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Varieties or Qualities? Horizontal and Vertical Intra-industry Trade within the NAFTA Trade Bloc

Klimis Vogiatzoglou

Department of Business Administration, University of Patras, Patras, Greece

This article investigates empirically the nature and the dynamics of intra-regional trade in North America. Specifically, we analyze intra-NAFTA patterns of horizontal and vertical intra-industry trade – H(V)IIT – in the United States, Canada and Mexico over the 1992-2002 period and examine some industry characteristics of observed IIT patterns for each IIT component. The results indicate that though HIIT and VIIT exhibit different trends, both IIT types are important in labour/resource-intensive sectors, suggesting that comparative advantage may be an important factor in intra-NAFTA IIT. The most striking finding is that HIIT is consistently increasing, while VIIT exhibits a significant downward trend. Hence, our findings suggest that intra-NAFTA IIT has increasingly become an exchange of different varieties rather than different qualities, indicating to some extent an economic convergence process within the NAFTA trade bloc.

Keywords: horizontal and vertical intra-industry trade; NAFTA; unit values

1. Introduction

In the 1990s, regional processes of economic integration have emerged in different locations of the world, inducing a considerable empirical literature on the analysis of intra-regional specialization patterns and intra-industry trade (IIT) – the two-way exchange of commodities that belong in the same industry classification. However, the bulk of this literature refers to the European Union and the central and eastern European countries that constitute the new members of the EU (Greenaway and Hine, 1991; Fontagne, Freudenberg, and Peridy, 1997; Brulhart and Elliott, 1998; Aturupane, Djankov, and Hoekman, 1999; Kandogan, 2003).

Yet, with the formation of the North American Free Trade Agreement (NAFTA) in 1994 between the United States, Canada, and Mexico, which extends the former Canada-U.S. Free Trade Agreement (1989), a huge regional integration area (RIA) has been formed, bringing with it the intensification of intra-regional trade and a number of changes in trade patterns, specialization, and industrial adjustment. Given the crucial importance of North America as an RIA and the fact that empirical research in this area is rather limited,¹ this article investigates the trends and industry characteristics of intra-NAFTA IIT patterns during a recent period of regional economic integration. It thereby contributes to this line of empirical research and sheds light on the empirical relevance and importance of recent theoretical frameworks of international trade. Since new developments in the empirical IIT literature have challenged the traditional analysis of IIT and its hypotheses, we follow the recent practice of decomposing IIT into horizontal IIT (HIIT) and vertical IIT (VIIT).

IIT in horizontally differentiated products arises when different varieties of the same quality are exchanged (exchange of varieties), while IIT in vertically differentiated products arises when different varieties of different qualities are exchanged (exchange of qualities). Though the case of VIIT appeared in the theoretical literature in the 1980s, it was until recently “empirically under-researched due to the difficulties of disentangling vertical and horizontal intra-industry trade in the data” (Greenaway, Hine, and Milner, 1995, p. 1506). Since the contributions of Abd-el-Rahman (1991), Greenaway, Hine, and Milner, (1994, 1995), and Fontagne and Freudenberg (1997), which provided the methodological tools to empirically disentangle HIIT and VIIT, many studies have emerged in the literature, indicating in most cases the high and increasing relative importance of VIIT vis-à-vis HIIT (Greenaway, Hine, and Milner, 1995; Fontagne, Freudenberg, and Peridy, 1997; Aturupane, Djankov, and Hoekman, 1999; Kandogan, 2003; Hurley, 2003). The

remainder of the article proceeds as follows. Section 2 presents a brief overview of the relevant theoretical literature. In section 3, we analyze patterns of intra-NAFTA HIIT and VIIT during the time period 1992-2002. In section 4, we examine some industry-specific characteristics of the observed patterns of horizontal and vertical IIT within the NAFTA trade bloc. Finally, section 5 concludes.

