INTRA-INDUSTRY TRADE BETWEEN THE UNITED STATES AND LATIN AMERICAN COUNTRIES

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ABSTRACT

This paper aims to explain the extent of vertical and horizontal intra-industry trade (IIT) in United State's foreign trade with 20 Latin American countries. It also attempts to identify the country- and industry-specific determinants of vertical and horizontal IIT. One of the main findings is that, with the exception of Mexico, the U.S. trade patterns with rest of Latin American countries are dominated by one-way trade. Another main finding is that the observed increase in intra-industry trade between the United States and Latin America is almost entirely due to two-way trade in vertical differentiation. The third important finding is that, among the country-specific determinants, the level of per capita income and trade intensity are found to affect the shares of all three types of IIT positively while difference in per capita income, difference in economic size, distance, difference in factor endowment, and trade imbalances are found to affect the share of all three types of IIT negatively. Finally, among the industry-specific variables, product differentiation, vertical product differentiation, industry size, and product quality differences are found to have a positive effect while industry concentration is found to have a negative and statistically significant effect on all three types of IIT share.

INTRODUCTION

Since the introduction of the concept of intra-industry trade (IIT) in the 1960s, a large number of theoretical and empirical studies have investigated 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 IIT aggregation and measurement issues.

The majority of empirical studies have tried to explain the IIT of developed countries due to the 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 as well as identify their determinants. Most of these studies are concentrated on IIT in European countries and only a few are on the U.S. IIT. Some of the previous studies on the U.S. IIT include Clark (2006), Clark and Stanley (2003), Gonzalez and Valez (1993, 1995), Hart and McDonald (1992), and Manrique (1987). 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.

This paper attempts to (a) explain the extent of vertical and horizontal intra-industry trade in the United State's foreign trade with Latin America, and (b) identify the country- and 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. 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, 1990-2005.

The remainder of the paper is organized as follows: Section 2 provides a brief discussion of the general performance of international trade of the U.S. with the Latin America during the past sixteen years. Alternative measures of intra-industry trade and the estimated model are discussed in Section 3 while Section 4 presents a discussion of the estimated IIT indices. Section 5 presents and discusses the empirical results of the estimated regression models. Section 6 summarizes the main findings.

GENERAL PERFORMANCE OF U.S. TRADE WITH THE LATIN AMERICA

In this section, we describe the extent, nature and dynamics of trade between the United States and Latin America. Of the 20 trading partners in Latin America, Mexico, Venezuela, and Brazil are the largest trading partners of the United States, accounting for about 14% of total United States merchandise trade with the other 17 Latin American partners accounting for only about 4% of total trade (see Table 1). In 2005, Mexico was the largest Latin American trading partner of the United States, accounting for approximately one eighth of the total merchandise trade of the United States. Brazil and Venezuela are the second and third largest U.S. trading partners in the Western Hemisphere, accounting for about 2.7% of total U.S. merchandise trade. The share of U.S. trade with Latin America increased from 12.4% in 1990 to 17.9% in 2005 (see Table 1). The United States' total trade (exports + imports) with Latin America increased significantly from $110.1 billion in 1990 to $461.1 billion in 2005, an annual average increase of about 10.3%. The share of U.S. exports to Latin America, however, increased from 12.5% in 1990 to 20.1% in 2005 while the corresponding share of imports increased marginally from 12.3% to 16.7% during this period (see Table 1).

Of the 20 trading partners in Latin America, 8 countries experienced growth rates of total trade exceeding 10% during the 1990-2005 period. The U.S. trade with Latin America grew at a faster rate relative to its trade with all other countries. However, the U.S. trade with the Latin American trading partners as well as with the rest of the world slowed down significantly during 2000-2005 period, especially after September 11, 2001. It should also be noticed that some of the smaller trading partners, each accounting for less than 1% of the U.S. total merchandise trade, experienced rapid growth rates. United State's international trade with Mexico increased significantly during the 1990-2005 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 $266.6 billion in 2005, an annual average increase of about 11.6%. Mexican share of U.S. total merchandise trade increased from 6.6% in 1990 to 11.3% in 2005. The share of U.S. exports to Mexico almost doubled during this period, increasing from 7.2% in 1990 to 13.3% in 2005. The share of U.S. imports from Mexico also rose during this period, increasing from 6.1% in 1990 to 10.2% in 2005.

