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An Empirical Estimation of the U.S. Intra-Industry Trade with Spain

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ABSTRACT

The trade between the United States and Spain is increasingly characterized by intra-industry trade. This paper aims to explain the extent of vertical and horizontal intra-industry trade ( ) in United State's foreign trade with Spain. 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. 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 2004. One of the main findings is that the observed increase in intra-industry trade between the United States and Spain is almost entirely due to two-way trade in vertical differentiation. Another important finding is that the share of vertical intra-industry trade has increased significantly during this period.

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

Una estimación empírica del comercio intra-industrial entre EE.UU. y España

RESUMEN

Los flujos comerciales entre España y los EEUU están caracterizados por un creciente componente intra-industrial. Este artículo pretende explicar el comercio intra-industrial tanto vertical como horizontal entre los EEUU y España. Para dicho análisis se han descompuesto los flujos comerciales en los tres tipos: el comercio Inter.-industrial, el comercio intra-industrial con diferenciación horizontal y con diferenciación vertical. Los datos utilizados se basan en el Sistema Armonizado con diez dígitos para el período 1990-2004. Los resultados demuestran que el comercio intra-industrial se explica principalmente por la diferenciación vertical de los productos y que dichos flujos se han incrementado de forma significativa durante ese período.

Palabras clave: Comercio intra-industrial, comercio intra-industrial vertical y horizontal.

JEL classification: F14

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1. 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. As Greenway and Milner (1986) and Greenway and Torstensson (1997) point out, the theoretical and empirical interest in IIT has continued ever since the evidence on rapidly increasing IIT was identified nearly four decades ago. 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. 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.

Studies on intra-industry trade tend to focus on a variety of topics including the measurement of the extent of IIT , development of theoretical models of IIT , and estimation of econometric models to test the theory of IIT with data on a given country or a group of countries. Empirical studies of IIT have varied widely in terms of their hypotheses and selection of explanatory variables, their method of measurement of IIT , the countries or group of countries considered and the time periods covered. The majority of empirical studies have tried to explain the IIT of developed countries due to availability of detailed trade data for these countries. In identifying the determinants of IIT some studies have focused on country-specific determinants while others have focused on industry-specific determinants, with a few studies focusing on both types of determinants. Some recent studies have also attempted to estimate the extent of horizontal and vertical intra-industry trade and identify their determinants. Despite the diversity of approaches, 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 explain the extent of vertical and horizontal intra-industry trade in United State's foreign trade with Spain. 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 the 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, 1990-2004.

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 Spain during the past two and a half decades. Alternative measures of intra-industry trade are discussed in Section III. Section IV presents a discussion of the estimated IIT indices. Section V summarizes the main findings.

2. GENERAL PERFORMANCE OF U.S. TRADE WITH SPAIN

In this section, we describe the extent, nature and dynamics of trade between the United States and Spain. Spain continued to one of the top trading partners of the United States during the past few decades. In 2004, Spain was the sixth largest trading partner of the United States, accounting for about 3.9 percent of total merchandise trade of the United States. In fact outside EU, USA is the biggest trading partner to Spain. The United States' total trade (exports + imports) with Spain increased significantly from $43.8 billion in 1990 to $76.6 billion in 2004, an annual average increase of about 4.6 percent. However, the shares of total trade, exports, and imports of Spain dropped marginally between 1990 and 2004. For instance, total trade share dropped from 4.9 percent in 1990 to 3.9 percent in 2004. Corresponding share of exports dropped from 6.0 percent to 4.7 percent while import share dropped from 4.1 percent to 3.4 percent during this period. Although the share of Spain in United State's international trade is relatively smaller (3.9 percent of total U.S. trade in 2004), total trade (exports + imports) grew at an annual average rate of 4.6 percent during 1990-2004. During the same period U.S. exports to Spain grew at an annual rate of 3.3 percent while U.S. imports from Spain grew at annual average rate of 6.1 percent.

Of the total trade of $76.6 billion in 2004, nearly 19.1 percent was accounted for by machinery (HS 84) industry. Other major trading products include passenger vehicles (HS 87) with trade share of 9.9 percent, pharmaceutical products (HS 30) with trade share of 8.2 percent, electrical machinery (HS 85) with trade share of 7.9 percent, and mineral fuel and oil (HS 27) with trade share of 7.4 percent. The top 10 export and import products in 1990 and 2004 are presented in Table 1. Machinery continued to be the major product exported and imported during this period. Top five export products also remained the same even though the rank of them changed. However, there are some changes in the major import products.

Table 1. United States Total Trade with Spain
(Value is in Millions of US Dollars and Share is in Percent

(a) Top 10 Export Products

1990			2004		
Product	Value	Share	Product	Value	Share
Aircraft, Spacecraft	1,065.5	20.5	Machinery	1,273.1	19.2
Machinery	773.7	14.9	Aircraft, Spacecraft	636.8	9.6
Electrical Machinery	335.3	6.4	Electrical Machinery	493.2	7.4
Misc Grain, Seed, Fruit	323.5	6.2	Optical and Medical Instruments	490.8	7.4
Mineral Fuel, Oil Etc	320.3	6.2	Pharmaceutical Products	467.3	7.0
Optical and Medical Instruments	285.3	5.5	Passenger Vehicles	309.4	4.7
Cereals	251.6	4.8	Edible Fruit and Nuts	260.5	3.9
Tobacco	191.3	3.7	Misc Grain, Seed, Fruit	235.2	3.5
Special Other	121.8	2.3	Wood	215.1	3.2
Food Waste; Animal Feed	116.8	2.2	Mineral Fuel, Oil Etc	209.3	3.2

(b) Top 10 Import Products

1990			2004		
Product	Value	Share	Product	Value	Share
Mineral Fuel, Oil Etc	478.4	14.5	Machinery	807.8	10.8
Footwear	365.4	11.0	Organic Chemicals	463.2	6.2
Preserved Food	215.4	6.5	Mineral Fuel, Oil Etc	461.8	6.2
Passenger Vehicles	189.1	5.7	Pharmaceutical Products	435.6	5.8
Machinery	181.7	5.5	Special Other	354.5	4.7
Iron and Steel	147.5	4.5	Passenger Vehicles	338.8	4.5
Rubber	140.1	4.2	Electrical Machinery	336.9	4.5
Special Other	127.1	3.8	Preserved Food	311.1	4.2
Electrical Machinery	113.3	3.4	Ceramic Products	281.9	3.8
Aircraft, Spacecraft	111.5	3.4	Iron and Steel	278.8	3.7

Source: World Trade Atlas database.

