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VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE BETWEEN THE U.S. AND NAFTA PARTNERS

EL COMERCIO INTRAINDUSTRIAL VERTICAL Y HORIZONTAL ENTRE LOS ESTADOS UNIDOS Y LOS SOCIOS DEL NAFTA

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Abstract

The main objectives of this paper are to (a) explain the extent of vertical and horizontal intra-industry trade in the United State's foreign trade with the North American Free Trade Area (NAFTA), and (b) identify the industry-specific determinants of vertical and horizontal intra-industry trade. One of the main findings is that the observed increase in intra-industry trade between the United States and NAFTA is almost entirely due to two-way trade in vertical differentiation. Another important finding is that the share of horizontal intra-industry trade has increased significantly during this period, although vertical intra-industry trade continued to be dominant in the U.S.-NAFTA IIT Trade. Among the industry-specific variables, product differentiation, vertical product differentiation, and product quality differences are found to have a positive effect on all three types of IIT shares. Industry

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concentration and industry size are found to have a negative and statistically significant effect on all three types of IIT share.

Keywords: *Vertical and Horizontal Intra-Industry Trade, NAFTA.*

JEL Classification: *F14.*

Resumen

El objetivo principal de este trabajo es (a) explicar el crecimiento del comercio intraindustrial (CII) vertical y horizontal de los Estados Unidos con sus socios del NAFTA y (b) identificar los determinantes específicos que explican el comercio intraindsutrial vertical y horizontal.
Una de las principales contribuciones es que el incremento del comercio intraindustrial entre los Estados Unidos y el resto del NAFTA es debido en gran parte a la diferenciación vertical. Otra importante contribución es que el porcentaje del comercio intraindustrial horizontal se ha incrementado significativamente durante este período, aunque el comercio intraindustrial vertical continúa siendo dominante en el CII entre USA-NAFTA. Entre las variables específicas a nivel de industria, la diferenciación de productos, la diferenciación vertical de producto y las diferencias de calidad de productos tienen un efecto positivo en los tres tipos de participación de CII. La concentración industrial y el tamaño de la industria tienen un efecto negativo y estadísticamente significativo en los porcentajes o participaciones de los tres tipos de CII.

Palabras Clave: Comercio Intraindustrial Vertical y Horizontal, NAFTA.

Clasificación JEL: F14.

I. INTRODUCTION

Since the introduction of the concept of intra-industry trade (IIT) in the 1960s, a large number of theoretical and empirical studies have been conducted to investigate the determinants of this trade. Intra-industry trade is defined as the simultaneous export and import of commodities of the same industry group. Intra-industry trade describes trade in similar, but slightly differentiated products based on imperfect competition, or trade in close substitutes demanded by consumers in different countries who may have distinct tastes or preferences. As Greenway and Milner (1986) and Greenway and Torstensson (1997) point out, the interest in IIT arose mainly because the traditional theory of comparative costs, dealing with homogenous products, is incapable of explaining the simultaneous exports and imports to a country of the same

statistical category. The theoretical studies focused mainly on providing explanations for the existence and development of IIT while empirical studies mainly focused on investigating determinants of IIT, with a small number of studies focusing on aggregation and measurement issues of IIT.

The greater part of practical studies strived to describe the IIT of developed countries by reason of the accessibility of a comprehensive trade data for these countries. Several current research papers have tried to estimate the degree of horizontal and vertical intra-trade in addition to categorize their determinants. Selected prior studies on the U.S. IIT include Clark (2007, 2006), Clark and Stanley (2003), Gonzalez and Velez (1993, 1995), Hart and McDonald (1992), and Manrique (1987). In spite of the variety of methodologies applied, certain reliable outcomes and universal features about the kinds of factors impacting IIT have surfaced. Analysis of bilateral trading arrangements established that resemblance in industrial configuration, demand patterns, and size of countries are vital country-specific factors whereas the characteristics of product differentiation and scale economies are significant industry-specific factors. Although most of the empirical work confirms that intra-industry trade levels vary with market, production and product characteristics across industries, the results show a degree of inconsistency across studies (see Greenaway and Milner, 1986). Unlike most other studies on intra-industry trade, this study uses detailed trade data at the 10-digit Harmonized System (HS) industry level and covers a longer and more recent period, 1990-2007.

The majority of empirical studies have tried to explain the IIT of developed countries due to availability of detailed trade data for these countries. Some recent studies have also attempted to estimate the extent of horizontal and vertical intra-industry trade and identify their determinants. Most of these studies are concentrated on IIT in European countries and only a few are on the U.S. IIT. Despite the diversity of approaches used by these studies, some consistent results and common features regarding the types of factors influencing IIT have emerged. Studies of bilateral trading arrangements have found that similarity in industrial structure, demand patterns, and size of countries are important country-specific factors while the characteristics of product differentiation and scale economies are important industry-specific factors. Multilateral studies have found that the size of countries and their average level of income are positively related to IIT.

The main objective of this paper is to (a) explain the extent of vertical and horizontal intra-industry trade in the United State's foreign trade with the North American Free Trade Area (NAFTA), and (b) identify the industry-specific determinants of vertical and horizontal intra-industry trade. Trade patterns are identified by breaking up total trade into three trade types: one-way (i.e., inter-industry) trade, two-way (i.e., intra-industry) trade in horizontally differentiated products, and two-way trade in vertically differentiated products. The vertical IIT can be defined as exchange of similar goods of different quality while the horizontal IIT can be defined as exchange of similar goods that are differentiated by characteristics rather than quality. As some authors have argued, making such a distinction is important as the determinants of each type of IIT differs (see Abd-el-Rahman (1991) and Hine, Greenaway and Milner (1995)). This conceptual specification is important because theoretical models have

demonstrated that the forces underlying the two forms of product differentiation within IIT are not the same. In general, in the case of vertical IIT, the dynamics of product differentiation (by quality) operate according to a Heckscher-Ohlin model based on comparative advantages deriving from resource endowments and factor proportions; in the case of horizontal IIT, the typical ingredients of imperfectly competitive market structures play the dominant role.

Unlike most other studies on intra-industry trade, this study uses detailed trade data at the 10-digit Harmonized System (HS) industry level and covers a longer and more recent period, 1990-2007. This study is also important because there are no studies that analyze the IIT in all products between the U.S. and the NAFTA partners, although there are few studies that analyze IIT in agricultural food crops (see Qasmi and Fausti (2001), Kim, Cho, and Koo (2003), and Clark, Fullerton and Burdorf (2001)). However, there are few studies that analyze IIT between the U.S. and some selected Latin American countries (see Gonzalez and Velez (1993, 1995)). These studies, however, do not distinguish between horizontal and vertical IIT. In the NAFTA context the distinction is particularly relevant because the level and growth in horizontal IIT is a good indicator of the extent to which Mexico and Canada are "similar" to the U.S. Our findings suggest that vertical IIT accounts for 70 to 75% of total IIT of the U.S. with NAFTA partners, 70 to 90% of total IIT of the U.S. with Mexico, and 65 to 75% of total IIT of the U.S. with Canada.