MEASUREMENT OF INTRA-INDUSTRY TRADE

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) and Lloyd and Grubel (2003)). 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

Table 1: Average Growth and Share of the U.S. Trade with Latin America, 1990-2005
(Average share and annual average growth rate for 1990-2005, %)

Country	Total Trade Share			Exports Share			Imports Share			Average Annual Growth Rate		
	1990	2005	Avg.	1990	2005	Avg,	1990	2005	Avg,	Trade	Exports	Imports
Argentina	0.3	0.3	0.4	0.3	0.5	0.6	0.3	0.3	0.3	9.6	14.3	8.6
Belize	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	7.3	6.3
Bolivia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	4.7	3.9
Brazil	1.5	1.5	1.5	1.3	1.7	1.8	1.6	1.5	1.3	8.2	9.1	8.2
Chile	0.3	0.5	0.4	0.4	0.6	0.5	0.3	0.4	0.3	10.4	9.5	11.9
Colombia	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.5	0.5	7.6	8.5	7.9
Costa Rica	0.2	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.3	9.2	9.4	9.4
Dominican Republic	0.4	0.4	0.5	0.4	0.5	0.5	0.4	0.3	0.4	7.2	7.5	7.0
Ecuador	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.2	10.2	9.8	11.4
El Salvador	0.1	0.1	0.2	0.1	0.2	0.2	0.0	0.1	0.1	11.6	9.0	15.9
Guatemala	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	9.6	9.5	9.8
Honduras	0.1	0.3	0.2	0.1	0.4	0.3	0.1	0.2	0.2	13.9	12.8	15.1
Mexico	6.6	11.3	10.0	7.2	13.3	11.1	6.1	10.2	9.2	11.6	10.8	12.5
Nicaragua	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	25.8	18.6	42.9
Panama	0.1	0.1	0.1	0.2	0.2	0.2	0.0	0.0	0.0	6.1	6.9	2.8
Paraguay	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	9.0	9.9	3.7
Peru	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2	11.7	8.2	14.5
Suriname	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	5.7	12.0
Uruguay	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	10.7	9.6	14.8
Venezuela	1.4	1.6	1.2	0.8	0.7	0.8	1.9	2.0	1.5	9.9	8.5	11.6
Total Latin America	**0.3**	**0.3**	**0.4**	**0.3**	**0.5**	**0.6**	**0.3**	**0.3**	**0.3**	**10.3**	**9.6**	**11.0**
Total All Countries	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**7.5**	**5.9**	**8.6**

This table shows the shares of the U.S.-Latin America merchandise trade, exports, and imports and their corresponding rates of growth during 1990-2005. For example, Mexico accounted for 11.3% of the U.S. merchandise trade, 13.3% of the U.S. merchandise exports, and 10.2% of the U.S. merchandise imports in 2005. Source: Authors' calculations based on data from World Trade Atlas Database.

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

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

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

$$IIT_j = \frac{\sum_{i=1}^{n}(X_{ij} + M_{ij}) - \sum_{i=1}^{n}\left|X_{ij} - M_{ij}\right|}{\sum_{i=1}^{n}(X_{ij} + M_{ij})} \qquad (2)$$

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

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 explains 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 α = 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, α = 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 α = 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.

MODEL SPECIFICATION: COUNTRY- AND INDUSTRY-SPECIFIC ANALYSIS

Following Greenway and Milner (1994), Hine, Greenway and Milner (1999), and others, a number of country-specific and 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:

Country-specific Determinants:

Per Capita Income (PCI **)**: Intra-industry trade with any given trading partner may tend to be higher as per capita income (PCI) of the partner country is higher. According to Greenway and Milner (1994), customer demand at low levels of PCI is generally small and standardized with respect to product characteristics, but with higher PCI, demand will become more complex and differentiated. This will lead to greater demand for differentiated products. On the other hand, if the stage of development can be measured by PCI, a higher PCI then leads to higher intra-industry trade. The effect of this variable, measured as per capita GDP in U.S. dollars on the extent of intra-industry trade, is anticipated to be positive, reflecting enhanced demand for differentiated goods.

