

REGIONALIZATION AND INTRA-INDUSTRY TRADE. AN ANALYSIS OF AUTOMOBILE INDUSTRY TRADE IN NAFTA

Sylvie MONTOUT*, Jean-Louis MUCCHIELLI**
and Soledad ZIGNAGO***

Abstract - As was shown in some previous studies, the creation of the North American Free Trade Agreement (NAFTA) has significantly increased trade and investment flows between member countries. Consequently, it seems appropriate to analyze the incidences of the free trade agreement on the nature of trade. In this paper, we study the intra-industry trade in the automobile industry within the NAFTA area. Our results highlight an increase in intra-industry trade since the beginning of the 1990s. The importance of intra-industry trade is evaluated with the Grubel and Lloyd indicator (1975). For final and intermediate goods, we distinguish those which are horizontally differentiated in quality (differences in unit values) from those in varieties (similar unit values). In NAFTA, intra-industry trade exists in most sectors and in two bilateral relations (United States-Canada and United States-Mexico). Therefore, we analyze the nature of that increase and more precisely, the determinants of intra-industry trade in this industry. Through a gravity model integrating some country-specific and sector variables, we found that economic distance and market size have a predominant influence on horizontal intra-industry trade. In this way, we also confirm the significant role of regional integration on the intensity of intra-industry trade.

Keywords - AUTOMOBILE INDUSTRY, INTRA-INDUSTRY TRADE, REGIONAL INTEGRATION.

JEL Classification: F15, L62.

* Panthéon-Sorbonne University, TEAM University of Paris 1-CNRS, 106-112 bd de l'Hôpital, 75647 Paris Cédex 13, France.

** Professor at the University Panthéon-Sorbonne and affiliate professor at the European Management School.

*** CEPII and Panthéon-Sorbonne University, TEAM University of Paris 1-CNRS, 106-112 bd de l'Hôpital, 75647 Paris Cédex 13, France.

1. INTRODUCTION

It has been argued that the creation of economic areas such as NAFTA may enhance trade integration between southern and northern countries. Therefore, questions in terms of integration effects on trade and specialization are determinant. This regional integration implies the reduction and the elimination of tariff and non-tariff barriers, as well as a general deregulation and strengthening of competition. With the acceleration of growth in the United States and since the creation of NAFTA, Mexican exports to the US rose by more than 20 per cent a year in the 1990s. Today, the US represents almost four fifths of Mexican imports and exports. Symmetrically, Mexico has also increased its share in US international trade and is currently the third largest trading partner after Canada and Japan. Thus, the regional process has induced an intensification of trade between member countries. Looking at these trends, it is interesting to analyze the nature of trade in which NAFTA countries are engaged.

According to the theoretical and empirical model (Lundberg, 1992; Chudnovsky et al., 1996; Fontagné et Freudenberg, 1997), regionalization often implies an emergence of intra-industry trade (IIT). However, most of the empirical work explaining IIT refers to the European Union. This paper concentrates on the NAFTA case. Given its crucial importance in the growth of manufacturing bilateral trade, the motor vehicles and autoparts industry has become an appropriate case to study. Furthermore, the automobile industry plays a key role in Mexican GDP since it represents 12 % of its industrial GDP nowadays. Moreover, the expansion of intra-industry trade in this industry may reflect the new international production strategies of multinational firms. Our results indicate that products made by the motor vehicles and autopart industries account for the largest volume of trade and indicate the highest rates of IIT within intra-regional trade since NAFTA creation. According to the theory, we can thus suggest the significant role of regional integration in the intensity of intra-industry trade.

The remainder of this paper is organized as follows. In section 2, we present the automobile regime implied by NAFTA. Definitions and empirical measure of intra-industry trade are indicated in section 3. Section 4 presents empirical investigations for the automobile industry and investigates the nature of NAFTA trade within the region and with the main external partners. The model is represented in section 5. The different variables and hypotheses are tested in section 6. Section 7 consists of the conclusion.