The remainder of the paper is organized as follows: Section II provides a brief discussion of general performance of international trade of the U.S. with the NAFTA during the past sixteen years. A brief survey of literature is presented in Section III. Alternative measures of intra-industry trade are discussed in Section IV. Section V presents a discussion of the estimated IIT indices. Section VI presents and discusses the empirical results of the estimated regression models. Section VII summarizes the main findings.

II. GENERAL PERFORMANCE OF U.S. TRADE WITH THE NAFTA

In this section, we describe the extent, nature and dynamics of trade between the United States and the NAFTA. The NAFTA partners, Canada and Mexico, continued to be the top trading partners of the United States during the past fifteen years. In 2007, Canada was the largest trading partner of the United States, accounting for approximately one fifth of the total merchandise trade of the United States. The United States' total trade (exports + imports) with Canada increased significantly from $ 174.3 billion in 1990 to $ 565.9 billion in 2007, an annual average increase of about 7.3%. However, the shares of total trade of Canada dropped marginally between 1999 and 2007, having increased during 1990 and 1999 (see Table 1). The share of exports, however, increased marginally from 21.1% in 1990 to 21.4% in 2007. Corresponding share of imports dropped marginally from 18.4% to 16.2% during this period. United State's international trade with Mexico increased significantly during the 1990-2007 period, especially after the implementation of the NAFTA in 1994. The United States' total trade with Mexico increased significantly from $58.5 billion in 1990 to $ 346.8

TABLE 1

SHARE OF UNITED STATES TRADE WITH NAFTA PARTNERS 1990-2007
(As a percent of U.S. trade with all countries, %)

Year	NAFTA			Canada			Mexico		
	Total Trade	Exports	Imports	Total Trade	Exports	Imports	Total Trade	Exports	Imports
1990	26.2	28.3	24.5	19.6	21.1	18.4	6.6	7.2	6.1
1991	26.5	28.1	25.1	19.4	20.2	18.7	7.1	7.9	6.4
1992	27.0	29.2	25.2	19.3	20.1	18.5	7.7	9.1	6.6
1993	28.0	30.5	26.0	20.2	21.6	19.1	7.8	9.0	6.9
1994	29.2	32.2	26.9	20.7	22.3	19.4	8.5	9.9	7.5
1995	28.5	29.4	27.8	20.5	21.6	19.5	8.1	7.8	8.3
1996	29.6	30.4	29.0	20.4	21.3	19.8	9.2	9.1	9.2
1997	30.5	32.2	29.2	20.4	21.8	19.3	10.1	10.4	9.9
1998	31.5	34.3	29.5	20.6	22.7	19.1	10.9	11.6	10.4
1999	32.5	36.2	30.1	21.1	23.7	19.4	11.5	12.6	10.7
2000	32.7	36.9	30.0	20.3	22.6	18.8	12.4	14.3	11.2
2001	32.7	36.3	30.5	20.3	22.4	19.0	12.4	13.9	11.5
2002	32.5	37.3	29.6	20.0	23.2	18.0	12.5	14.1	11.6
2003	31.6	36.9	28.6	19.8	23.4	17.6	11.9	13.4	11.0
2004	31.2	36.7	28.1	19.5	23.2	17.4	11.7	13.5	10.6
2005	30.7	36.7	27.5	19.5	23.4	17.4	11.3	13.3	10.2
2006	29.9	35.2	27.0	18.4	22.3	16.3	11.5	12.9	10.7
2007	29.3	33.1	27.0	18.1	21.4	16.2	11.1	11.7	10.8

Source: Authors' calculations based on data from World Trade Atlas database.

billion in 2007, an annual average increase of about 11.4%. Mexican share of U.S. total merchandise trade increased from 6.6% in 1990 to 11.1% in 2007. The share of U.S. exports to Mexico almost doubled during this period, increasing from 7.2% in 1990 to 11.7% in 2007. The share of U.S. imports from Mexico also rose during this period, increasing from 6.1% in 1990 to 10.8% in 2007.

The rapid growth of U.S. trade with Canada and Mexico is evident from growth rates presented in Table 2. During 1990-2007, the U.S. trade with the NAFTA grew at an annual average rate of 8.5% while exports to the NAFTA grew at an annual rate of 7.8% and the U.S. imports from the NAFTA grew at annual average rate of 9.2%. When compared with pre- NAFTA period, the U.S. trade with Canada and Mexico has grown significantly after the NAFTA was implemented in 1994 (Table 2). However, the U.S. trade with the NAFTA trading partners as well as with the rest of the world slowed down significantly during 2000-2007 period, especially after 2001.

III. SURVEY OF LITERATURE

Although there are numerous studies dealing with intra-industry trade, only few draw on U.S. intra-industry trade. We are listing below the main research on the topic.

Clark (2007) explored variations in intra-industry specialization indicators over the 1992-2004 period. The objective of the study was to assess the potential of structural adjustment problems that may arise in the United States growth in trade resulting from the United States–Central America –Dominican Republic Free Trade Agreement (CAFTA-DR) between the United States and six Central American countries–Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and the Dominican Republic. Clark uncovered that CAFTA-DR will expand market access for US exporters and few US industries are likely to encounter structural adjustment problems. Given the relatively large size of the US economy, and the small number of industries that face potential adjustment pressures, the United States should have liberalized all trade immediately.

In another study, Clark (2006) investigated country and industry-level determinants of vertical specialization-based trade. Industries that engage in this pattern of trade were identified through their use of offshore assembly provisions in the US tariff code. The study's findings justified why industries engage in vertical specialization-based trade while shedding some light on the factors that cross production location decisions. Identifying factors that encourage vertical specialization-based production and trade may enhance our understanding of industry strategy and how trade patterns will evolve as the process of globalization persists. The results also propose that vertical specialization-based trade will continue to grow relative to total trade.