Difference in Per Capita Income ($DPCI$ **)**: Intra-industry trade will be negatively correlated with differences in per capita income, indicating differences in demand structures and/or differences in resource endowments. If PCI is interpreted as an indicator of demand structure, a greater difference in PCI implies that demand structures have become more dissimilar. This indicates that the potential for intra-industry trade decreases. For trade to exist between two countries, there must in each country be a demand for products of high quality produced by the other. Therefore, when the difference between the per capita incomes of two trading partners is greater, the scope for intra-industry trade tends to be smaller. Following Balassa (1986), Balassa and Bauwens (1987), and Durkin and Krygier (2000), the relative difference in PCI in U.S. dollars, between the U.S. and a given country j, is measured as

$$DPCI_j = 1 + \frac{[w_j \ln w_j + (1 - w_j)\ln(1 - w_j)]}{\ln 2} \qquad (4)$$

where $$w_j = \frac{PCI_{US}}{PCI_{US} + PCI_j}$$

Difference in Economic Size ($DGDP$ **)**: If the economies of two countries are large, there is more scope for intra-industry trade than in cases where the markets are of very different size. Thus, a greater divergence in economic size between two countries yields a lower volume of intra-industry trade. The relative difference in economic size as measured by GDP, between the U.S. and a given country, is measured in a manner similar to the measurement of difference in per capita income in equation (4).

Distance ($DIST$ **)**: Intra-industry trade is negatively correlated with the trade barriers between trading partners, representing the availability and cost of information necessary for trading differentiated products. To account for barriers to trade, this study uses transportation cost. Following Balassa (1986) and Nilsson (1999), since no information is available on transportation cost, the direct-line distance between the U.S. and a given trading partner was used as a proxy.

Difference in Factor Endowment (*DFEND*): Following Martin and Orts (2002), we define the factor endowment differences as,

$$DFEND = \left| \frac{Y_i}{L_i} - \frac{Y_j}{L_j} \right|,$$

where $Y_{i(j)}$ is the level of GDP in country i (j) and $L_{i(j)}$ is the total employment of country i (j). It can be expected that the smaller the factor endowment difference, the more likely for countries to specialize in horizontally differentiated goods and less likely to specialize in vertically differentiated goods. Thus, we can expect the factor endowment difference to affect horizontal intra-industry trade negatively and vertical intra-industry trade positively.

Trade Orientation (*TO*): Intra-industry trade will be positively correlated with the country's trade orientation. Following Balassa and Bauwens (1987) and others, TO is defined as the residuals from a regression of per capita trade (PCT) on per capita income (PCI) and population (POP).

$$PCT = (Exports + Imports) / Popolation$$

where exports and imports are measured in millions of U.S. dollars and population is measured in thousands. TO is measured as the residuals from the following regression equation:

$$\ln PCT = \beta_0 + \beta_1 \ln PCI + \beta_2 \ln POP + \varepsilon$$

Trade Intensity (*TINT*): According to Greenway and Milner (1995), the extent of intra-industry trade will be positively correlated with the trade intensity ($TINT$) of the U.S. with a trading partner. As the trade volume with a country increases, there will be more chances for more differentiated products to be traded. $TINT$ is defined as the ratio of the U.S.'s trade volume with a country to its total trade volume.

Trade Imbalance ($TIMB$): Trade imbalance is expected to be negatively correlated with the intra-industry trade. Some recent studies (for example, Lee and Lee (1993), Stone and Lee (1995), and Havrylyshyn and Kuznel (1997)) have also used trade imbalance ($TIMB$) as an additional explanatory variable.

Trade imbalance is measured by

$$TIMB_j = \frac{\left| X_j - M_j \right|}{X_j + M_j},$$

where X_j and M_j are exports and imports of the U.S. to and from country j, and $TIMB_j$ is the measure of trade imbalance with country j.