3. MEASUREMENT OF INTRA-INDUSTRY TRADE

3.1. Measures of Intra-Industry Trade

The most widely used measure of intra-industry trade is the Grubel-Lloyd (G-L) index. While several alternative measures of IIT have been proposed in the literature, perhaps the most widely adopted has been some variant of 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

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

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

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

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

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

The IIT_j index in (2), as Grubel and Lloyd (1975) pointed out, is a downward-biased measure of IIT in the presence of an imbalance in a country's commodity trade. The greater the imbalance, the greater the share of net trade and the smaller the share of IIT. Aquino (1978), and Balassa (1986), among others, have suggested adjusted measures to correct this deficiency. Grubel and Lloyd (1975) proposed to adjust the index by incorporating overall trade imbalance into (2) as follows:

$$IIT_j^a = \frac{\sum_{i=1}^{n}(X_{ij} + M_{ij}) - \sum_{i=1}^{n}\left|X_{ij} - M_{ij}\right|}{\sum_{i=1}^{n}(X_{ij} + M_{ij}) - \left|\sum_{i=1}^{n}X_{ij} - \sum_{i=1}^{n}M_{ij}\right|} \tag{3}$$

where IIT_j^a is the adjusted IIT index. Since this adjusted measure of IIT index incorporates the total trade imbalance, it is measured with respect to total balanced trade. Even with this adjustment, one problem associated with this measure is the aggregation bias, i.e., aggregating trade data by sector will yield an apparent increase in IIT.

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:

$$IIT_j = HIIT_j + VIIT_j \tag{4}$$

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

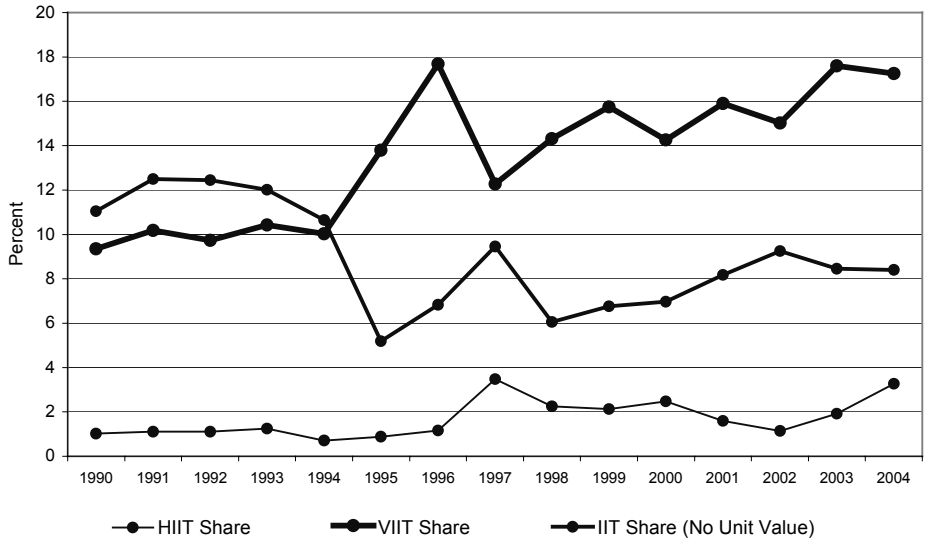
$$1-\alpha \le \frac{UV_{ij}^x}{UV_{ij}^m} \le 1+\alpha$$

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

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

where α = 0.15 or 0.20 or 0.25.

Figure 1. Share of HIIT and VIIT in U.S.-Spain Intra-Industry Trade



Note: These shares are based on a dispersion factor (α) of 15 percent.

3. DATA

This study is based on detailed trade data desegregated at 10-digit Harmonized System (HS) industries, covering the period from 1990 to 2004. 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. The data on other relevant variables were taken from the International Monetary Fund's, *International Financial Statistics Yearbook 2004* and the World Bank, *World Development Report 2004*.

4. ESTIMATION OF INTRA-INDUSTRY TRADE INDICES

In this section, we describe the extent of intra-industry trade between the United States and Spain. 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 1990-2004, at the 10-digit level of the Harmoni-

zed System (HS). In 1990, U.S. – Spain trade activities took place in 10,348 10-digit level industries, of which nearly 26.8 percent of industries (or 3,261 industries) had some intra-industry trade. By 2004, trade activities increased to some 13,966 10-digit level industries, of which nearly 24.7 percent of industries (or 3,453 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 2 shows the weighted average of the Grubel-Lloyd IIT indices computed using (2) and (3) for the years 1990 to 2004. Three points are worth noting. First, the IIT index in United States' trade with Spain remained relatively constant during the period 1990-2004, although it increased somewhat between 1990 and 1996. Second, the adjusted IIT index is relatively higher than the unadjusted IIT index. Third, the share of IIT in U.S. – Spain trade decreased from 48.5 percent in 1990 to 40.2 percent in 2004 while the share of inter-industry trade increased from 51.5 percent to 59.8 percent.