Clark and Stanley (2003) investigated determinants of intra-industry trade between the United States and twenty-two industrial nations. They analyzed the country-level characteristics suggested by modern models of monopolistic competition and trade, industry-level variables relating to imperfect competition, scale economies, and product differentiation. Country-level determinants of intra-industry trade consisted of relative factor endowment differences, relative country size differences, distance, trade

TABLE 2 (A)

GROWTH OF UNITED STATES TRADE WITH NAFTA PARTNERS, 1990-2007

Year	World			NAFTA			Canada			Mexico		
	X + M	Exports	Imports	X + M	Exports	Imports	X + M	Exports	Imports	X + M	Exports	Imports
1991	2.4	7.3	–1.4	3.4	6.4	0.7	1.1	2.6	–0.3	10.1	17.3	3.4
1992	7.6	6.1	8.8	9.8	10.4	9.3	7.0	5.9	8.1	17.5	22.0	12.8
1993	6.8	3.9	9.3	10.7	8.5	12.8	11.9	11.1	12.6	7.6	2.6	13.5
1994	12.5	10.3	14.4	17.4	16.5	18.3	15.3	14.2	16.3	23.0	22.1	23.9
1995	12.7	13.6	12.0	10.0	3.7	15.9	11.4	10.1	12.5	6.7	–10.7	24.7
1996	6.7	7.0	6.4	10.7	10.5	10.9	6.6	5.2	7.8	21.1	25.0	18.2
1997	10.2	10.4	10.0	13.5	17.0	10.7	10.1	13.2	7.4	21.2	25.8	17.7
1998	2.3	–1.0	5.0	5.7	5.3	6.2	3.4	2.7	4.0	10.5	10.7	10.3
1999	7.7	1.8	12.1	11.2	7.6	14.3	10.1	6.3	13.4	13.3	10.2	15.8
2000	16.3	12.6	18.7	16.9	14.8	18.5	12.0	7.6	15.6	25.9	28.3	23.9
2001	–6.4	–6.6	–6.2	–6.3	–8.1	–4.8	–6.4	–7.4	–5.6	–6.1	–9.3	–3.4
2002	–0.8	–4.9	1.8	–1.7	–2.4	–1.1	–2.5	–1.5	–3.3	–0.2	–3.8	2.5
2003	6.9	4.6	8.2	4.1	3.5	4.6	5.8	5.6	6.0	1.5	–0.1	2.6
2004	15.5	13.0	16.9	13.7	12.5	14.6	14.0	11.7	15.7	13.3	13.8	12.9
2005	12.7	10.7	13.9	11.2	10.5	11.7	12.6	11.6	13.3	8.9	8.6	9.1
2006	12.1	14.4	10.8	9.2	9.7	8.7	6.1	8.9	4.2	14.4	11.3	16.5
2007	7.9	12.1	5.6	5.5	5.6	5.4	6.2	7.9	4.8	4.4	1.6	6.3

TABLE 2 (B)

AVERAGE ANNUAL GROWTH OF UNITED STATES TRADE WITH NAFTA PARTNERS, 1990-2007

Period	World			NAFTA			Canada			Mexico		
	X + M	Exports	Imports	X + M	Exports	Imports	X + M	Exports	Imports	X + M	Exports	Imports
’90-’93	5.6	5.8	5.6	8.0	8.4	7.6	6.7	6.5	6.8	11.8	13.9	9.9
’94-’00	9.8	7.8	11.2	12.2	10.8	13.5	9.8	8.5	11.0	17.4	15.9	19.2
’01-’07	6.8	6.2	7.3	5.1	4.5	5.6	5.1	5.3	5.0	5.2	3.2	6.7
’94-’07	8.3	7.0	9.3	8.7	7.6	9.6	7.5	6.9	8.0	11.3	9.5	12.9
’90-’07	7.8	6.8	8.6	8.5	7.8	9.2	7.3	6.8	7.8	11.4	10.3	12.4

Note: X + M indicates the total trade (Exports + Imports).
Source: Authors’ calculations based on data from World Trade Atlas database.

orientation, and the trade balance. Measures of factor intensity, scale economies, market structure, and product differentiation were also included as country-level variables. The findings generally supported the predictions of modern trade theories.

Shelburne (2001) investigated how U.S.-Mexican intra-industry trade has evolved since the creation of the NAFTA beginning in 1994. The major inferences of this study were as follows: (a) unlike the European experience after the creation of the European Common Market, and most other regional trade arrangements, trade between the U.S. and Mexico has remained mostly inter-industry trade, and the growth of trade has been largely inter-industry as measured by both IIT indexes and marginal intra-industry trade (MIIT) indexes; (b) unlike most studies of IIT using European countries, the IIT and the MIIT indexes were highly correlated across sectors; (c) the fall in the IIT indexes since NAFTA was due significantly to Mexico's trade surplus with the U.S.; (d) the IIT and MIIT indexes at a sectoral level were significantly related to the duty treatment of U.S. imports; that is the higher the percentage of imports entering duty-free, the higher the IIT and MIIT indexes, and the higher the actual ad valorem duty rate, the lower the IIT and MIIT indexes; and (e) there was a significant "smoking gun" evidence that the U.S.- Mexico IIT was not typical IIT but was significantly composed of the U.S. re-import of U.S. components within the same sector. The percentage of U.S. components in the value of U.S. imports by product, was significantly related to the IIT and MIIT indexes even at the most extensive level of product disaggregation. Furthermore, a new graphical measure for IIT was proposed to better describe the level of IIT.

The study by Clark and Stanley (1999) examined country- and industry-level determinants of North-South IIT between the United States and the 30 largest developing countries. The study used data on trade flows pertaining to 1992 for 30 developing countries and 300 four-digit U.S. SIC industries. The study revealed that IIT was falling with larger disparities in relative factor endowments (proxied by differences in per capita GDP) between North and South. In addition, the size of the trading partner influenced IIT in a positive way. Distance influenced IIT in a negative way. Trade orientation of the developing country exerted a positive effect on IIT. These findings were consistent with the predictions of Helpman and Krugman's (1985) theoretical model.

Gonzalez and Velez (1995) presented estimates for the level of intra-industry trade in the 1994 bilateral commerce between the United States and Argentina, Brazil, Chile, Colombia, Mexico, Paraguay, Uruguay, and Venezuela. The findings of the study suggested that intra-industry trade was positively correlated with income and with foreign investment. Furthermore, Mexico and the United States presented high levels of intra-industry trade, while the rest of the Middle Eastern countries investigated held relatively low levels. The study concluded that Mexico should experience much less difficulty in adjusting to free trade with the United States than other countries.

In another study, Gonzalez and Velez (1993) presented an evaluation of the level of intra-industry trade between Mexico and the United States. The calculated indexes of intra-industry trade pointed to a fast increase in this type of trade during the 1982-1990 period. Moreover, the current level of intra-industry trade between these nations was relatively high compared to similar indexes. The results helped explain the evident ease of adjustment to expanded Mexican exports to the U.S. during the 1980s.

Furthermore, the high level of intra-industry trade indicated that after the NAFTA is implemented, there should be no major dislocation of productive activities in these countries due to the expansion in trade.