2. THE AUTOMOTIVE REGIME IN THE NAFTA AREA

The negotiations relating to the automobile trade with the Canada-US Auto Pact constituted a first step toward regional integration. The Auto Pact

signed in January 1965 created a sectoral free trade agreement, which implied that about 95 % of the Canada-United States trade in automotive products were liberalized since then. To be qualified as a Pact member some conditions must be met, notably those concerning local content requirements. For instance, passenger vehicles have to maintain a minimum of 60 % Canadian value added. Canada implemented this agreement multilaterally so that vehicles and parts could enter duty free from any country in the world as long as the conditions of the agreement were met. In contrast, the United States implemented the agreement bilaterally so that only parts and vehicles from Canada are qualified for duty-free entry. The Canada-US Free Trade Agreement in 1989 cemented this process while Mexico remained isolated. Until the late 1980's, Mexico used Auto Decrees, foreign investment regulations, and tariffs to keep the industries segmented along the Rio Grande, the border with the US.

NAFTA was envisaged to gradually eliminate Mexican tariffs, local content requirements, and trade balancing requirements on vehicles from the U.S and Canada. Mexican tariffs on cars and light trucks from the US or Canada were reduced from 20 to 10 % on January 1, 1994. The tariff on passenger cars was subsequently reduced by 1.2 % in 1995 and by 1.1 % per year and is still expected to be totally removed on January 1, 2003. For light trucks, the tariff is reduced by 2.5 % per year in order to attain zero on January 1, 2003. The NAFTA rules of origin are regional content requirements that establish the minimum criteria for the products in order to benefit from preferential tariff treatment between the US, Canada and Mexico. For example, from 1994 to 1997, a minimum of 50 % of a light vehicle's net cost was required to come from North America. From 1998 to 2001, this value has increased to 56 %, and is expected to reach 62.5 % by this year. All others vehicles had to meet 50 % between 1994 and 1997, 55 % between 1998 and 2001, and will have to meet 60 % thereafter.

This policy framework was certainly influenced by the predominant presence of affiliates of multinational firms in the production structure of this sector. It is obvious that the main factors influencing the strategies of firms are the compensation agreements within NAFTA and the local content requirements for finished vehicles. The local content requirements have encouraged the final car manufacturers to be directly involved in the domestic production of parts and to develop supplier networks regionally. Given the importance of multinationals in the NAFTA automobile industry, the strategies of firms certainly have a significant effect on the nature of trade.

3. INTRA-INDUSTRY TRADE: DEFINITIONS AND EMPIRICAL MEASURE

Intra-industry trade (IIT) represents simultaneous exports and imports within the same industry. In IIT we have horizontal intra-industry trade differentiated by quality and varieties. Horizontal intra-industry trade is the two-

way trade within one single industry between products arrived at the same stage in the production process. Goods can be considered as differentiated by their varieties when their value-added is equal or by quality when their value added is quite different. IIT also describes vertical two-way trade for products or parts belonging to the same industry but at different stage of the production process. This IIT will also be considered as intra-product trade.

For horizontal IIT, we can consider that international and regional trades increase the size of the market leading to a greater variety of goods, thus increasing the opportunity to benefit from scale economies. Products can also differ by quality (differences of prices). In this case, the specialization is based along quality ranges within the same industry. The economic distance, which illustrates differences among countries in the allocation of specific resources along the quality spectrum, is compatible with intra-industry trade differentiated by quality.

3.1. Measurement of intra-industry trade

The most widely used indicator to measure the extent of intra-industry trade was put forward by Grubel & Lloyd (1975). We use it in order to calculate the part of balanced trade (overlap between exports and imports) in all trade in a given industry k between the country i and j .