2. International Trade Theory and Horizontal and Vertical IIT

Since traditional comparative advantage models of international trade and specialization are incompatible with IIT, they have long been criticized as an insufficient theoretical framework, which fails to capture a considerable part of the forces that are crucial in shaping and explaining trade patterns (Grubel, 1967, 1970; Hufbauer and Chilas, 1974). The empirical observation that since the post-war period IIT shares have been consistently growing manifested the need for the development of alternative trade theories and stimulated research on various issues related to IIT. In fact, new developments and advances in theoretical models of international trade and specialization emerged in the 1980s. In these models, known in the literature as the “new trade theory”, product differentiation plays a crucial role for the existence and explanation of IIT. Though product differentiation can be horizontal or vertical, the former type of differentiation has received greater attention in IIT models.

HIIT is associated with horizontal product differentiation, monopolistic competition, and increasing returns to scale, on the supply-side, and diverse consumer preferences for different varieties, on the demand-side (Krugman, 1979, 1980, 1981; Lancaster, 1980; Helpman, 1981). In this setting, firms in each country specialize in different varieties of the horizontally differentiated good and take advantage of scale economies, whilst consumers gain in the form of greater product variety at decreasing costs. Here, the more similar the countries (in terms of relative factor endowments) the higher the extent of IIT. In addition, Helpman and Krugman (1985) incorporate relative factor endowment differences in a standard model that generates and explains the coexistence of IIT and inter-industry trade. This model predicts that the capital-abundant country exports the capital-intensive, horizontally differentiated good, and the labour-abundant country exports the labour-intensive, homogeneous good as well as some quantity of the differentiated product. Relative factor endowments determine only inter-industry trade (trade and specialization in the homogeneous product). As in other HIIT models, as factor endowments diverge, IIT in the differentiated good diminishes.

On the other hand, VIIT involves two-way trade in products that are differentiated by quality, and is associated with comparative advantage considerations (Falvey,

1981; Falvey and Kierzkowski, 1985; Shaked and Sutton, 1984; Flam and Helpman, 1987). In particular, the key contribution is the VIIT model developed by Falvey (1981) and complemented by Falvey and Kierzkowski (1985). In this framework, it is assumed that countries differ in their relative endowments of capital and labour, high-quality varieties require a higher capital/labour ratio (capital-intensity), consumers, who demand only one type of variety, prefer high-quality varieties, and consumption of types of varieties depends on personal income (higher-income consumers consume high-quality varieties and lower-income consumers consume low-quality varieties).

Given these assumptions, the relatively capital-abundant country specializes in high-quality varieties, whilst the relatively labour-abundant country specializes in low-quality varieties. Thus, IIT emerges between the two countries, although not in the same way as predicted by HIIT models. In fact, VIIT is determined by comparative advantage, with the extent of VIIT being higher, the greater the differences in the relative factor endowments.

3. Horizontal and Vertical Intra-industry Trade Patterns in NAFTA

This section provides a comprehensive empirical analysis of trends in intra-NAFTA IIT patterns for products of manufacturing (SITC sections 5 through 8) over the 1992-2002 period. Since these descriptive empirical data give a good picture regarding the nature of trade flows and specialization among NAFTA members – by decomposing total trade into inter-industry trade, HIIT and VIIT – we gain some insights into and evidence of the integration effects of the progressing North American economic integration process. The empirical methodology used to disentangle horizontal and vertical IIT is presented in the technical annex.

The extent of HIIT and VIIT by NAFTA country and industry (aggregated to one-digit SITC sections) is shown in tables 1 and 2, respectively. The upper portions of both tables report bilateral GL indices, whilst the lower portions report intra-NAFTA GL indices of each member country. Looking first at table 1 and bilateral HIIT indices, it is evident that bilateral HIIT is more pronounced between the United States and Canada as well as between the United States and Mexico, than between Canada and Mexico. A similar picture emerges when looking at total intra-NAFTA manufacturing HIIT patterns in each country. Specifically, intra-NAFTA HIIT is highest in Canada (7.5 percent in 1992 and 24.4 percent in 2002), followed by the United States (6.7 percent in 1992 and 21.8 percent in 2002) and Mexico (4.3 percent in 1992 and 17.2 percent in 2002).