IV. MEASUREMENT OF INTRA-INDUSTRY TRADE

4.1 Measures of Intra-Industry Trade

The most widely used measure of intra-industry trade is the Grubel-Lloyd (G-L) index (see Grubel and Lloyd (1975)). While several alternative measures of IIT have been proposed in the literature, perhaps the most widely adopted has been the G-L index. It is considered to be the most appropriate measure for documenting an industry's trade pattern in a single period of time. The G-L index measures the share of IIT of industry *i* for a given country *j* as

$$IIT_{ij} = 1 - \frac{\left|X_{ij} - M_{ij}\right|}{(X_{ij} + M_{ij})} \tag{1}$$

where X_{ij} and M_{ij} are home country's exports of industry *i* to country *j* and home country's imports of industry *i* from country *j*, respectively. Thus, IIT_{ij} index in (1) measures the intensity or proportion of intra-industry trade in industry *i* with country *j*. If all trade in industry *i* is intra-industry trade, i.e., $X_{ij} = M_{ij}$, then $IIT_{ij} = 1$. Similarly, if all trade in industry *i* is inter-industry trade, i.e., either $X_{ij} = 0$ or $M_{ij} = 0$, then $IIT_{ij} = 0$. Thus, the index of intra-industry trade takes values from 0 to 1 as the extent of intra-industry trade increases, i.e., $0 \leq IIT_{ij} \leq 1$.

The IIT index in (1) can be modified to measure the intra-industry trade in all products with country *j* as a weighted measure of the IIT_{ij} 's and can be written as

$$IIT_j = \sum_{i=1}^{n} w_{ij}\left[1 - \frac{\left|X_{ij} - M_{ij}\right|}{(X_{ij} + M_{ij})}\right] \quad where \quad w_{ij} = \left[\frac{(X_{ij} + M_{ij})}{\sum_{i=1}^{n}(X_{ij} + M_{ij})}\right]$$

$$\text{i.e.,} \quad IIT_j = \frac{\sum_{i=1}^{n}(X_{ij} + M_{ij}) - \sum_{i=1}^{n}\left|X_{ij} - M_{ij}\right|}{\sum_{i=1}^{n}(X_{ij} + M_{ij})} \tag{2}$$

where *n* is the number of industries at a chosen level of aggregation.

4.2 Measuring Vertical and Horizontal Intra-Industry Trade

The literature on intra-industry trade increasingly emphasizes the importance of differentiating between horizontal and vertical intra-industry trade. Horizontal intra-industry trade (*HIIT*) is generally defined as the exchange of commodities differentiated by different attributes excluding quality, while vertical intra-industry trade (*VIIT*) is the exchange of commodities characterized by different qualities. This is why the presence of one or the other has different implications for the trading partners. Horizontal intra-industry trade (*HIIT*) is considered to be of greater relevance to trade among developed countries with high and similar per capita incomes while *VIIT* is considered to be particularly relevant to trade among unequal trading partners with different income levels. Recent empirical studies, however, show that even among developed countries vertical IIT are predominant as compared to horizontal IIT (see for example, Greenway *et al*. (1994) and Athurupane *et al*. (1999)).

In the evaluation of trade flows, quality analysis is undertaken mainly with the use of unit value indices, which measure the average price of a bundle of items from the same general product grouping. The rationale for using unit value as an indicator of quality is that, assuming perfect information, a variety sold at a higher price must be of higher quality than a variety sold more cheaply. According to Stiglitz (1987), prices will reflect quality even with imperfect information.

In disentangling total *IIT* into horizontal *IIT* (*HIIT*) and vertical *IIT* (*VIIT*), we use unit value information at the 10-digit HS industry level as follows:

$$IIT_i = HIIT_i + VIIT_i \tag{3}$$

where $HIIT_i$ is given by (2) for those products (k) in industry i where unit values of imports (UV_{ki}^m) and exports (UV_{ki}^x) for a particular dispersion factor (α) satisfy the condition,

$$1-\alpha \;\le\; \frac{UV_{ki}^x}{UV_{ki}^m} \;\le\; 1+\alpha$$

and $VIIT_i$ is given by (2) for those products (k) in industry i where,

$$\frac{UV_{ki}^x}{UV_{ki}^m} < 1-\alpha \qquad \text{or} \qquad \frac{UV_{ki}^x}{UV_{ki}^m} > 1+\alpha$$

where $\alpha = 0.15$. Typically, trade flows are defined as horizontally differentiated where the spread in the unit value of exports relative to the unit value of imports is less than 15% at the 10-digit HS level. Where relative unit values are outside this range products are considered as vertically differentiated. The presumption is that transport and other

freight costs do not cause a difference in export and import unit values by more than this percentage. Although we used three levels of dispersion factor (namely, $\alpha = 0.15$, 0.20, and 0.25) to calculate the horizontal and vertical *IIT*, due to the limitation of space we are reporting the results only for $\alpha = 0.15$. Both Abd-el-Rahman (1991) and Greenaway, Hine and Milner (1994, 1995) demonstrate that increasing the range from 15% to 25% does not radically alter the division of trade into horizontally and vertically differentiated products.

Moreover, $VIIT_j$ is assumed to have two components, high quality ($HQVIIT_j$) and low quality ($LQVIIT_j$). A high share of $HQVIIT_j$ implies that $VIIT_j$ takes the form of high-valued exports in the vertically differentiated sectors. A high share of $LQVIIT_j$ implies that a country is specializing into relatively low-price exports goods in the vertically differentiated sectors. Therefore, if the relative unit value of a good is below (above) the limit of 0.85 (1.15), it is considered as a low (high) quality export.

4.3 Model Specification: Industry-Specific Analysis

Following Greenway and Milner (1994), Hine, Greenway and Milner (1999), and others, a number of industry-specific determinants of the U.S. intra-industry trade are identified as main determinants, drawn from the available theoretical and empirical literature. The determinants identified can be listed as follows:

(a) **Product Differentiation** (*PD*): Both the horizontal differentiation model and the vertical differentiation model suggest that industries with higher degrees of product differentiation tend to have higher IIT shares, as more product variety broadens the basis for intra-industry trade. In other words, it is expected that industries with higher degree of product differentiation tend to have higher intra-industry trade shares. Following Greenway, Hine and Milner (1994, 1995), we define industrial product differentiation as the number of 10-digit HS industries across 2-digit HS industries. This measure is expected to affect both types of intra-industry shares positively, as more product variety broadens the basis for intra-industry trade.

(b) **Vertical Product Differentiation** (*VPD*): Similar to the product differentiation variable, vertical product differentiation variable also suggest that industries with higher degrees of vertical product differentiation tend to have higher IIT shares, as more product variety broadens the basis for intra-industry trade. It is expected that industries with higher degree of vertical product differentiation tend to have higher intra-industry trade shares. Following Clark and Stanley (1999), we use the advertising-to-sales ratio at 2-digit HS industry level to measure vertical product differentiation. This measure is expected to affect vertical intra-industry shares positively.