Industry-Specific Determinants:

Product Differentiation (PD): It is expected that industries with higher degree of product differentiation tend to have higher intra-industry trade shares, as more product variety broadens the basis for intra-industry trade. Following Greenway, Hine and Milner (1994, 1995), we define product differentiation as the number of 10-digit HS industries across 2-digit HS industries for the U.S. trading partners. This measure is expected to affect intra-industry shares positively.

Vertical Product Differentiation (VPD): 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 intra-industry shares positively.

Industry Concentration ($ICON$): 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.

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.

Product Quality Differences ($PRQD$**)**: 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:

$$\begin{aligned} SIIT_{ij} = {} & \beta_0 + \beta_1 PCI_j + \beta_2 DPCI_j + \beta_3 DGDP_j + \beta_4 DIST_j + \beta_5 DFEND_j + \beta_6 TO_j + \beta_7 TINT_j \\ & + \beta_8 TIMB_j + \beta_9 PD_{ij} + \beta_{10} VPD_{ij} + \beta_{11} ICON_{ij} + \beta_{12} INDSIZE_{ij} + \beta_{13} PRQD_{ij} + u_{ij} \end{aligned} \tag{5}$$

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:

$$\ln\left[\frac{SIIT_j}{1 - SIIT_j}\right] = \beta Z + u \tag{6}$$

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.

Data

This study is based on detailed trade data desegregated at 10-digit Harmonized System (HS) industries, covering the period from 1990 to 2005. The 20 countries in Latin America include Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, and Venezuela. 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.

Data on *GDP* and *PCI* are from the International Monetary Fund's *World Economic Outlook Database*. The data on geographic distance (*DIST*) is obtained from the CEPII's distance measures database available at http://www.cepii.fr/anglaisgraph/bdd/distances.htm. Data on industry concentration (*ICON*) is from the *2002 Economic Census*. Data on trade intensity (*TINT*), trade imbalance (*TIMB*), and 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*. 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. The data on other relevant variables were taken from the International Monetary Fund's, *International Financial Statistics Yearbook 2005* and the World Bank, *World Development Report 2005*.

ESTIMATION OF INTRA-INDUSTRY TRADE INDICES

In this section, we describe the extent of intra-industry trade between the United States and the Latin American trading 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 1990-2005, at the 10-digit level of the Harmonized System (HS). The shares of IIT in the U.S. trade with the Latin American trading partners are presented in Table 2.

Table 2: Share of the U.S. Intra-Industry Trade with Latin America, 1990-2005
(Intra-Industry Trade as Percentage of Total Merchandise Trade, %)

Country	1990	1992	1994	1996	1998	2000	2002	2004	2005
Argentina	13.2	14.0	15.8	16.5	19.4	28.8	15.4	14.2	15.0
Belize	0.2	0.6	0.5	3.7	6.6	1.1	5.1	1.2	6.2
Bolivia	0.6	4.0	0.1	0.9	2.1	18.5	1.4	1.9	1.1
Brazil	27.1	19.9	21.5	26.3	27.6	34.2	30.7	29.7	27.7
Chile	6.4	7.4	10.7	14.2	16.3	12.0	10.8	15.1	29.3
Colombia	3.2	5.2	6.7	9.8	7.9	10.0	9.4	9.5	8.4
Costa Rica	10.1	7.6	7.8	9.3	10.1	20.3	35.5	38.1	37.7
Dominican Republic	15.0	14.3	13.6	15.5	14.1	15.7	16.5	20.2	22.3
Ecuador	1.0	2.5	7.4	2.7	8.0	11.1	8.3	4.9	4.4
El Salvador	6.7	4.8	6.6	8.2	8.0	13.1	10.3	7.8	9.5
Guatemala	5.1	3.3	3.7	5.0	3.8	8.7	5.5	3.6	4.4
Honduras	5.3	4.6	5.3	9.5	9.2	11.6	12.5	10.7	15.3
Mexico	35.3	42.5	33.7	43.4	41.0	42.5	42.3	37.8	44.7
Nicaragua	0.0	4.0	0.2	0.7	0.5	0.6	1.0	6.9	9.2
Panama	6.1	4.7	6.3	4.1	6.6	7.8	8.7	12.3	11.5
Paraguay	4.3	0.3	0.4	5.2	1.9	0.3	0.2	8.4	3.3
Peru	5.0	4.0	4.9	7.5	8.5	7.2	6.6	6.1	11.7
Suriname	22.0	20.9	15.9	24.3	29.7	39.8	43.4	39.9	34.6
Uruguay	7.0	7.2	14.2	6.1	4.4	3.2	12.1	8.7	4.3
Venezuela	16.6	13.0	15.8	16.4	33.7	14.1	9.0	7.1	10.9
Total Latin America	**25.6**	**28.7**	**25.1**	**31.8**	**32.6**	**34.8**	**34.3**	**30.2**	**34.6**