Table 2. The Development of U.S. - Spain Intra-Industry Trade, 1990-2004

Year	Grubel-Lloyd IIT Index	Adjusted Grubel-Lloyd IIT Index	Intra-Industry Trade Share (%)	Inter-Industry Trade Share (%)
1990	0.3404	0.4056	21.4	78.6
1991	0.3193	0.4073	23.8	76.2
1992	0.3297	0.3892	23.3	76.7
1993	0.3289	0.4400	23.7	76.3
1994	0.3443	0.3851	21.4	78.6
1995	0.3456	0.3805	19.9	80.1
1996	0.3356	0.3686	25.7	74.3
1997	0.3358	0.3852	25.2	74.8
1998	0.3509	0.4073	22.6	77.4
1999	0.3507	0.3601	24.6	75.4
2000	0.3527	0.3739	23.7	76.3
2001	0.3627	0.3707	25.7	74.3
2002	0.3538	0.4888	25.4	74.6
2003	0.3686	0.5161	28.0	72.0
2004	0.3646	0.5169	28.9	71.1

Source: Author´s calculations.

Table 3. Distribution of IIT Indices in United States´ Trade with Spain

	Number of Products				
Year	0.00 < GL < 0.25	0.25 < GL < 0.50	0.50 < GL < 0.75	0.75 < GL < 1.00	Total
1990	549	233	162	161	1,105
1991	586	194	188	129	1,097
1992	575	227	174	143	1,119
1993	571	222	165	145	1,103
1994	531	252	185	141	1,109
1995	553	239	205	155	1,152
1996	676	286	198	190	1,350
1997	701	316	188	195	1,400
1998	705	298	234	220	1,457
1999	727	327	221	237	1,512
2000	765	304	245	248	1,562
2001	713	352	293	223	1,581
2002	776	336	266	238	1,616
2003	780	324	282	276	1,662
2004	749	357	314	242	1,662
	Share of Products (%)				
Year	0.00 < GL < 0.25	0.25 < GL < 0.50	0.50 < GL < 0.75	0.75 < GL < 1.00	Total
1990	49.7	21.1	14.7	14.6	100.0
1991	53.4	17.7	17.1	11.8	100.0
1992	51.4	20.3	15.5	12.8	100.0
1993	51.8	20.1	15.0	13.1	100.0
1994	47.9	22.7	16.7	12.7	100.0
1995	48.0	20.7	17.8	13.5	100.0
1996	50.1	21.2	14.7	14.1	100.0
1997	50.1	22.6	13.4	13.9	100.0
1998	48.4	20.5	16.1	15.1	100.0
1999	48.1	21.6	14.6	15.7	100.0
2000	49.0	19.5	15.7	15.9	100.0
2001	45.1	22.3	18.5	14.1	100.0
2002	48.0	20.8	16.5	14.7	100.0
2003	46.9	19.5	17.0	16.6	100.0
2004	45.1	21.5	18.9	14.6	100.0

Source: Author´s calculations.

The trend in aggregate IIT indices presented in Table 2 is further analyzed by breaking down the IIT indices for each industry by (1) for the same time period. Table 3 shows the distribution of IIT indices by four major intervals. It shows both the number of products and the share of products in each category. The results presented in Table 3 are consistent with results presented in Table 2. There is no major change in the structure of IIT in U.S. – Spain trade during this period; the shares of each of the four ranges of IIT remained relatively constant, although number of products with IIT indices above 0.75 increased from 583 in 1990 to 613 in 2004.

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 8,887 in 1990 to 10,513 in 2004.

Table 4. Changes in Intra-Industry Trade by Major Industry, 1990-2004

HS	Industry	Total Trade Share (%)		G-L IIT Index		IIT Share (%)	
		1990	2004	1990	2004	1990	2004
01-05	Live Animals; Animal Products	0.5	1.1	0.2530	0.3076	26.0	5.5
06-14	Vegetable Products	8.0	5.2	0.2392	0.3127	5.3	30.5
15	Animal or Vegetable Fats and Oils	0.6	0.9	0.0000	0.0157	0.0	78.4
16-24	Prepared Foodstuffs; Beverages; Tobacco	9.0	7.5	0.2823	0.3191	2.0	20.9
25-27	Mineral Products	10.0	5.3	0.0872	0.4017	6.9	20.4
28-38	Products of the Chemical or Allied Industries	5.4	14.0	0.3333	0.3818	14.4	44.4
39-40	Plastics and Articles thereof; Rubber and Articles thereof	2.6	3.3	0.3777	0.3104	50.2	46.4
41-43	Raw Hides and Skins, Leather, Furskins and Articles Thereof	0.8	0.7	0.3434	0.3001	23.5	18.5
44-46	Wood and Articles of Wood; Wood Charcoal; Cork and Articles of Cork; Manufacturers of Straw	1.5	2.6	0.1986	0.3008	6.8	13.1
47-49	Pulp of Wood or of Other Fibrous Cellulosic Material; Waste and Scrap of Paper or Paperboard; Paper and Paperboard and Articles Thereof	2.8	2.3	0.3503	0.2433	23.4	33.2
50-63	Textile and Textile Articles	2.4	1.7	0.2661	0.3765	7.6	10.9
64-67	Footwear, Headgear, Umbrellas, Walking Sticks, etc.	4.4	1.6	0.3275	0.5581	0.6	2.1
68-70	Articles of Stone, Plaster, Cement, etc; Ceramic Products; Glass and Glassware	2.3	4.1	0.3461	0.4484	28.9	18.0
71	Natural Or Cultured Pearls, Precious or Semi-Precious Stones, Precious Metals, etc.	0.5	0.6	0.7189	0.4319	2.0	7.8
72-83	Base Metals and Articles of Base Metal	5.2	5.3	0.3895	0.3950	13.8	15.8
84-85	Machinery and Mechanical Appliances; Electrical Equipment; etc.	16.3	20.2	0.3391	0.3650	41.7	37.6
86-89	Vehicles, Aircraft, Vessels and Associated Transport Equipment	17.9	10.8	0.3994	0.3208	29.3	11.3
90-92	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical or Surgical Instruments and Apparatus; Clocks and Watches; Musical Instruments;	3.6	4.4	0.2208	0.2731	46.6	54.8
93	Arms and Ammunition; Parts and Accessories Thereof	0.6	0.5	0.3336	0.1421	27.5	67.6
94-96	Miscellaneous Manufactured Articles	1.6	1.8	0.3946	0.4667	20.6	30.8
97	Works of Art, Collectors' Pieces and Antiques	0.9	2.0	0.6897	0.4272	97.3	95.2
98-99	Special Classification Provisions	3.0	4.1	0.0000	0.0000	0.0	0.0

Note: Total trade share indicates the share of each industry's total trade (exports+imports) as percentage of total U.S. - Spain trade. G-L IIT index is the Grubel-Lloyd intra-industry trade index for each industry group weighted by shares in total bilateral trade. IIT share denotes the share of intra-industry trade in a given industry's total trade.