(c) **Industry Concentration** (I*CON*): Early studies have recognized that product standardization reduces the number of differentiated products, and thus reduces the basis for intra-industry trade. Balassa (1986) argues that product standardization is related to the extent of industrial concentration and hypothesizes that intra-

industry trade will be negatively associated with industry concentration. Following Crespo and Fontoura (2005), we use the share of sales of the 4 largest firms in the total sales of the sector as a measure of industry concentration. This is the traditional variable to capture the level of concentration of the market. It can be hypothesized that the possibilities for concentration can be expected to decline with the differentiation of the product. Thus, intra-industry trade will be negatively associated with industry concentration.

(d) **Industry Size** (*INDSIZE*): The size of the industry is measured as the number of products traded with any given country. It may be presumed that as the number of products traded increases, the volume of trade as well as intra-industry trade will increase. Therefore, we expect a positive coefficient for this variable.

(e) **Product Quality Differences** (*PRQD*): Generally it is be possible to separate between vertically and horizontally differentiated goods by looking at quality differences in trade. The problem that arises is then how to measure differences in product quality. Several studies have used unit prices as a proxy for quality differences (see, for example, Balance, Forstner and Sawyer, 1992; Greenaway et al., 1994; Torstensson, 1991; and Abd-el-Rahman, 1991). Following Torstensson (1991), Greenaway, Hine, and Milner (1994), Ballance, Forstner and Sawyer (1992), and Blanes and Martin (2000), we measure product quality differences in product *i* by the ratio between the unit value of U.S. exports and the unit value of U.S. imports. Product quality is expected to have a positive effect on both horizontal and vertical intra-industry trade.
The estimated model is as follows:

$$SIIT_{ij} = \beta_0 + \beta_1 PD_{ij} + \beta_2 VPD_{ij} + \beta_3 ICON_{ij} + \beta_4 INDSIZE_{ij} + \beta_5 PRQD_{ij} + u_{ij} \quad (4)$$

where $SIIT_{ij}$ is the share of total *IIT* in gross trade (exports + imports) of industry *i* with country *j* and all the explanatory variables are defined above. We also estimated two other models with the share of horizontal intra-industry trade ($SHIIT_{ij}$) and the share of vertical intra-industry trade ($SVIIT_{ij}$) as the dependent variable. Since these shares take values from 0 to 1, the regression equation may have predicted values for the dependent variable that lie outside the feasible interval. So, to restrict the predicted values between 0 and 1, following Stone and Lee (1995), Caves (1981), Bergstrand (1983), and Loertscher and Wolter (1980), we have used a Logit transformation of the dependent variable. In this case, we estimate the following model:

$$\ln\left[\frac{SIIT_j}{1 - SIIT_j}\right] = \beta Z + u \quad (5)$$

where Z is the vector of explanatory variables including a constant, β is the corresponding vector of coefficients and u is the random error term.

4.4 Data

This study is based on detailed trade data desegregated at 10-digit Harmonized System (HS) industries, covering the period from 1990 to 2007. The trade data was obtained from the Global Trade Information Services (GTIS)'s *World Trade Atlas Database* that uses primary data provided by the U.S. Department of Commerce's Foreign Trade Division. Additional information on trade was taken from the International Monetary Fund's, *Direction of Trade Statistics Yearbook* and U.S. Department of Commerce's International Trade Administration. Data on industry concentration (*ICON*) is from the *2002 Economic Census*. Data on product quality differences (*PRQD*) are from the Global Trade Information Services (GTIS)'s *World Trade Atlas Database*. Data on vertical product differentiation (*VPD*), as measured by advertising-to-sales ratio, is from Schonfeld & Assiciates, Inc., *Advertising Ratios and Budgets 2004*.

V. ESTIMATION OF INTRA-INDUSTRY TRADE INDICES

In this section, we describe the extent of intra-industry trade between the United States and the NAFTA partners. A specific problem measuring IIT is the level of desegregation. The scope of IIT and its main components heavily depend on the level of disaggregating. We have estimated the shares of intra-industry trade in United States total trade of detailed products for years 1990-2007, at the 10-digit level of the Harmonized System (HS). In 1990, U.S. – Canada trade activities took place in 13,025 10-digit level industries, of which nearly 28.9% of industries (or 3,764 industries) had some intra-industry trade. By 2007, trade activities increased to some 15,090 10-digit level industries, of which nearly 24.4% of industries (or 3,686 industries) had some intra-industry trade. Similarly, in 1990, U.S. – Mexico trade activities took place in 10,566 10-digit level industries, of which nearly 22.4% of industries (or 2,363 industries) had some intra-industry trade. By 2007, trade activities increased to some 13,637 10-digit level industries, of which nearly 22.1% of industries (or 3,033 industries) had some intra-industry trade. The data used in this study is not limited to manufactured products as is common in most other studies of IIT. Table 3 shows the weighted average of the Grubel-Lloyd IIT indices computed using (2) for the years 1990 to 2007, for NAFTA as well as for Canada and Mexico. Three points are worth noting. First, the IIT index in United States' trade with the NAFTA increased somewhat during the period 1990-2007. Second, the IIT index is relatively higher in U.S.-Canada trade than in U.S.-Mexico trade. Third, the share of IIT in U.S. – NAFTA trade increased from 43.4% in 1990 to 45.3% in 2007; the share of inter-industry trade for both Canada and Mexico increased marginally.

The trend in aggregate IIT indices presented in Table 3 is further analyzed by breaking down the IIT indices for each industry by equation (1) for the same time period. Table 4 shows the distribution of IIT indices by ten major intervals. It shows both the number of products and the share of products in each category. The results presented in Table 4 are consistent with results presented in Table 3. There is no major change in the structure of IIT in U.S. – NAFTA trade during this period; the shares