$$GL_{ij,k} = 1 - \frac{|X_{ij,k} - M_{ij,k}|}{X_{ij,k} + M_{ij,k}}$$

where $X_{ij,k}$ and $M_{ij,k}$ represent, respectively, exports and imports between countries i and j in industry k . Some caveats must be mentioned. Trade imbalance induces the main bias of this indicator since the flow cannot be completely considered as intra-industry. In order to correct this bias, in Grubel and Lloyd, Aquino proposed some adjustments. In addition, the traditional GL measure highlights the intensity of overlapping trade without distinguishing the nature of trade. Nevertheless, most economists continue to use the unadjusted Grubel and Lloyd indicator. By construction, this indicator displays the trade imbalance as part of inter-industry trade flows and trade overlap representing intra-industry trade. Therefore, two distinct theoretical concepts are used to explain different parts of one and the same flow. If we assume for example that the majority flow (here exports) is 60 and the corresponding minority flow (here imports) is 40, then the overlap of 80 is considered to be intra-industry trade, the remaining 20 being inter-industry flows. The risk is that inter-industry part (20) should be explained by the traditional theory based on comparative advantages and differences factor endowment in a perfect competition context. In contrast, the intra-industry part (40) should be explained by the "new trade" theories, with imperfect competition and increasing returns to scale.

Hence, in order to improve our analysis, we adopt a methodology which distinguishes a flow as either relevant to one-way (inter-industry trade) or two-way trade (IIT) (see Abd-EL-Rahman (1986) Fontagné and Freudenberg (1997)). According to the traditional methodology, trade is considered as a two-way trade when the value of the minority flow represents at least 20 % of the majority flow:

$$\frac{\text{Min}(X_{ij,kt}, M_{ij,kt})}{\text{Max}(X_{ij,kt}, M_{ij,kt})} > 20\%$$

where X and M represent exports and imports, index i refers to the declaring country, j to the partner country and k to the product in the year t.

3.2. Differentiation by quality and varieties

After determining a flow as a two-way trade, the exchange of products can be defined as differentiated by quality or by varieties. Following previous works, we assume that differences in price (unit values) reflect quality differences. Therefore, products with close unit value are considered to be similar and only differentiated by their varieties. Trade products are considered to be similar if export and import unit values differ by less than 15 %, when this is not the case, products are considered differentiated by their quality, following this condition:

$$\frac{1}{1,15} \leq \frac{UV_{ij,kt}^X}{UV_{ij,kt}^M} \leq 1,15$$

where UV represents export (X) and import (M) unit values between i referring to the declaring country and j referring to the partner country for the product K in the year t.

4. EMPIRICAL INVESTIGATIONS OF NAFTA

4.1. Trade in final products and automobile parts

We analyze the intra and inter-industry trade at the 6-digit level of the Harmonised System nomenclature inside the automobile industry. To compute the degree of IIT, in the first step, we use the Grubel and Lloyd indicator (1975). In the second step, we compute these indicators with data on imports at the 6-digit from the HS. These data were extracted from the Comtrade database over the period 1997-1999; and were extracted from OCDE over the period 1992-1996. The data¹ cover the period 1992 to 1999 and concern the nature of trade within NAFTA, and with their main partners. We analyze the pattern of intra-

¹ We lay out 38 714 lines of data in order to evaluate the intra-industry trade at the disaggregated level.

industry trade and inter-industry trade inside NAFTA over the last 7 years at the most aggregated level of the automobile industry.

The main sectors of trade in the automobile industry inside NAFTA are displayed. Figure n° 1 presents shares of each sector in the intra-NAFTA trade for automobile industry. In NAFTA, intra-regional trade in automobile industry mainly concerns three sectors- Motors Vehicles (final products), Motors Vehicles for Transport of Goods (final products) and Parts and Access (intermediate products), which concentrate about 80 % of the total trade. The "motor vehicles" represent the most important sector over the considered time period, with a share of about 47 %, followed by "parts and access of the motor vehicles" – with a share of about 30 % – and the "motor vehicles for the transport of goods" – with a share around 15 %. The share of these sectors in the total trade of automobile industry inside NAFTA remains quite stable.