Source: Authors' calculations.

The trend in aggregate IIT indices can further be analyzed by computing the share of IIT and IIT indices for each industry for the same time period. This is done first by looking at aggregated industry level and then at desegregated industry level. The intra-industry trade indices at the most aggregated level, i.e., at the 1-digit HS level, are presented in Table 4. These indices were computed taking the weighted average of IIT indices at the 10-digit HS level industries. The U.S. – Spain intra-industry trade is mainly concentrated in manufacturing products accounting for more than 80 percent of total trade. Of these major product groups, machinery and mechanical appliances (HS 84-85) recorded the highest IIT index. This sector accounts for about 30 percent of U.S. – Spain total merchandise trade while nearly a half of its total trade is intra-industry trade in nature. Pulp of wood or of other fibrous cellulosic material (HS 47-49) recorded the second highest IIT index. This group, however, accounted for only about 2 percent of Unites States' total trade in 2004. The product groups that recorded relatively high IIT indices in 2004 include arms and ammunition (HS 93), products of the chemical or allied industries (HS 28-38), works of art, collectors' pieces and antiques (HS 97), and plastics and rubber and articles thereof (HS 39-40). Of the major product groups shown in Table 4, products of the chemical or allied industries (HS 28-38) ranks number one in terms of increased IIT share between 1990 and 2004; its share increased from 42.9 percent to 66.1 percent, an increase of 23.3 percentage points. On the other hand, vehicles, aircraft, vessels and associated transport equipment sector experienced the greatest drop of IIT share during this period: its share decreased from 76.5 percent to 13.1 percent, a decrease of 63.4 percentage points. The IIT share of animals or vegetable fats and oils product (HS 15) also decreased from 49.3 percent in 1990 to 15.0 percent in 2004, a decrease of 34.3 percentage points. Of the 22 product groups presented in Table 4, only eight groups experienced increasing IIT shares during this period. It is also important to note that arms and ammunition (HS 93) recorded the highest share of IIT .

Table 5. Top 25 Industries with Highest Intra-Industry Trade Share, 1990-2004 (Ranked by IIT Share in Industry Total)

HS	Industry	Industry Trade Share (%) [1]		Industry Intra-Trade Share (%) [2]		Grubel-Lloyd IIT Index		IIT Share in Total Industry Trade [3]	
		1990	2004	1990	2004	1990	2004	1990	2004
14	Other Vegetable	0.01	0.00	0.03	0.01	0.0207	0.2201	62.0	97.4
97	Art and Antiques	0.94	1.99	4.26	6.56	0.6897	0.4272	97.3	95.2
86	Railway; Trf Sign Eq	0.02	0.55	0.03	1.56	0.7350	0.2418	32.5	81.8
15	Fats and Oils	0.63	0.92	0.00	2.50	0.0000	0.0157	0.0	78.4
96	Miscellaneous Manufactures	0.19	0.23	0.45	0.61	0.4842	0.4249	51.6	76.7
93	Arms and Ammunition	0.64	0.55	0.83	1.29	0.3336	0.1421	27.5	67.6
66	Umbrella, Wlk-Sticks, Etc	0.00	0.00	0.00	0.00	0.8571	0.7429	40.7	67.5
49	Book and Newspapr; Manuscripts	0.74	0.59	2.21	1.36	0.4141	0.2825	63.8	66.3
32	Tanning, Dye, Paint, Putty	0.36	0.43	0.28	0.96	0.3127	0.3686	16.9	65.6
30	Pharmaceutical Products	0.86	6.40	1.31	14.51	0.3275	0.3455	32.6	65.6
35	Albumins; Mod Strch; Glue	0.03	0.07	0.02	0.15	0.0340	0.2508	16.2	65.0
79	Zinc and Articles Thereof	0.44	0.00	0.00	0.00	0.0000	0.7411	0.0	64.5
83	Misc Art of Base Metal	0.40	0.39	1.44	0.85	0.2153	0.3889	76.8	62.0
08	Edible Fruit and Nuts	0.64	2.46	0.80	5.27	0.3283	0.0225	26.9	62.0
34	Soap, Wax, Et; Dental Prep	0.07	0.18	0.11	0.36	0.4675	0.4022	31.7	57.1
90	Optical and Medical Instruments	3.60	4.26	8.01	8.33	0.2478	0.2617	47.7	56.5
39	Plastic	0.68	1.93	1.12	3.68	0.3807	0.3834	35.2	55.2
85	Electrical Machinery	5.27	5.88	12.63	9.41	0.3390	0.3500	51.4	46.3
41	Hides and Skins	0.32	0.16	0.40	0.24	0.3225	0.1785	26.8	44.4
25	Salt; Sulfur; Earth, Stone	0.64	0.29	0.36	0.42	0.0482	0.3357	12.0	41.4
95	Toys and Sports Equipment	0.54	0.54	0.68	0.75	0.3335	0.5224	27.0	40.2
33	Perfumery, Cosmetic, Etc	0.56	1.17	0.50	1.54	0.3534	0.5109	19.0	38.1
89	Ships and Boats	0.76	0.64	0.54	0.80	0.0744	0.3407	15.2	36.4
68	Stone, Plastr, Cement, Etc	0.88	1.75	2.66	2.20	0.2504	0.3979	65.0	36.3
40	Rubber	1.91	1.40	4.95	1.67	0.3747	0.2373	55.6	34.4

Notes: 1. Total industry trade (exports+imports) as a percentage of total U.S. trade with Spain.
2. Intra-industry trade in a specific industry as a percentage of total intra-industry trade.
3. Total intra-industry trade in a specific industry as a percentage of total trade in the industry.