TABLE 3

DEVELOPMENT OF U.S.-NAFTA INTRA-INDUSTRY TRADE, 1990-2007

Year	Grubel-Lloyd IIT Index			Intra-Industry Trade Share (%)			Inter-Industry Trade Share (%)		
	Canada	Mexico	NAFTA	Canada	Mexico	NAFTA	Canada	Mexico	NAFTA
1990	0.329	0.297	0.321	46.2	35.3	43.4	53.8	64.7	56.6
1991	0.329	0.282	0.316	46.8	38.2	44.5	53.2	61.8	55.5
1992	0.329	0.269	0.312	46.7	42.5	45.5	53.3	57.5	54.5
1993	0.333	0.267	0.315	47.4	40.3	45.4	52.6	59.7	54.6
1994	0.340	0.261	0.317	42.5	33.7	39.9	57.5	66.3	60.1
1995	0.347	0.280	0.328	42.8	38.9	41.7	57.2	61.1	58.3
1996	0.355	0.285	0.333	45.4	43.4	44.8	54.6	56.6	55.2
1997	0.349	0.275	0.324	46.3	44.3	45.7	53.7	55.7	54.3
1998	0.355	0.281	0.329	43.1	41.0	42.4	56.9	59.0	57.6
1999	0.356	0.290	0.333	43.2	40.0	42.1	56.8	60.0	57.9
2000	0.358	0.288	0.332	45.0	42.5	44.1	55.0	57.5	55.9
2001	0.364	0.291	0.337	44.1	41.3	43.0	55.9	58.7	57.0
2002	0.367	0.290	0.337	43.3	42.3	42.9	56.7	57.7	57.1
2003	0.361	0.290	0.334	45.5	42.5	44.3	54.5	57.5	55.7
2004	0.365	0.290	0.337	45.6	37.8	42.7	54.4	62.2	57.3
2005	0.363	0.293	0.328	48.6	44.7	46.7	51.4	55.3	53.3
2006	0.360	0.296	0.335	46.3	44.2	45.5	53.7	55.8	54.5
2007	0.357	0.311	0.340	49.8	38.1	45.3	50.2	61.9	54.7

Note: The Grubel-Lloyd IIT index for NAFTA is the weighted average of IIT indexes of Canada and Mexico and intra-industry trade share for NAFTA is the weighted average of IIT shares of Canada and Mexico.

Source: Authors' calculations.

TABLE 4 (A)

DISTRIBUTION OF IIT INDICES IN UNITED STATES' TRADE WITH NAFTA, 1990–2007
NUMBER OF PRODUCTS

GL IIT Index	NAFTA									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	2,157	2,297	2,351	2,419	2,462	2,414	2,307	2,416	2,391	2,286
0.1 < GL < 0.2	790	808	809	828	815	857	921	840	844	778
0.2 < GL < 0.3	581	624	548	578	617	608	621	597	627	621
0.3 < GL < 0.4	495	477	412	504	534	544	520	525	505	548
0.4 < GL < 0.5	430	374	382	479	444	491	465	472	462	458
0.5 < GL < 0.6	357	373	378	409	477	471	451	412	425	414
0.6 < GL < 0.7	345	348	330	412	404	395	424	423	397	411
0.7 < GL < 0.8	343	319	302	412	373	395	397	437	440	407
0.8 < GL < 0.9	333	308	340	350	389	401	409	410	399	392
0.9 < GL < 1.0	296	302	342	376	360	373	393	392	400	404
Total	6,127	6,230	6,194	6,767	6,875	6,949	6,908	6,924	6,890	6,719

GL IIT Index	Canada									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	1,223	1,232	1,194	1,183	1,194	1,155	1,066	1,150	1,144	1,139
0.1 < GL < 0.2	503	514	490	453	447	460	516	460	464	417
0.2 < GL < 0.3	365	382	346	341	365	360	378	323	366	356
0.3 < GL < 0.4	331	320	263	297	311	320	325	298	303	303
0.4 < GL < 0.5	270	254	254	297	263	289	273	286	243	270
0.5 < GL < 0.6	231	236	265	263	300	295	273	257	237	242
0.6 < GL < 0.7	212	241	219	257	252	250	267	255	247	244
0.7 < GL < 0.8	219	203	204	263	243	240	241	285	282	246
0.8 < GL < 0.9	217	202	224	222	246	248	252	265	247	235
0.9 < GL < 1.0	193	208	230	236	234	234	262	244	250	234
Total	3,764	3,792	3,689	3,812	3,855	3,851	3,853	3,823	3,783	3,686

GL IIT Index	Mexico									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	934	1,065	1,157	1,236	1,268	1,259	1,241	1,266	1,247	1,147
0.1 < GL < 0.2	287	294	319	375	368	397	405	380	380	361
0.2 < GL < 0.3	216	242	202	237	252	248	243	274	261	265
0.3 < GL < 0.4	164	157	149	207	223	224	195	227	202	245
0.4 < GL < 0.5	160	120	128	182	181	202	192	186	219	188
0.5 < GL < 0.6	126	137	113	146	177	176	178	155	188	172
0.6 < GL < 0.7	133	107	111	155	152	145	157	168	150	167
0.7 < GL < 0.8	124	116	98	149	130	155	156	152	158	161
0.8 < GL < 0.9	116	106	116	128	143	153	157	145	152	157
0.9 < GL < 1.0	103	94	112	140	126	139	131	148	150	170
Total	2,363	2,438	2,505	2,955	3,020	3,098	3,055	3,101	3,107	3,033

Source: Authors' calculations.

TABLE 4 (B)

DISTRIBUTION OF IIT INDICES IN UNITED STATES' TRADE WITH NAFTA, 1990–2007
SHARE OF PRODUCTS (%)

GL IIT Index	NAFTA									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	35.2	36.9	38.0	35.7	35.8	34.7	33.4	34.9	34.7	34.0
0.1 < GL < 0.2	12.9	13.0	13.1	12.2	11.9	12.3	13.3	12.1	12.2	11.6
0.2 < GL < 0.3	9.5	10.0	8.8	8.5	9.0	8.7	9.0	8.6	9.1	9.2
0.3 < GL < 0.4	8.1	7.7	6.7	7.4	7.8	7.8	7.5	7.6	7.3	8.2
0.4 < GL < 0.5	7.0	6.0	6.2	7.1	6.5	7.1	6.7	6.8	6.7	6.8
0.5 < GL < 0.6	5.8	6.0	6.1	6.0	6.9	6.8	6.5	6.0	6.2	6.2
0.6 < GL < 0.7	5.6	5.6	5.3	6.1	5.9	5.7	6.1	6.1	5.8	6.1
0.7 < GL < 0.8	5.6	5.1	4.9	6.1	5.4	5.7	5.7	6.3	6.4	6.1
0.8 < GL < 0.9	5.4	4.9	5.5	5.2	5.7	5.8	5.9	5.9	5.8	5.8
0.9 < GL < 1.0	4.8	4.8	5.5	5.6	5.2	5.4	5.7	5.7	5.8	6.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