Table 1 Horizontal Intra-industry Trade Patterns within NAFTA, 1992–2002

	1992	1994	1996	1998	2000	2002
Bilateral HIIT						
United States – Canada						
5-Chemicals & related products	0.111	0.194	0.226	0.278	0.301	0.238
6-Manufact. classified by material	0.088	0.143	0.224	0.158	0.245	0.249
7-Machinery & transport equipment	0.075	0.096	0.261	0.076	0.209	0.279
8-Miscellaneous manufactures	0.007	0.049	0.139	0.033	0.188	0.049
5-8 Total manufacturing	0.076	0.108	0.240	0.106	0.222	0.249
United States – Mexico						
5-Chemicals & related products	0.074	0.088	0.056	0.040	0.077	0.079
6-Manufact. classified by material	0.097	0.059	0.136	0.057	0.167	0.161
7-Machinery & transport equipment	0.034	0.047	0.112	0.057	0.106	0.230
8-Miscellaneous manufactures	0.021	0.091	0.067	0.018	0.014	0.018
5-8 Total manufacturing	0.045	0.058	0.104	0.049	0.097	0.176
Canada – Mexico						
5-Chemicals & related products	0.043	0.061	0.088	0.064	0.066	0.065
6-Manufact. classified by material	0.005	0.031	0.059	0.033	0.071	0.068
7-Machinery & transport equipment	0.012	0.100	0.023	0.018	0.069	0.033
8-Miscellaneous manufactures	0.053	0.035	0.047	0.038	0.065	0.074
5-8 Total manufacturing	0.014	0.087	0.031	0.026	0.068	0.042
Intra-NAFTA HIIT						
United States						
5-Chemicals & related products	0.102	0.165	0.182	0.211	0.236	0.193
6-Manufact. classified by material	0.089	0.122	0.202	0.130	0.221	0.223
7-Machinery & transport equipment	0.064	0.081	0.212	0.069	0.166	0.258
8-Miscellaneous manufactures	0.012	0.066	0.106	0.024	0.096	0.031
5-8 Total manufacturing	0.067	0.093	0.196	0.085	0.172	0.218
Canada						
5-Chemicals & related products	0.111	0.192	0.224	0.275	0.298	0.235
6-Manufact. classified by material	0.087	0.142	0.223	0.156	0.243	0.246
7-Machinery & transport equipment	0.074	0.095	0.256	0.075	0.205	0.273
8-Miscellaneous manufactures	0.007	0.049	0.138	0.033	0.186	0.049
5-8 Total manufacturing	0.075	0.107	0.236	0.104	0.219	0.244
Mexico						
5-Chemicals & related products	0.074	0.087	0.056	0.041	0.077	0.078
6-Manufact. classified by material	0.094	0.058	0.134	0.056	0.164	0.158
7-Machinery & transport equipment	0.033	0.048	0.108	0.055	0.105	0.223
8-Miscellaneous manufactures	0.020	0.090	0.067	0.017	0.014	0.018
5-8 Total manufacturing	0.043	0.059	0.102	0.048	0.096	0.172

Note: Unadjusted Grubel-Lloyd indices calculated from four-digit SITC OECD trade data, weighted across industries.