Source: Authors' calculations.

Table 5 presents *IIT* indices at the 2-digit HS level industries for 1990 and 2004. Due to the limitation of space only the top 25 industries are presented in the table (there are 99 2-digit HS industries). These indices were also computed taking the weighted average of *IIT* indices at the 10-digit HS level industries. The industries are ranked according to the share of a given industry's intra-industry trade to the industry's total trade. All 25 industries presented have an *IIT* share exceeding 50 percent but majority of them accounted for less than 1 percent in total industry trade. For instance, almost all trade in zinc and articles thereof (HS 79) industry is intra-industry trade, and its *IIT* share increased from 36.1 percent in 1990 to 97.9 percent in 2004. However, this industry accounts for about 0.01 percent of total trade between the United States and Spain. The pharmaceutical products (HS 30) industry also shows a tremendous increase in its *IIT*

share during this period, increasing from 63.0 percent in 1990 to 94.6 percent in 2004. Of the 25 industries shown in the table, intra-industry trade share of sixteen industries and *IIT* index of thirteen industries increased during this period.

Table 6. Top 25 Industries with Highest Trade Share, 1990-2004
(Ranked by IIT Share in Industry Total)

HS	Industry	Industry Trade Share (%) [1]		Industry Intra-Trade Share (%) [2]		Grubel-Lloyd IIT Index		IIT Share in Total Industry Trade [3]	
		1990	2004	1990	2004	1990	2004	1990	2004
84	Machinery	11.22	14.74	19.44	17.43	0.3392	0.3800	37.2	34.2
30	Pharmaceutical Products	0.86	6.40	1.31	14.51	0.3275	0.3455	32.6	65.6
85	Electrical Machinery	5.27	5.88	12.63	9.41	0.3390	0.3500	51.4	46.3
88	Aircraft, Spacecraft	13.82	5.17	19.99	0.12	0.4864	0.4294	31.0	0.7
27	Mineral Fuel, Oil Etc	9.38	4.75	2.90	3.41	0.1263	0.4677	6.6	20.8
29	Organic Chemicals	2.14	4.71	0.71	3.85	0.3826	0.3176	7.1	23.7
87	Vehicles, Not Railway	3.54	4.59	4.25	1.79	0.3017	0.2712	25.7	11.3
90	Optical and Medical Instruments	3.60	4.26	8.01	8.33	0.2478	0.2617	47.7	56.5
98	Special Other	2.92	3.74	0.00	0.00	0.0000	0.0000	0.0	0.0
44	Wood	1.41	2.55	0.47	1.18	0.2880	0.2807	7.1	13.4
08	Edible Fruit and Nuts	0.64	2.46	0.80	5.27	0.3283	0.0225	26.9	62.0
20	Preserved Food	2.58	2.36	0.01	0.28	0.2714	0.3393	0.1	3.5
72	Iron and Steel	2.24	2.28	0.50	0.78	0.2375	0.1937	4.8	9.9
69	Ceramic Products	1.23	2.02	0.37	0.12	0.4198	0.4626	6.5	1.7
97	Art and Antiques	0.94	1.99	4.26	6.56	0.6897	0.4272	97.3	95.2
39	Plastic	0.68	1.93	1.12	3.68	0.3807	0.3834	35.2	55.2
68	Stone, Plastr, Cement, Etc	0.88	1.75	2.66	2.20	0.2504	0.3979	65.0	36.3
22	Beverages	1.12	1.75	0.01	0.14	0.5925	0.1100	0.1	2.3
12	Misc Grain, Seed, Fruit	3.82	1.69	0.01	0.24	0.1605	0.2338	0.1	4.0
73	Iron/Steel Products	1.28	1.67	0.61	0.62	0.3699	0.5232	10.3	10.8
64	Footwear	4.44	1.61	0.11	0.11	0.2192	0.2786	0.5	2.0
40	Rubber	1.91	1.40	4.95	1.67	0.3747	0.2373	55.6	34.4
48	Paper, Paperboard	0.73	1.19	0.64	0.97	0.3838	0.3566	18.8	23.6
33	Perfumery, Cosmetic, Etc	0.56	1.17	0.50	1.54	0.3534	0.5109	19.0	38.1
94	Furniture and Bedding	0.86	1.02	0.40	0.54	0.3662	0.4527	10.0	15.3

Notes: 1. Total industry trade (exports+imports) as a percentage of total U.S. trade with Spain.
2. Intra-industry trade in a specific industry as a percentage of total intra-industry trade.
3. Total intra-industry trade in a specific industry as a percentage of total trade in the industry.

Source: Authors' calculations.

Table 6 presents *IIT* indices at the 2-digit HS level industries for 1990 and 2004, ranking the industries according to the share of a given industry's total trade to the total trade between the industry's total trade. Of all 25 industries presented, majority of them accounted for less than 5 percent in total industry trade. The machinery (HS 84) industry accounts for about a fifth of total trade between the two countries. Nearly 42.4 percent of its total trade is intra-industry trade; its *IIT* share marginally increased from 41.9 percent in 1990 to 42.4 percent in 2004. Of the 25 industries shown in the table, total trade share of fifteen of the industries increased during this period.