GL IIT Index	Canada									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	32.5	32.5	32.4	31.0	31.0	30.0	27.7	30.1	30.2	30.9
0.1 < GL < 0.2	13.4	13.6	13.3	11.9	11.6	11.9	13.4	12.0	12.3	11.3
0.2 < GL < 0.3	9.7	10.1	9.4	8.9	9.5	9.3	9.8	8.4	9.7	9.7
0.3 < GL < 0.4	8.8	8.4	7.1	7.8	8.1	8.3	8.4	7.8	8.0	8.2
0.4 < GL < 0.5	7.2	6.7	6.9	7.8	6.8	7.5	7.1	7.5	6.4	7.3
0.5 < GL < 0.6	6.1	6.2	7.2	6.9	7.8	7.7	7.1	6.7	6.3	6.6
0.6 < GL < 0.7	5.6	6.4	5.9	6.7	6.5	6.5	6.9	6.7	6.5	6.6
0.7 < GL < 0.8	5.8	5.4	5.5	6.9	6.3	6.2	6.3	7.5	7.5	6.7
0.8 < GL < 0.9	5.8	5.3	6.1	5.8	6.4	6.4	6.5	6.9	6.5	6.4
0.9 < GL < 1.0	5.1	5.5	6.2	6.2	6.1	6.1	6.8	6.4	6.6	6.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

GL IIT Index	Mexico									
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2007
0.0 < GL < 0.1	39.5	43.7	46.2	41.8	42.0	40.6	40.6	40.8	40.1	37.8
0.1 < GL < 0.2	12.1	12.1	12.7	12.7	12.2	12.8	13.3	12.3	12.2	11.9
0.2 < GL < 0.3	9.1	9.9	8.1	8.0	8.3	8.0	8.0	8.8	8.4	8.7
0.3 < GL < 0.4	6.9	6.4	5.9	7.0	7.4	7.2	6.4	7.3	6.5	8.1
0.4 < GL < 0.5	6.8	4.9	5.1	6.2	6.0	6.5	6.3	6.0	7.0	6.2
0.5 < GL < 0.6	5.3	5.6	4.5	4.9	5.9	5.7	5.8	5.0	6.1	5.7
0.6 < GL < 0.7	5.6	4.4	4.4	5.2	5.0	4.7	5.1	5.4	4.8	5.5
0.7 < GL < 0.8	5.2	4.8	3.9	5.0	4.3	5.0	5.1	4.9	5.1	5.3
0.8 < GL < 0.9	4.9	4.3	4.6	4.3	4.7	4.9	5.1	4.7	4.9	5.2
0.9 < GL < 1.0	4.4	3.9	4.5	4.7	4.2	4.5	4.3	4.8	4.8	5.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations.

of each of the ten ranges of IIT remained relatively constant, although number of products with IIT indices above 0.5 increased from 1,674 in 1990 to 2,028 in 2007. However, the number of products with only inter-industry trade (products with only exports and no imports or products with only imports and no exports) increased from 9,261 in 1990 to 11,495 in 2007 in U.S.-Canada trade and increased from 8,203 in 1990 to 10,700 in 2007 in U.S.-Mexico trade.

Having discussed the general trends in IIT, let us now discuss the extent of horizontal and vertical IIT in U.S. – NAFTA trade. The shares of horizontal IIT (*HIIT*) and vertical IIT (*VIIT*) as well as its two components for the period 1990-2007 are presented in Table 5. Three dispersion factors ($\alpha = 15\%$, $\alpha = 20\%$, and $\alpha = 25\%$) were used to calculate these shares. While most other studies use only one dispersion factor, we used three dispersion factors to check the accuracy of estimates. In the process of calculating these shares, we faced a major obstacle; the unit prices of a large number of products with IIT were not available. In the U.S.-Canada trade, nearly 8% of products with IIT did not have unit prices while in the U.S.-Mexico trade, nearly 13% of products with IIT did not have unit prices in 1990. However, these shares dropped to 5% and 6%, respectively, in 2007. As a result, the actual share of *HIIT* or *VIIT* cannot be calculated for these industries. Despite this limitation, our first finding is that IIT is overwhelmingly vertical (Table 5). It should be noted here that the actual shares of vertical and horizontal IIT may have been underestimated. The results also show that the share of vertical IIT is relatively higher in the U.S.-Mexico trade than in the U.S.-Canada trade regardless of the level of α; even at the level of $\alpha = 0.25$, the share of horizontal IIT remained below vertical in 2007, even though Canada has more horizontal trade than Mexico. Furthermore, the share of high-quality vertical IIT is much higher than that of the low-quality vertical *IIT*.

Given the level of development and the similarity of per capita incomes of Canada and the United States, we would have expected to find most of IIT to be horizontal in nature. However, most of the total intra-industry trade is vertical. This finding is not surprising; it is consistent with findings of some recent studies. Vertical IIT share, however, has decreased significantly during this period, with vertical IIT share decreasing from 68.4% in 1990 to 57.6% in 2006 in the U.S.-Canada trade and decreasing from 89.6% in 1990 to 82.2% in 2007 in the U.S.-Mexico trade.

VI. EMPIRICAL RESULTS

We estimate three equations, using as the dependent variable the share of *IIT*, share of horizontal *IIT*, and the share of vertical *IIT*. The models are estimated using industry-specific data. Although the trade data are reported at the 10-digit HS level, industry-specific variables are reported only at the 2-digit *SIC* (Standard Industry Classification) or *NAICS* (North American Industry Classification System) levels. Therefore, intra-industry trade shares as well as horizontal intra-industry share and vertical industry share were re-estimated at the 2-digit HS level before estimating models. Since some of the industry-specific variables were only reported for some of the years in our sample period, we estimated the models using data for 2004. Regression results are reported in Table 6. All the variables are expressed in logarithmic

TABLE 5

SHARES OF VERTICAL AND HORIZONTAL FLOWS IN US-NAFTA INTRA-INDUSTRY TRADE, 1990-2007

Canada									
Year	α = 0.15			α = 0.20			α = 0.25		
	Horizontal	Vertical-HQ	Vertical-LQ	Horizontal	Vertical-HQ	Vertical-LQ	Horizontal	Vertical-HQ	Vertical-LQ
1990	31.6	44.7	23.7	36.7	41.3	22.0	49.8	29.7	20.4
1991	31.4	44.5	24.1	41.6	37.5	20.9	44.3	36.2	19.5
1992	28.5	44.2	27.3	38.3	35.9	25.8	43.6	33.3	23.2
1993	33.9	42.8	23.3	40.1	37.9	22.0	43.2	36.3	20.5
1994	37.1	42.3	20.6	41.3	40.2	18.5	44.7	38.2	17.1
1995	32.3	38.7	29.0	40.6	33.1	26.3	43.1	31.8	25.1
1996	32.2	37.7	30.1	37.0	35.7	27.3	41.1	33.5	25.4
1997	36.6	36.1	27.2	42.6	32.3	25.2	46.3	30.9	22.8
1998	30.0	40.4	29.7	35.5	37.6	26.9	38.3	36.2	25.4
1999	24.8	39.0	36.2	39.1	32.1	28.8	43.6	30.2	26.2
2000	33.7	37.2	29.1	43.5	30.9	25.6	54.6	22.5	23.0
2001	31.8	39.5	28.6	38.6	34.7	26.7	42.4	33.2	24.4
2002	30.4	38.9	30.7	42.2	30.1	27.6	51.8	26.4	21.8
2003	27.3	45.7	27.1	43.0	31.2	25.8	46.6	28.9	24.6
2004	35.5	28.7	35.8	46.0	26.2	27.7	53.4	23.3	23.3
2005	43.4	24.2	32.5	48.6	22.7	28.7	52.4	20.6	27.0
2006	42.4	30.8	26.8	46.5	29.4	24.1	54.6	22.8	22.6
2007	26.3	47.1	26.6	32.5	44.7	22.8	51.4	28.9	19.6