Figure n° 1: Share of sectors in intra-NAFTA trade, 1992-1999

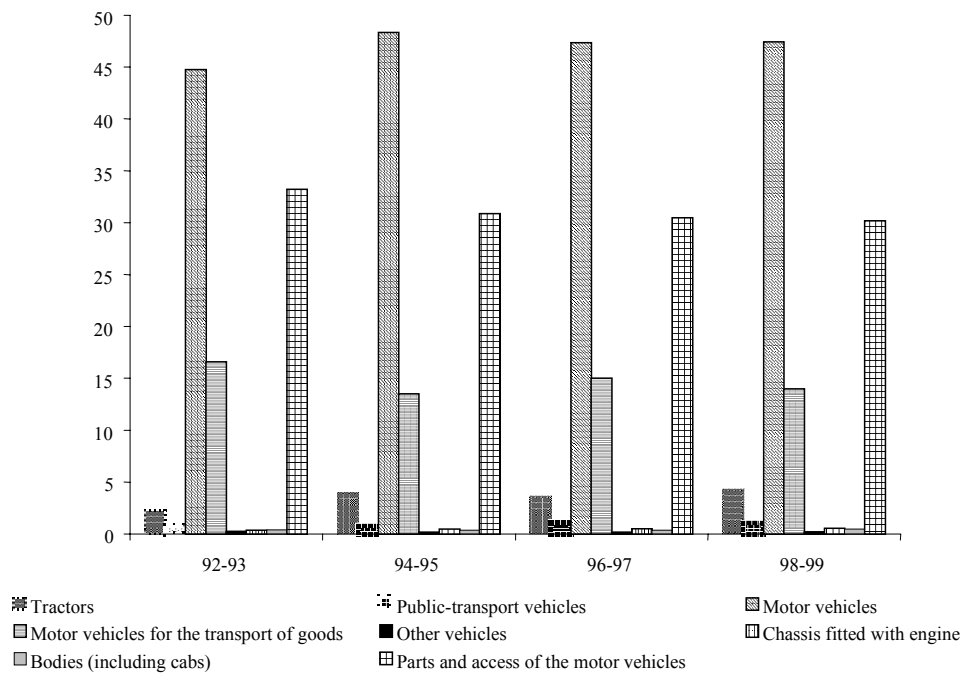
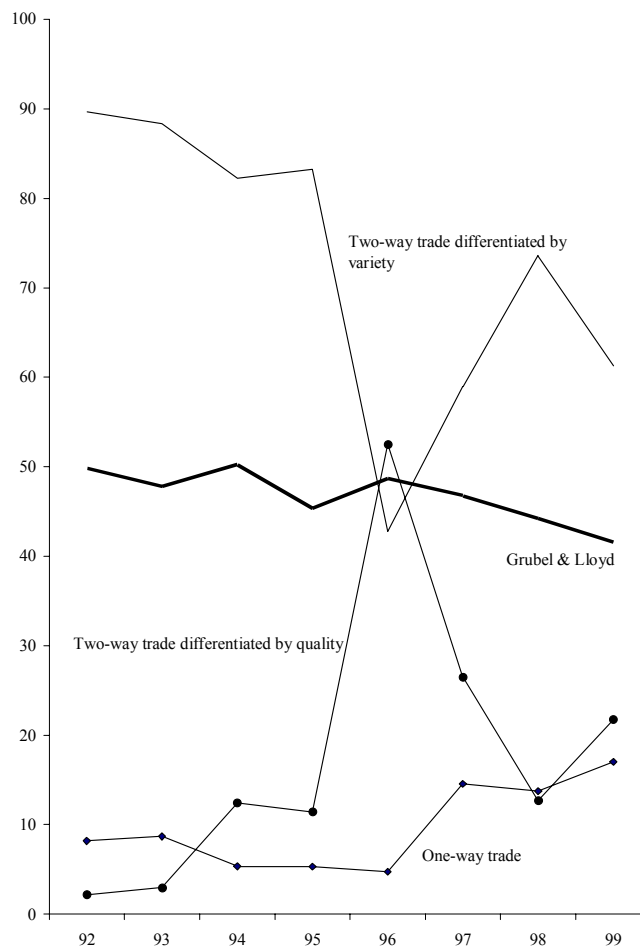


Figure n° 2 plots the traditional Grubel and Lloyd (GL) indicator and the share of the three trade types in intra-NAFTA from 1992 to 1999. First, we can notice that the IIT in NAFTA is particularly great. Within the automobile industry, we distinguish trade in final products (motors vehicles, motors vehicles