Table 2 Vertical Intra-industry Trade Patterns within NAFTA, 1992–2002

	1992	1994	1996	1998	2000	2002
Bilateral VIIT						
United States – Canada						
5-Chemicals & related products	0.377	0.349	0.337	0.324	0.281	0.367
6-Manufact. classified by material	0.357	0.422	0.295	0.438	0.290	0.306
7-Machinery & transport equipment	0.491	0.465	0.313	0.514	0.355	0.324
8-Miscellaneous manufactures	0.475	0.544	0.489	0.544	0.440	0.545
5-8 Total manufacturing	0.453	0.455	0.327	0.486	0.344	0.344
United States – Mexico						
5-Chemicals & related products	0.229	0.233	0.283	0.258	0.204	0.242
6-Manufact. classified by material	0.261	0.296	0.297	0.401	0.257	0.255
7-Machinery & transport equipment	0.546	0.538	0.368	0.477	0.406	0.269
8-Miscellaneous manufactures	0.614	0.508	0.435	0.498	0.440	0.405
5-8 Total manufacturing	0.490	0.478	0.364	0.457	0.382	0.290
Canada – Mexico						
5-Chemicals & related products	0.042	0.084	0.119	0.149	0.168	0.147
6-Manufact. classified by material	0.091	0.14	0.174	0.165	0.147	0.135
7-Machinery & transport equipment	0.069	0.09	0.116	0.364	0.142	0.164
8-Miscellaneous manufactures	0.155	0.211	0.254	0.299	0.302	0.353
5-8 Total manufacturing	0.076	0.102	0.130	0.308	0.152	0.170
Intra-NAFTA VIIT						
United States						
5-Chemicals & related products	0.339	0.318	0.323	0.305	0.259	0.332
6-Manufact. classified by material	0.337	0.391	0.295	0.428	0.28	0.291
7-Machinery & transport equipment	0.506	0.486	0.331	0.501	0.376	0.301
8-Miscellaneous manufactures	0.529	0.529	0.465	0.520	0.440	0.463
5-8 Total manufacturing	0.463	0.462	0.339	0.476	0.359	0.322
Canada						
5-Chemicals & related products	0.375	0.347	0.336	0.322	0.280	0.365
6-Manufact. classified by material	0.355	0.419	0.294	0.434	0.288	0.304
7-Machinery & transport equipment	0.487	0.458	0.309	0.512	0.350	0.320
8-Miscellaneous manufactures	0.473	0.541	0.487	0.541	0.439	0.543
5-8 Total manufacturing	0.450	0.450	0.325	0.483	0.341	0.341
Mexico						
5-Chemicals & related products	0,227	0,230	0,280	0,255	0,203	0,239
6-Manufact. classified by material	0,256	0,292	0,295	0,393	0,255	0,252
7-Machinery & transport equipment	0,532	0,520	0,359	0,474	0,397	0,266
8-Miscellaneous manufactures	0,609	0,504	0,433	0,496	0,438	0,404
5-8 Total manufacturing	0,479	0,466	0,357	0,453	0,376	0,287

Note: Unadjusted Grubel-Lloyd indices calculated from four-digit SITC OECD trade data, weighted across industries.

Evidently, in each NAFTA economy HIIT levels increased significantly between 1992 and 2002. In fact, HIIT shares more than tripled in the United States and Canada and even quadrupled in Mexico. Additionally, what is of particular importance is the evolution of HIIT in individual industries. While in 1992 in all NAFTA countries,

industries that are classified under SITC sections 5 (chemicals and related products) and 6 (manufactures classified by material) exhibited the highest HIIT levels, in 2002 HIIT was most pronounced in industries of section 7 (machinery and transport equipment). Thus, our results indicate that NAFTA integration induced a huge IIT expansion in horizontally differentiated products, which is particularly pronounced in the manufacturing industries of SITC section 7. This finding may be associated with the fact that preferential trade liberalization in North America has been particularly important within the automobile industry. In fact, there is evidence that the economies of the United States and Mexico have become increasingly integrated in recent years, especially in manufacturing sectors such as machinery and transport equipment (Gonzalez and Velez, 1995; Burfischer, Robinson, and Thierfelder, 2001).

Turning to the analysis of VIIT, it becomes clear that a totally different pattern arises (table 2). It is evident that VIIT appears to be much higher than HIIT in all industries and NAFTA members. In addition, VIIT exhibits a significant decreasing trend. While total intra-NAFTA manufacturing VIIT in 1992 in the United States, Canada, and Mexico represented 46.3 percent, 45 percent, and 47.9 percent of total intra-NAFTA manufacturing trade, respectively, the corresponding VIIT shares in 2002 amounted to 32.2 percent, 34.1 percent, and 28.7 percent, respectively. In 1992 VIIT was particularly high in miscellaneous manufactured products (section 8) and machinery and transport equipment (section 7), whilst in 2002 industries of sections 5 and 8 recorded the highest VIIT levels, with industries of section 7 experiencing a strong fall in VIIT. These findings imply that large quality differences exist among NAFTA members in products such as travel goods, handbags, articles of apparel and clothing accessories, footwear, and professional and scientific instruments (classified under section 8), and to a lesser extent in some chemical and pharmaceutical products (classified under section 5). An interesting fact to note is that in the manufacturing industries of SITC section 7, HIIT increased significantly, while at the same time VIIT declined steeply. Thus, it seems that there has been a restructuring of IIT in favour of the horizontal component.