Mexico									
Year	α = 0.15			α = 0.20			α = 0.25		
	Horizontal	Vertical-HQ	Vertical-LQ	Horizontal	Vertical-HQ	Vertical-LQ	Horizontal	Vertical-HQ	Vertical-LQ
1990	10.4	54.1	35.5	15.2	52.7	32.1	19.6	50.0	30.3
1991	10.8	55.6	33.6	15.0	54.2	30.8	19.0	53.4	27.6
1992	7.6	45.0	47.4	22.5	45.6	31.8	26.1	43.8	30.0
1993	14.1	49.1	36.8	21.4	47.7	30.9	23.5	45.3	31.2
1994	12.3	50.7	37.0	17.2	47.3	35.5	22.2	46.6	31.3
1995	11.4	55.7	32.9	15.4	52.9	31.7	27.3	42.5	30.3
1996	19.9	48.8	31.3	24.8	46.2	28.9	30.4	44.3	25.4
1997	18.4	52.9	28.7	25.5	50.4	24.1	30.3	49.1	20.6
1998	20.8	50.0	29.2	24.9	49.1	26.0	29.3	47.6	23.1
1999	18.9	49.5	31.7	28.4	42.0	29.6	32.5	40.8	26.6
2000	29.0	38.9	32.2	35.2	34.5	30.4	43.2	30.6	26.2
2001	12.1	48.9	39.0	18.4	47.0	34.6	24.1	43.0	32.9
2002	15.8	35.5	48.7	33.7	34.5	31.8	40.0	31.8	28.3
2003	15.1	35.3	49.6	22.0	32.5	45.5	26.0	30.4	43.7
2004	23.7	33.2	43.2	26.4	31.9	41.6	31.5	29.6	39.0
2005	13.8	33.5	52.8	16.4	32.0	51.6	28.9	28.0	43.1
2006	35.4	33.2	31.4	43.4	30.8	25.8	48.2	29.2	22.6
2007	17.8	42.3	39.9	27.1	39.6	33.3	32.2	38.3	29.5

Source: Authors' calculations.

form. The results presented in Table 6 confirm the theoretical expectations but some coefficients are not highly statistically significant. The adjusted R^2 values for the three models are relatively low, ranging from 0.10 to 0.15. However, they are similar to the results of previous studies.

Among the industry-specific variables, product differentiation is found to have a positive effect on all three types of *IIT* shares, although not statistically significant. Similarly, the vertical product differentiation is also found to have a positive effect. Industry concentration is found to have a negative and statistically significant effect on all three types of *IIT* shares. The industry size is expected positive effect; but is has a negative and statistically significant effect. The results for the variable measuring quality differences support the hypothesis that the more differentiated products are in terms of quality, the larger the share of bilateral *IIT* will be. The coefficient has the expected sign and is statistically significant for total *IIT* share and vertical *IIT* share at the 1% level.

The findings of this study are subject to inevitable limitations. The main difficulty arises from the limitation of data; the industry based statistics are only published at the 2-digit *SIC* (Standard Industry Classification) or *NAICS* (North American Industry Classification System) levels in the U.S., so this limits the scope of empirical studies. For more reliable results, this exercise should be repeated for different time intervals and the change in the calculated *IIT* levels should be analyzed. However, despite these considerations, we have identified some important industry-specific determinants of U.S.- NAFTA intra-industry trade.

TABLE 6

DETERMINANTS OF THE U.S.–NAFTA INTRA–INDUSTRY TRADE

Independent Variable	(1) Dependent Variable: *SIIT*	(2) Dependent Variable: *SHIIT*	(3) Dependent Variable: *SVIIT*
Constant	9.301 (3.07)	9.041 (2.77)	2.435 (1.04)
PD	0.265* (2.30)	0.127 (0.97)	0.141 (1.44)
VPD	0.211 (1.56)	0.088 (0.57)	0.200** (1.84)
ICON	–2.666* (–3.49)	–2.224** (–1.94)	–1.852* (–3.04)
INDSIZE	–0.265* (–2.30)	–0.621* (–2.61)	–0.576** (–1.81)
PRQD	0.281* (2.35)	0.072 (0.58)	0.352* (3.59)
Adjusted R^2	0.15	0.10	0.16
n	187	166	187

Note: Figures in parentheses are t–statistics * and ** indicate the significance at the 1% level and 5% level, respectively.

VII. SUMMARY AND CONCLUSIONS

This study analyzes the development of intra-industry and inter-industry trade between the United States and the NAFTA during the period 1990 to 2007. The main objective of this paper is to explain the extent of vertical and horizontal intra-industry trade in United State's foreign trade with the NAFTA. For this purpose, trade patterns are identified by breaking up total trade into three trade types: one-way trade (i.e. inter-industry trade), two-way trade (i.e. intra-industry trade) in horizontally differentiated products, and two-way trade in vertically differentiated products. Unlike most other studies on intra-industry trade, this study uses detailed trade data at the 10-digit Harmonized System (HS) industry level and covers a longer and more recent period, 1990 through 2007. The Grubel-Lloyd intra-industry trade index is used to calculate the intensity of these two types of intra-industry trade.

One of the main findings is that the observed increase in intra-industry trade between the U.S. and NAFTA is almost entirely due to two-way trade in vertical differentiation: thus, the 1990-2007 period is characterized by an increasing specialization of three countries along ranges of qualities within products, suggesting a 'qualitative' division of labor. This may also be due to the product differentiation, labor intensity of production, and economies of scale.

Another important finding is that the share of vertical intra-industry trade has decreased for Canada while it increased for Mexico during this period, although it continued to remain the dominant type of intra-industry trade.

It is also interesting to note that in more than half of the industries, the low-quality vertical IIT is dominant. This observation is valid for both the U.S.-Canada trade and the U.S.-Mexico trade. The results also suggest that bilateral trade flows between the United States and the NAFTA have become more intense indicating trading relations are strengthening.

Among the industry-specific variables, product differentiation, vertical product differentiation, and product quality differences are found to have a positive effect on all three types of *IIT* shares. Industry concentration and industry size are found to have a negative and statistically significant effect on all three types of *IIT* share.

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