This table shows how the share of intra-industry trade has changed between 1990 and 2005.
Source: Authors' calculations based on data from World Trade Atlas Database.

The share of IIT is relatively high only for a handful of countries. Of the 20 countries, only 7 countries had a share exceeding 10% in 1990 and 11 countries had a share exceeding 10% in 2005. This finding is not surprising given the smaller size and the level of development of the majority of these trading partners. Larger trading partners such as Mexico and Brazil have relatively larger share of IIT. Although

the *IIT* share increased between 1990 and 2005 for majority of these trading partners, the inter-industry trade continued to be the dominant type of trade. For instance, Mexico's IIT share increased from 35.3% in 1990 to 44.7% in 2005 but the inter-industry share was 55.3% in 2005.

In order to get a full understanding of the level of IIT, it is important to know how common this type of trade is in terms of the number of products traded. The number of products traded and the number of products with IIT are presented in Table 3.

Table 3: Number of Products in U.S. Intra-Industry Trade with Latin America, 1990-2005

	1990			2005		
Country	Total Number of Products Traded	Number of Products with IIT	Percent of Products with IIT	Total Number of Products Traded	Number of Products with IIT	Percent of Products with IIT
Argentina	4,828	399	8.3	6,498	678	10.4
Belize	1,482	4	0.3	1,941	27	1.4
Bolivia	1,313	6	0.5	2,082	36	1.7
Brazil	6,731	1,071	15.9	9,621	1,703	17.7
Chile	4,780	179	3.7	6,183	434	7.0
Colombia	5,630	267	4.7	7,700	613	8.0
Costa Rica	4,455	198	4.4	5,860	464	7.9
Dominican Republic	4,742	228	4.8	6,666	523	7.8
Ecuador	3,326	39	1.2	5,013	283	5.6
El Salvador	3,025	47	1.6	4,610	161	3.5
Guatemala	4,186	82	2.0	5,800	217	3.7
Honduras	3,268	38	1.2	4,843	178	3.7
Mexico	10,566	2,363	22.4	13,825	3,125	22.6
Nicaragua	911	2	0.2	3,081	43	1.4
Panama	4,050	94	2.3	4,753	212	4.5
Paraguay	1,390	6	0.4	1,266	15	1.2
Peru	3,478	73	2.1	5,804	293	5.0
Suriname	1,132	2	0.2	1,802	21	1.2
Uruguay	2,040	34	1.7	2,757	100	3.6
Venezuela	5,809	520	9.0	5,989	433	7.2
Total Latin America	**77,142**	**5,652**	**7.3**	**106,094**	**9,559**	**9.0**

This table shows how the number of products with intra-industry trade has changed between 1990 and 2005. For example, in 1990, Argentina had 399 products with both exports and imports. In 2005, this number increased to 678, indicating an increase of intra-industry trade.
Source: Authors' calculations based on data from World Trade Atlas Database.

The number of products traded varies widely across the Latin American trading partners, as evident in Table 3. Generally, these numbers are larger for larger trading partners, such as Mexico, Brazil, and the Dominican Republic. 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 2005, trade activities increased to some 13,801 10-digit level industries, of which nearly 22.5% of industries (or 3,101 industries) had some intra-industry trade. Although the countries with higher share of IIT tend to have a higher share of products with IIT, product shares are relatively lower than the IIT shares.