In general, our results reveal that intra-NAFTA HIIT increased to a large extent at the expense of VIIT. Indeed, when the results for HIIT and VIIT are combined, it is evident that total intra-NAFTA IIT in the United States remained at about the same level (it rose from 53 percent in 1992 to 54 percent in 2002), as increases of HIIT levels have been almost perfectly matched by decreases of VIIT levels. In Canada total IIT clearly increased during NAFTA integration. Although in Canada increases of HIIT have been also followed by decreases of VIIT, HIIT growth has been stronger than the decline of VIIT, thus increasing IIT from 52.5 percent in 1992 to 58.5 percent

in 2002. The case of Mexico is interesting, as HIIT growth has been accompanied by a much stronger negative growth of VIIT, thus decreasing IIT from 52.3 percent to 45.9 percent. Consequently, 54.1 percent of total intra-NAFTA manufacturing trade in Mexico in 2002 was inter-industry trade.

Thus, it seems that NAFTA integration induced more inter-industry specialization in Mexico. Overall however, the results suggest that within the NAFTA area IIT represents a large and growing share of total intra-regional trade, indicating increasing intra-industry specialization. Finally, the finding of declining VIIT and increasing HIIT implies that relative factor endowments of member countries are converging and that comparative advantage considerations are becoming less important in shaping trade and specialization patterns.

4. Industry Characteristics of Horizontal and Vertical IIT

In this section we conduct a more analytical examination by analyzing some industry characteristics of intra-NAFTA HIIT and VIIT. In order to take a look at industry-specific characteristics and factors of observed horizontal and vertical IIT patterns we classify our industry sample according to various aspects of industry characteristics. For the purpose of this analysis, a good categorization of industries, containing relevant information on some industry characteristics, is the one compiled by UNCTAD (2002), which “classifies each product group into different categories according to the mix of different skill, technology and capital intensities and scale characteristics” (UNCTAD, 2002, p. 87).

We distinguish the following four categories:²

1. Labour-intensive and resource-based manufactures
2. Manufactures with low skill and technology intensity
3. Manufactures with medium skill and technology intensity
4. Manufactures with high skill and technology intensity

We classify each three-digit SITC industry of our sample into one of these categories and transform these categories into dummy variables, which we regress on the calculated GL indices. The regression results, which are reported in table 3, indicate that industries with high skill and technology intensity followed by labour/resource-intensive industries account for a large part of observed U.S.-Canada HIIT levels, whilst low skill as well as medium skill industries exhibit the highest VIIT levels. In the case of U.S.-Mexico trade, HIIT is mainly shaped by labour/resource-intensive industries and medium skill and technology industries, with VIIT being more important in low skill and medium skill industries. HIIT and VIIT

between Canada and Mexico are more pronounced in industries that are characterized by a high labour/resource intensity and medium-skill and technology intensity.