Table 7. Top 25 Industries with Highest Trade Share, 1990-2004
(Ranked by IIT Share in Industry Total)

HS	Industry	Industry Trade Share (%) [1]		Industry Intra-Trade Share (%) [2]		Grubel-Lloyd IIT Index		IIT Share in Total Industry Trade [3]	
		1990	2004	1990	2004	1990	2004	1990	2004
84	Machinery	11.22	14.74	19.44	17.43	0.3392	0.3800	37.2	34.2
30	Pharmaceutical Products	0.86	6.40	1.31	14.51	0.3275	0.3455	32.6	65.6
85	Electrical Machinery	5.27	5.88	12.63	9.41	0.3390	0.3500	51.4	46.3
90	Optical and Medical Instruments	3.60	4.26	8.01	8.33	0.2478	0.2617	47.7	56.5
97	Art and Antiques	0.94	1.99	4.26	6.56	0.6897	0.4272	97.3	95.2
08	Edible Fruit and Nuts	0.64	2.46	0.80	5.27	0.3283	0.0225	26.9	62.0
29	Organic Chemicals	2.14	4.71	0.71	3.85	0.3826	0.3176	7.1	23.7
39	Plastic	0.68	1.93	1.12	3.68	0.3807	0.3834	35.2	55.2
27	Mineral Fuel, Oil Etc	9.38	4.75	2.90	3.41	0.1263	0.4677	6.6	20.8
15	Fats and Oils	0.63	0.92	0.00	2.50	0.0000	0.0157	0.0	78.4
68	Stone, Plastr, Cement, Etc	0.88	1.75	2.66	2.20	0.2504	0.3979	65.0	36.3
87	Vehicles, Not Railway	3.54	4.59	4.25	1.79	0.3017	0.2712	25.7	11.3
40	Rubber	1.91	1.40	4.95	1.67	0.3747	0.2373	55.6	34.4
86	Railway; Traffic Sign Eq	0.02	0.55	0.03	1.56	0.7350	0.2418	32.5	81.8
33	Perfumery, Cosmetic, Etc	0.56	1.17	0.50	1.54	0.3534	0.5109	19.0	38.1
49	Book and Newspapr; Manuscripts	0.74	0.59	2.21	1.36	0.4141	0.2825	63.8	66.3
93	Arms and Ammunition	0.64	0.55	0.83	1.29	0.3336	0.1421	27.5	67.6
44	Wood	1.41	2.55	0.47	1.18	0.2880	0.2807	7.1	13.4
48	Paper, Paperboard	0.73	1.19	0.64	0.97	0.3838	0.3566	18.8	23.6
32	Tanning, Dye, Paint, Putty	0.36	0.43	0.28	0.96	0.3127	0.3686	16.9	65.6
83	Misc Art of Base Metal	0.40	0.39	1.44	0.85	0.2153	0.3889	76.8	62.0
89	Ships and Boats	0.76	0.64	0.54	0.80	0.0744	0.3407	15.2	36.4
72	Iron and Steel	2.24	2.28	0.50	0.78	0.2375	0.1937	4.8	9.9
95	Toys and Sports Equipment	0.54	0.54	0.68	0.75	0.3335	0.5224	27.0	40.2
73	Iron and Steel Products	1.28	1.67	0.61	0.62	0.3699	0.5232	10.3	10.8

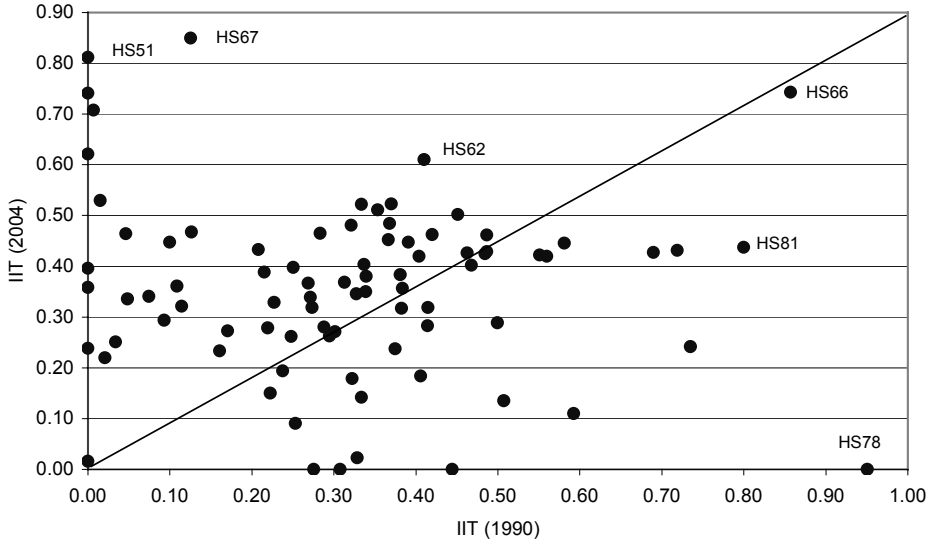
Notes: 1. Total industry trade (exports+imports) as a percentage of total U.S. trade with Spain.
2. Intra-industry trade in a specific industry as a percentage of total intra-industry trade.
3. Total intra-industry trade in a specific industry as a percentage of total trade in the industry.

Source: Authors' calculations.

Table 7 presents *IIT* indices at the 2-digit HS level industries for 1990 and 2004, ranking the industries according to the share of a given industry's intra-industry trade to the total intra-industry trade. For example, the machinery (HS 84) industry accounts for about a fifth of total intra-industry trade between the two countries. The pharmaceutical products (HS 30) industry also accounts for nearly a fifth of total intra-industry trade. These two industries together with electrical machinery (HS 85) industry accounted for more than a half of intra-industry trade in 2004. Of all 25 industries presented in Table 7, majority of them accounted for less than 5 percent in total intra-industry trade. Further, total intra-industry trade share of sixteen of the industries increased during this period. Intra-industry share of aircraft and spacecraft (HS 88) industry dropped significantly from 23.3 percent in 1990 to 1.8 percent in 2004.