The weighted average of the Grubel-Lloyd IIT indices computed using (2) for the years 1990 to 2005, for all Latin American trading partners are presented in Table 4. Although the IIT index in United States' trade with Latin America increased marginally during the period 1990-2005, it is not easy identify any trend for any given country. The IIT indices are not much different when we compare larger trading partners with smaller trading partners. The intensity of intra-industry has remained relatively constant during the period from 1990 to 2005.

Table 4: Grubel-Lloyd Intra-Industry Trade Index for U.S. Trade with Latin America, 1990-2005

Country	1990	1992	1994	1996	1998	2000	2002	2004	2005
Argentina	0.343	0.280	0.266	0.277	0.253	0.259	0.339	0.309	0.294
Belize	0.356	0.430	0.385	0.420	0.247	0.544	0.432	0.283	0.442
Bolivia	0.604	0.316	0.551	0.415	0.264	0.296	0.315	0.356	0.421
Brazil	0.313	0.321	0.313	0.274	0.259	0.279	0.288	0.296	0.312
Chile	0.294	0.287	0.262	0.244	0.225	0.262	0.258	0.283	0.257
Colombia	0.319	0.312	0.283	0.270	0.283	0.299	0.294	0.301	0.281
Costa Rica	0.330	0.304	0.292	0.291	0.295	0.311	0.314	0.299	0.295
Dominican Republic	0.344	0.331	0.307	0.322	0.313	0.316	0.326	0.283	0.303
Ecuador	0.338	0.277	0.318	0.290	0.297	0.308	0.270	0.282	0.305
El Salvador	0.355	0.385	0.363	0.355	0.335	0.315	0.311	0.310	0.298
Guatemala	0.312	0.299	0.315	0.241	0.271	0.304	0.303	0.295	0.295
Honduras	0.335	0.360	0.281	0.248	0.291	0.323	0.303	0.306	0.316
Mexico	0.297	0.269	0.261	0.285	0.281	0.288	0.290	0.290	0.293
Nicaragua	0.567	0.502	0.597	0.366	0.269	0.334	0.291	0.294	0.322
Panama	0.267	0.281	0.262	0.262	0.265	0.297	0.277	0.291	0.284
Paraguay	0.214	0.330	0.408	0.322	0.109	0.336	0.338	0.323	0.311
Peru	0.307	0.356	0.297	0.290	0.250	0.308	0.334	0.337	0.295
Suriname	0.201	0.196	0.276	0.218	0.419	0.428	0.423	0.424	0.471
Uruguay	0.384	0.364	0.321	0.321	0.253	0.353	0.404	0.382	0.342
Venezuela	0.307	0.284	0.302	0.267	0.276	0.245	0.275	0.260	0.236
Total Latin America	**0.339**	**0.324**	**0.333**	**0.299**	**0.273**	**0.320**	**0.319**	**0.310**	**0.319**

This table shows the weighted average of the Grubel-Lloyd IIT indices computed using (2) for the years 1990 to 2005.
Source: Authors' calculations based on data from World Trade Atlas Database.

Having discussed the general trends in IIT, let us now discuss the extent of horizontal and vertical IIT in U.S. – Latin America trade. The shares of horizontal IIT (*HIIT*) and the shares of vertical IIT (*VIIT*) are presented in Table 5. While we used three dispersion factors (α = 15%, α = 20%, and α = 25%) to calculate these shares, due to the limitation of space only the shares for the dispersion factor, α = 15% are presented in these tables. 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 about 5% of products with IIT were not available making it difficult to identify the product as vertically or horizontally differentiated. As a result, the actual shares of *HIIT* or *VIIT* presented in Tables 5 could be slightly underestimated. Despite this limitation, our first finding is that IIT is overwhelmingly vertical (Table 5). The average share of vertical IIT for the entire Latin American region ranged from 70% to 90% during the period 1990-2005. The results also show that the share of vertical IIT is relatively lower for larger trading partners such as Mexico and Brazil. However, most of the total intra-industry trade is vertical. This finding is not surprising; it is consistent with the findings of some recent studies (see, for example, Clark (2006), Clark and Stanley (2003)).