Table 3 Industry Characteristics of Horizontal and Vertical IIT within NAFTA

	Labour/resource intensive	Low skill & technology	Medium skill & technology	High skill & technology	Adj. R ²
U.S. – Canada					
HIIT	0.144 (9.017) [0.000]	0.124 (6.472) [0.000]	0.130 (9.212) [0.000]	0.159 (12.318) [0.000]	0.308
VIIT	0.409 (22.626) [0.000]	0.469 (21.614) [0.000]	0.456 (28.506) [0.000]	0.343 (23.542) [0.000]	0.746
U.S. – Mexico					
HIIT	0.092 (8.068) [0.000]	0.047 (3.434) [0.001]	0.078 (7.692) [0.000]	0.069 (7.400) [0.000]	0.187
VIIT	0.346 (18.807) [0.000]	0.362 (16.323) [0.000]	0.347 (20.983) [0.000]	0.311 (20.467) [0.000]	0.645
Canada – Mexico					
HIIT	0.057 (7.337) [0.000]	0.035 (3.677) [0.000]	0.038 (5.419) [0.000]	0.035 (5.501) [0.000]	0.121
VIIT	0.210 (14.455) [0.000]	0.182 (9.968) [0.000]	0.187 (14.166) [0.000]	0.147 (12.232) [0.000]	0.422
NAFTA (pooled)					
HIIT	0.095 (13.509) [0.000]	0.068 (7.888) [0.000]	0.081 (12.748) [0.000]	0.086 (14.837) [0.000]	0.199
VIIT	0.316 (29.793) [0.000]	0.334 (25.803) [0.000]	0.325 (34.123) [0.000]	0.262 (30.172) [0.000]	0.591

Note: t-statistics in parentheses; p-values in square brackets.

Overall, the results suggest that labour/resource-intensive industries (and thus comparative advantage considerations) play to some extent an important role in intra-NAFTA HIIT and VIIT patterns, which is particularly true between Canada and Mexico. However, we would expect labour/resource-intensive products to be subject to the traditional Heckscher-Ohlin scenario with high inter-industry trade and specialization. Notably, in a comprehensive study for the EU, Brulhart (1998) has also

detected high levels of IIT in labour-intensive industries and hypothesized that “high IIT in labour-intensive sectors could result from a process of industrial dispersion in these industries” (Brulhart, 1998, p. 331). In any case, it has to be stressed that some of the above results might be driven by data limitations and by the UNCTAD (2002) classification of product groups.

5. Conclusions

This study, by disentangling the horizontal and vertical components of IIT, analyzed intra-NAFTA IIT patterns and assessed the trade effects of regional economic integration in North America over the 1992-2002 period. Our empirical analysis revealed that manufacturing HIIT and VIIT within NAFTA display considerable differences with regard to their patterns and trends. While in all member economies intra-NAFTA HIIT shares more than tripled, VIIT shares deteriorated significantly during the period under investigation. In fact, it seems that HIIT increased to a large extent at the expense of VIIT. Though there has been a convergence in the levels of HIIT and VIIT, IIT in vertically differentiated products still represents the dominant IIT type.

Bilateral horizontal and vertical IIT is more pronounced between the United States and Canada and between the United States and Mexico than it is between Canada and Mexico. Notably, with HIIT increasing and VIIT declining, total intra-NAFTA IIT increased slightly in the United States and significantly in Canada, while it decreased in Mexico. Hence, with the exception of Mexico, trade liberalization within the NAFTA area seems to have promoted intra-industry specialization and adjustment. Interestingly, labour- and resource-intensive industries are found to display high levels of horizontal as well as vertical IIT, suggesting that traditional comparative advantage may represent to some extent an important factor in intra-NAFTA trade patterns. On the other hand, however, our finding of a significant downward trend in intra-NAFTA VIIT may be considered to some extent an indication that comparative advantage is losing importance as a factor driving trade and specialization patterns within the NAFTA area. In any case, and keeping in mind that some results could be sensitive to the methodology adopted and data used, our explorations suggest that intra-regional manufacturing trade structures and quality levels of NAFTA members have become more similar. Consequently, it seems that intra-NAFTA IIT is increasingly becoming an exchange of different varieties rather than of different qualities, indicating to some extent an economic convergence process within the NAFTA trade bloc.

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Endnotes

1. With regard to the examination of trade patterns within the whole NAFTA trade bloc, an exception, for instance, is Brulhart and Thorpe (2001) who examine intra-NAFTA IIT patterns of NAFTA members for the period 1980-1998 without, however, decomposing IIT into HIIT and VIIT. Clark (2002) examines total IIT between the United States and Mexico for the first five years of NAFTA.
2. In the UNCTAD (2002) report two more categories are distinguished, "unclassified products" and "primary commodities", which are not considered in our analysis.

The technical annex to this paper, pages 222-225 is available as a separate document.

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