Figure 2 shows the changes in IIT indices at 2-digit HS level industries between 1990 and 2004. The figure is drawn measuring Grubel-Lloyd IIT index for the two years in the form of a scatter diagram, with horizontal axis showing 1990 values and vertical axis showing corresponding 2004 values. A point that lies above (below) the diagonal represents an increase (a decrease) in the IIT index between 1990 and 2004. The vertical distance between the diagonal and any point above (below) represents the absolute increase (decrease) in the IIT index over the period. Although Tables 1 and 2 suggest that there is no major change in the structure of IIT over the period, the scatter diagram displays a somewhat different picture. Many products with a high IIT index in 1990 maintained a high IIT index in 2004. Some products with high IIT index in 1990 moved into low IIT index range in 2004. Likewise, some products with low IIT index in 1990 moved into high IIT index range in 2004. Of the ninety eight 2-digit HS level industries shown in Figure 2, fifty one industries experienced an increased IIT index between 1990 and 2004. These gross movements counter each other, such that there is little change in the net frequency distribution.

Figure 2. Changes in Intra-Industry Trade index by Industry



Key:
HS 51: Animal Hair and Yarn, Fabrc
HS 62: Woven Apparel
HS 66: Umbrella, Wlk-Sticks, Etc
HS 67: Artificial Flowers, Feathers
HS 78: Lead
HS 81: Other Base Metals, Etc.

Table 8. Share on Vertical and Horizontal Trade, 1990-2004 (%)

(a) Horizontal and Vertical Intra-Industry Trade Share Including Products with No Unit Value

	HIIT Share			VIIT Share			IIT Share (No Unit Value)		
Year	α = 0.15	α = 0.20	α = 0.25	α = 0.15	α = 0.20	α = 0.25	α = 0.15	α = 0.20	α = 0.25
1990	1.0	1.2	1.9	9.4	9.1	8.5	11.0	11.0	11.0
1991	1.1	1.5	2.2	10.2	9.7	9.1	12.5	12.5	12.5
1992	1.1	1.2	1.3	9.7	9.6	9.5	12.4	12.4	12.4
1993	1.2	1.4	1.7	10.4	10.2	10.0	12.0	12.0	12.0
1994	0.7	1.0	1.4	10.0	9.7	9.3	10.6	10.6	10.6
1995	0.9	1.5	1.7	13.8	13.2	13.0	5.2	5.2	5.2
1996	1.2	1.5	2.9	17.7	17.3	15.9	6.8	6.8	6.8
1997	3.5	4.0	4.3	12.3	11.8	11.4	9.5	9.5	9.5
1998	2.2	2.6	3.1	14.3	14.0	13.5	6.1	6.1	6.1
1999	2.1	2.4	2.7	15.7	15.5	15.1	6.8	6.8	6.8
2000	2.5	3.0	3.5	14.3	13.7	13.2	7.0	7.0	7.0
2001	1.6	2.1	2.8	15.9	15.4	14.7	8.2	8.2	8.2
2002	1.1	1.6	2.0	15.0	14.6	14.2	9.3	9.3	9.3
2003	1.9	3.1	3.5	17.6	16.4	16.0	8.5	8.5	8.5
2004	3.3	4.4	5.1	17.3	16.1	15.5	8.4	8.4	8.4

(b) Horizontal and Vertical Intra-Industry Trade Share Excluding Products with No Unit Value

	HIIT Share			VIIT Share		
Year	α = 0.15	α = 0.20	α = 0.25	α = 0.15	α = 0.20	α = 0.25
1990	9.9	12.0	17.9	90.1	88.0	82.1
1991	9.8	13.7	19.6	90.2	86.3	80.4
1992	10.2	11.1	11.8	89.8	88.9	88.2
1993	10.6	12.4	14.4	89.4	87.6	85.6
1994	6.6	9.3	13.0	93.4	90.7	87.0
1995	6.0	10.2	11.5	94.0	89.8	88.5
1996	6.1	8.0	15.5	93.9	92.0	84.5
1997	22.1	25.3	27.5	77.9	74.7	72.5
1998	13.5	15.5	18.6	86.5	84.5	81.4
1999	11.9	13.4	15.3	88.1	86.6	84.7
2000	14.8	17.9	20.9	85.2	82.1	79.1
2001	9.1	12.2	15.9	90.9	87.8	84.1
2002	7.0	9.6	12.3	93.0	90.4	87.7
2003	9.8	16.0	17.9	90.2	84.0	82.1
2004	15.9	21.3	24.7	84.1	78.7	75.3

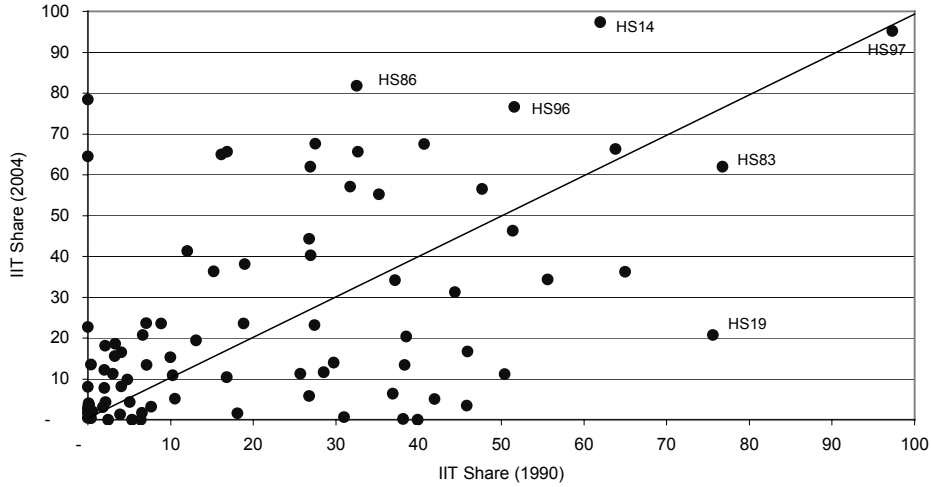
Source: Authors' calculations.

