bloc. By rationalizing their product lines and utilizing IIT with the United States, a North American competitive advantage is achieved. Greater access to American products, combined with the similarity of the demand structures, means that Canadian buyers will raise their level of consumer sophistication -- a factor that may previously have been thwarted by high tariffs.

This study provides the groundwork for continued theoretical and empirical research in the area of international commodity flows and IIT between Canada and the United States, with specific regard toward the effects that economic integration will have on the formation and strengthening of international industrial clustering. The first step in future analysis should be to increase the sample database to include the full scope of manufactured products. A temporal approach examining relative trade-overlap will provide insight into the changing demand structure in North America. A study comparing the levels of IIT among Canada, Mexico, and the United States will add insight into the effects of economic integration upon trade flows between developed and lesser developed nations.

Once a thorough database is collected, a geographic information system (GIS), programmed to query by commodity or country will allow the researcher to visualize changing trade patterns over time, examine the level of various commodity flows, and perform a variety of statistical analyses. Another useful form of inquiry would be a regional, sector-specific international survey based on the perception of individual firms on the value and direction of trade flow in similar products, comparing the results to national figures.

The late 1980s and early 1990s suggest a trend toward economic integration at the international level. The rationalization of firms, positioning themselves to gain a competitive edge and to take advantage of lower tariffs and non-tariff barriers, should lead to an increase in cross-trade, especially in the case of Canada with its relatively small domestic market. Linkages, whether through joint ventures, foreign direct investment, or trade, will lessen the protectionist effects of the international border, enhancing regional international clusters of competitive firms. The independent variable in future levels of IIT will be the policy actions and initiatives of government agencies, both at the provincial/state and/or national levels.

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TABLE 1 High Technology Sectors

H.S. Code	Sector Description
8401	Nuclear reactors
8471	Data processing machines
8534	Printed circuits
8541	Semiconductors
8542	Integrated circuits
8802	Aircraft
9002	Optical fibers
9012	Lasers and optical devices
9018	Medical equipment
9027	Physical or chemical analysis equipment

Source:Markusen, Hall, and Glasmeier (1986).

TABLE 2 Lower Technology Sectors

H.S. Code	Sector Description
8302	Mountings and fittings of base metal
8402	Watertube or vapor generating boilers
8423	Weighing machines
8432	Ploughs, disc, and other farm equipment
8441	Print type-setting machinery
8459	Drilling, boring, and milling machines
8467	Hand tools
8903	Fishing vessels and pleasure water craft
9029	Instruments for measuring revolution production
9032	Thermostats, monostats, and other controlling instruments

Source:Markusen, Hall, and Glasmeier (1986).

TABLE 3 Technological Intensity and Intra-Industry Trade

High-Technology Sectors		Low-Technology Sectors	
H.S. Code	Index	H.S. Code	Index
8534	94.45	8903	85.84
8802	88.14	8302	80.88
8542	67.66	8402	75.84
9012	54.12	8423	60.56
8401	46.32	9029	60.29
8541	43.15	8467	53.68
8471	40.60	8441	50.77
9002	36.46	8432	50.59
9027	24.77	9032	48.49
9018	15.51	8459	37.50

Source:Markusen, Hall, and Glasmeier (1986).

TABLE 4 Technological Intensity and Intra-Industry Trade, 1975-1990

High-Technology Commodities					Low-Technology Commodities				
H.S. Code	1975	1980	1985	1990	H.S. Code	1975	1980	1985	1995
8401	40.82	42.75	51.08	46.32	8302	71.00	76.78	75.07	80.88
8471	31.08	34.01	37.03	40.60	8402	65.47	72.45	68.31	75.84
8534	85.08	91.32	87.02	94.45	8423	61.78	57.49	51.58	46.86
8541	27.39	32.41	48.71	43.15	8432	51.76	52.77	47.89	50.59
8542	58.02	56.72	69.89	67.66	8441	47.88	45.32	30.77	50.77
8802	89.14	88.97	80.17	88.14	8459	43.81	45.76	40.42	37.50
9002	34.16	31.89	38.46	36.46	8467	63.02	59.98	48.51	53.68
9012	47.83	62.77	55.46	54.12	8903	94.71	92.85	81.03	85.84
9018	45.89	40.70	38.19	15.51	9029	43.07	40.02	55.01	60.29
9027	32.18	34.18	23.00	24.77	9032	49.50	52.17	62.00	48.49

TABLE 5 Percent of Intra-Industry Trade by Aggregation Level

	Grubel and Lloyd Index	
H.S. Code	United States	World
Total	Higher	Lower
2-digit	57%	43%
4-digit	65%	35%
6-digit	71%	29%

TABLE 6 Commodity Aggregation Comparison: 2-digit

H.S. Code	# of 4-digit in 2-digits H.S.	# of 4-digit H.S. Codes		Percent Lower
		Higher than 2-digit	Lower than 2-digit	
8300	11	3	8	72.7%
8400	74	20	54	72.9%
8500	4	2	2	50.0%
8600	8	2	6	75.0%
8800	5	1	4	80.0%
8900	8	2	6	75.0%
9000	31	11	20	64.5%
Total:	141	41	100	70.9%