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 country- and industry-specific data for 2004. All the relevant industry-specific variables are measured at the 2-digit HS industry level. Regression results are reported in Table 6. All the variables, with the exception of *TO*, are expressed in logarithmic form. The first seven independent variables are country-specific variables while the last five independent variables are industry-specific variables.

Table 5: Share of Vertical and Horizontal Intra-Industry Trade with Latin America, 1990-2005
(Vertical and Horizontal Intra-Industry Trade as Percentage of Intra-Industry Trade, %)

	Vertical Intra-Industry Share					Horizontal Intra-Industry Share				
Country	1990	1994	1998	2002	2005	1990	1994	1998	2002	2005
Argentina	92.0	89.2	87.7	84.2	83.3	8.0	10.8	12.3	15.8	16.7
Belize	100.0	88.4	100.0	96.6	96.3	0.0	11.6	0.0	3.4	3.7
Bolivia	100.0	88.1	100.0	70.3	99.2	0.0	11.9	0.0	29.7	0.8
Brazil	65.6	94.0	79.4	87.6	93.1	34.4	6.0	20.6	12.4	6.9
Chile	93.9	96.1	77.9	93.1	84.7	6.1	3.9	22.1	6.9	15.3
Colombia	92.7	69.6	95.4	75.1	83.5	7.3	30.4	4.6	24.9	16.5
Costa Rica	77.3	93.2	95.0	98.6	97.2	22.7	6.8	5.0	1.4	2.8
Dominican Republic	77.5	97.3	87.6	88.4	87.0	22.5	2.7	12.4	11.6	13.0
Ecuador	99.7	90.6	54.6	89.5	97.9	0.3	9.4	45.4	10.5	2.1
El Salvador	99.9	86.3	61.3	66.5	95.9	0.1	13.7	38.7	33.5	4.1
Guatemala	62.2	72.0	93.7	77.4	91.2	37.8	28.0	6.3	22.6	8.8
Honduras	99.6	73.3	60.1	84.3	96.2	0.4	26.7	39.9	15.7	3.8
Mexico	86.2	85.5	78.5	85.3	83.7	13.8	14.5	21.5	14.7	16.3
Nicaragua	98.5	97.5	55.8	100.0	69.6	1.5	2.5	44.2	0.0	30.4
Panama	83.0	54.8	85.6	73.2	91.0	17.0	45.2	14.4	26.8	9.0
Paraguay	99.9	100.0	100.0	100.0	99.8	0.1	0.0	0.0	0.0	0.2
Peru	99.6	90.0	57.7	59.8	96.0	0.4	10.0	42.3	40.2	4.0
Suriname	100.0	100.0	99.9	99.9	99.9	0.0	0.0	0.1	0.1	0.1
Uruguay	38.8	97.9	97.8	96.7	73.2	61.2	2.1	2.2	3.3	26.8
Venezuela	60.5	76.1	92.1	68.7	73.7	39.5	23.9	7.9	31.3	26.3
Total Latin America	**80.5**	**86.1**	**79.3**	**85.2**	**84.5**	**19.5**	**13.9**	**20.7**	**14.8**	**15.5**

These shares are based on a dispersion factor (α) of 15 percent.
Source: Authors' calculations based on data from World Trade Atlas Database.

The results presented in Table 6 confirm the theoretical expectations but some coefficients are not statistically significant. The adjusted R^2 values for the three models are relatively low, ranging from 0.08 to 0.12. However, they are similar to the results of previous studies. Among the country-specific determinants, the level of per capita income is found to affect the shares of all three types of IIT positively but statistically insignificant. The positive coefficient for per capita income indicates that the share of IIT will be higher in trade with high income countries than countries with a lower level of per capita income. These findings are similar to those of earlier empirical studies of total IIT (see, for example, Greenway and Milner, 1995; Clark and Stanley, 2003; Clark, 2006).