Having discussed the general trends in IIT, let us now discuss the extent of horizontal and vertical IIT in U.S. – Spain trade. The shares of horizontal IIT ($HIIT$) and vertical IIT ($VIIT$) for the period 1990-2004 are presented in Table 8. Three dispersion factors (α = 15 percent, α = 20 percent, and α = 25 percent) 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. Nearly 30 percent of products with IIT in 1990 did not have unit prices. However, this share dropped to 20 percent in 2004. 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 (see Figure 3). It should be noted here that the actual share of vertical IIT may have been underestimated.

Given the level of development and the similarity of per capita incomes of the two trading partners, we would have expected to find most of IIT to be horizontal in nature. However, more than two-third of total intra-industry trade is vertical. This finding is not surprising; it is consistent with findings of some recent studies. For example, Greenway et al. (1994) found that vertical IIT are dominant in Spain's bilateral trade, accounting for almost 80 percent or more of the total number of 5-digit SITC products with every developed country. Further, Fontagne and Freudenburg (2002) also found that vertical IIT are dominant in Spain's bilateral trade. It is interesting to note that regardless of the level of dispersion factor (α = 15 percent, α = 20 percent, and α = 25 percent), vertical IIT are dominant. Vertical IIT has also increased significantly during this period, with vertical IIT share increasing from 63.1 percent in 1990 to 70.5 percent in 2004.

Finally, Table 9 presents results on the breakdown of IIT between horizontal IIT and vertical IIT by major industry groups in 2004. These results confirm that the vertical IIT are dominant in the United States' bilateral trade with Spain. Horizontal IIT was dominant only in one industry, namely, mineral products industry, out of a total of 22 industries.

Figure 3. Changes in Intra-Industry Trade Share by Industry



Key:
HS 14: Other Vegetable
HS 19: Baking Related
HS 83: Misc Art of Base Metal
HS 86: Railway; Traffic Sign Eq
HS 96: Miscellaneous Manufactures
HS 97: Art and Antiques

Table 9. Components of Intra-Industry Trade by Major Industry, 2004

HS	Industry	G-L IIT Index	IIT Share (%)			
			Total	HIIT Share	VIIT Share	IIT (NUV) Share
01-05	Live Animals; Animal Products	0.3076	5.48	1.62	3.86	0.00
06-14	Vegetable Products	0.3127	30.53	24.99	5.55	0.00
15	Animal or Vegetable Fats and Oils	0.0157	78.40	7.47	70.93	0.00
16-24	Prepared Foodstuffs; Beverages; Tobacco	0.3191	2.81	1.62	1.19	0.00
25-27	Mineral Products	0.4017	20.41	0.12	20.29	0.00
28-38	Products of the Chemical or Allied Industries	0.3818	44.38	11.81	30.46	2.11
39-40	Plastics and Articles thereof; Rubber and Articles thereof	0.3104	46.42	16.08	24.24	6.09
41-43	Raw Hides and Skins, Leather, Furskins and Articles Thereof	0.3001	18.49	6.72	4.32	7.46
44-46	Wood and Articles of Wood; Wood Charcoal; Cork and Articles of Cork; Manufacturers of Straw	0.3008	13.13	0.49	12.23	0.41
47-49	Pulp of Wood or of Other Fibrous Cellulosic Material; Waste and Scrap of Paper or Paperboard; Paper and Paperboard and Articles Thereof	0.2433	33.20	7.86	25.34	0.00
50-63	Textile and Textile Articles	0.3765	10.92	4.68	6.24	0.00
64-67	Footwear, Headgear, Umbrellas, Walking Sticks, etc.	0.5581	2.08	0.00	2.06	0.02
68-70	Articles of Stone, Plaster, Cement, etc; Ceramic Products; Glass and Glassware	0.4484	17.95	0.10	2.03	15.82
71	Natural Or Cultured Pearls, Precious or Semi-Precious Stones, Precious Metals, etc.	0.4319	7.80	1.21	2.32	4.27
72-83	Base Metals and Articles of Base Metal	0.3950	15.78	2.32	12.73	0.80
84-85	Machinery and Mechanical Appliances; Electrical Equipment; etc.	0.3650	37.65	2.62	26.03	9.00
86-89	Vehicles, Aircraft, Vessels and Associated Transport Equipment	0.3208	11.30	0.42	6.55	4.33
90-92	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical or Surgical Instruments and Apparatus; Clocks and Watches; Musical Instruments;	0.2731	54.76	0.53	6.10	48.13
93	Arms and Ammunition; Parts and Accessories Thereof	0.1421	67.60	40.74	8.33	18.54
94-96	Miscellaneous Manufactured Articles	0.4667	30.76	0.38	11.61	18.77
97	Works of Art, Collectors' Pieces and Antiques	0.4272	95.25	0.00	0.03	95.22
98-99	Special Classification Provisions	0.0000	0.00	0.00	0.00	0.00
Total All Industries		**0.3646**	**28.93**	**5.04**	**15.80**	**8.09**

Note: G-L IIT index is the Grubel-Lloyd intra-industry trade index for each industry group weighted by shares in total bilateral trade. IIT share denotes the share of intra-industry trade in a given industry's total trade.

These shares are based on a dispersion factor (α) of 20 percent.

Source: Authors' calculations.

5. SUMMARY AND CONCLUSIONS

This study analyzes the development of intra-industry and inter-industry trade between the United States and Spain during the period 1990 to 2004. 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 Spain. 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 the 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 2004. 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 Spain is almost entirely due to two-way trade in vertical differentiation: thus, the 1990-2004 period is characterized by an increasing specialization of two 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 increased significantly during this period. Although it was difficult to accurately measure the actual share of vertical intra-industry trade due to the unavailability of unit prices of exports or imports for some industries, it can be observed that the share of vertical intra-industry trade is increasing.

The results also suggest that bilateral trade flows between the United States and Spain has become more intense indicating trading relations are strengthening.

Since the main objective of the paper was to measure the extent of vertical and horizontal intra-industry trade in United State's foreign trade with Spain, no attempt has been made to identify any industry-specific determinants of vertical and horizontal trade. Identification of these determinants could be a possible extension of this study.

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