Difference in per capita income has a negative effect on all three types of IIT shares; however, none of the coefficients is statistically significant. Similarly, difference in economic size also has a negative effect on all three types of IIT shares but only two are statistically significant. The geographic distance from the U.S. to a given trading partner is also found to have the expected negative effect on intra-industry trade shares. However, it is not statistically significant. This could be due to the relatively close proximity of all trading partners within the Western Hemisphere.

The rest of the country-specific variables, namely, difference in factor endowment, trade orientation, trade intensity, and trade imbalance, also display anticipated signs. However, none of these variables is statistically significant. Among the industry-specific variables, product differentiation is found to have a positive and statistically significant effect on all three types of IIT shares. 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 has the expected positive effect and is statistically significant. 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.

Table 6: Determinants of the U.S.-Latin America Intra-Industry Trade
(Heteroskedasticity-corrected *t*-statistics in Parentheses)

Independent Variable	(1) Dependent Variable: *SIIT*	(2) Dependent Variable: *SHIIT*	(3) Dependent Variable: *SVIIT*
Constant	27.591 (0.64)	100.036 (1.66)	152.094 (2.03)
PCI	0.106 (0.32)	0.500 (1.11)	0.103 (0.31)
DPCI	-1.908 (-0.48)	-7.754 (-1.38)	-2.749 (-0.70)
DGDP	-13.903** (-2.36)	-11.332 (-1.27)	-12.491*** (-1.95)
DIST	-0.256 (-1.23)	-0.465 (-1.48)	-0.246 (-1.21)
DFEND	-0.467 (-0.40)	-0.848 (-1.01)	-0.145 (-0.18)
TO	-0.001 (-0.41)	-0.002 (-0.94)	-0.001 (-0.25)
TINT	0.145 (0.15)	0.151 (1.03)	0.011 (0.12)
TIMB	-0.306 (-0.36)	-0.032 (-0.26)	-0.028 (-0.33)
PD	0.272* (5.53)	0.269* (3.63)	0.313* (6.49)
VPD	0.151* (2.87)	0.198** (2.36)	0.109** (2.03)
ICON	-1.222* (-4.37)	-1.278** (-2.33)	-1.073* (-3.75)
INDSIZE	0.272* (5.53)	0.612** (2.02)	0.506* (3.33)
PRQD	0.153* (4.77)	0.047 (0.87)	0.170* (5.38)
Adjusted R^2	0.12	0.08	0.12
n	930	526	890

** significant at the 1% level; ** significant at the 5% level; *** significant at the 10% level.*

Among the industry-specific variables, product differentiation is found to have a positive and statistically significant effect on all three types of IIT shares. 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 has the expected positive effect and is statistically significant. 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 country- and industry-specific determinants of U.S.- Latin America intra-industry trade.

SUMMARY AND CONCLUSIONS

This study analyzes the development of intra-industry and inter-industry trade between the United States and the Latin American countries during the period 1990 to 2005. 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 Latin American countries, and (b) identify the country- and industry-specific determinants of vertical and horizontal intra-industry trade. 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 2005. 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 finding is that the share of IIT is relatively high only for a handful of countries. Of the 20 countries, only 7 countries had a share exceeding 10% in 1990 and by 2005 only 11 countries had a share exceeding 10%. This finding is not surprising given the smaller size and the level of development of the majority of these trading partners. Larger trading partners such as Mexico and Brazil have relatively larger share of IIT. Although the IIT share increased between 1990 and 2005 for the majority of these trading partners, inter-industry trade continued to be the dominant type of trade.

Another main finding is that the observed increase in intra-industry trade between the U.S. and Latin America is almost entirely due to two-way trade in vertical differentiation. The results also suggest that bilateral trade flows between the United States and Latin America have become more intense indicating that trade relations are strengthening.

Among the country-specific determinants, the level of per capita income and trade intensity are found to affect the shares of all three types of IIT positively, while difference in per capita income, difference in economic size, distance, difference in factor endowment, and trade imbalances are found to affect the share of all three types of IIT negatively.

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

Industry concentration variable is found to have a negative and statistically significant effect on all three types of IIT share.

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