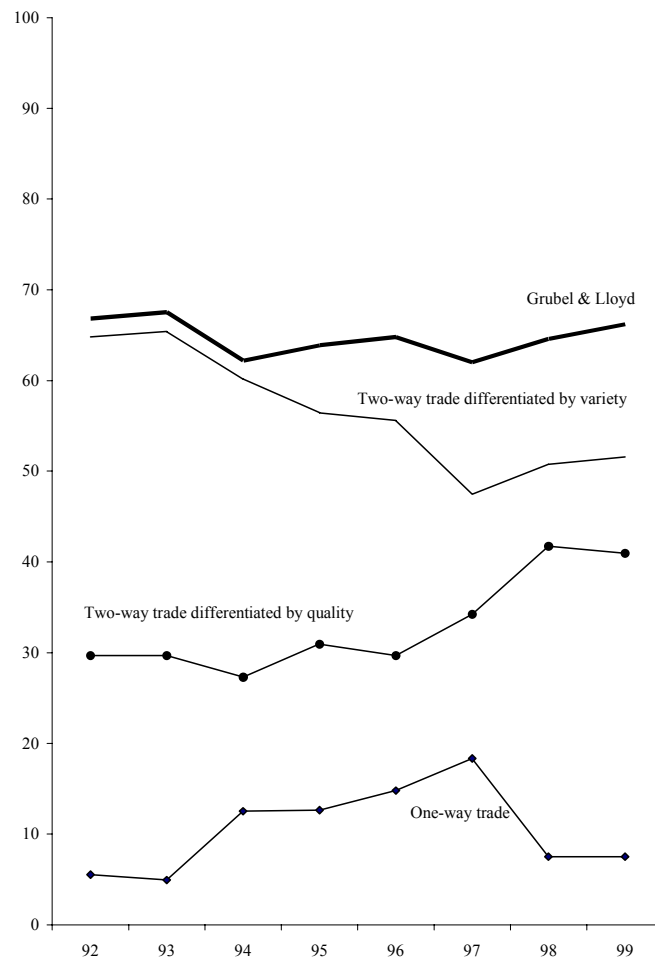
for the transport of goods, tractors...) and trade in intermediate goods (parts and access of the motor vehicles, chassis...). We estimate the pattern of trade considering differentiation in quality or varieties. During the period, the GL ratio was around 50 % in the early 90s, and remained stable. The most important trade for final goods in the beginning of the 1990s was the two-way trade differentiated by varieties; it represented approximately 70 % of the total trade. Two-way trade in quality has a share that was higher than 30 % since 1995.

Figure n° 2: Evolution of trade types and the GL indicator in intra-NAFTA trade, 1992-1999

Final goods



Intermediate goods



Source: Authors' calculations based on data from OECD, COMTRADE and DataIntal.

4.2. Type of trade of NAFTA with their main partners²

Table n° 1 presents the different kinds of trade by partner country for NAFTA over the last period. We observe a very interesting result for NAFTA, which reveals that intra-industry trade is higher between members of NAFTA

² Main partners of Canada, Mexico and the United States are Canada, France, Germany, Italy, Japan, Korea, Mexico, Spain, Sweden, Taiwan, the United Kingdom, and the United States.

than with other partners. Otherwise, Canada and the United States favor horizontal two-way trade in varieties. It represents more than 55 % of total trade. In contrast, an important share of horizontal two-way trade in quality characterizes the intra-industry trade between Mexico and NAFTA. Besides, third countries essentially develop one-way trade (with a share superior to 60 %) with NAFTA countries. Thus, we can assume that intra-industry trade develops between member countries of regional blocks and that external countries favour inter-industry trade. It seems that for this industry, free trade agreement coupled with geographic proximity may have a decisive impact on the pattern of trade.

Table n° 1: Share of trade types and GL indicator between NAFTA and their main partners

Countries	Share in 1998-1999 (%)			
	IIT differentiated by quality	IIT differentiated by varieties	One-way trade	Grubel and Lloyd
Canada	26,2	68,8	3,7	52,5
France	37,8	1,0	60,1	31,9
Germany	15,4	0,0	84,6	21,9
Italy	27,9	1,2	70,8	24,2
Korea	15,9	0,0	84,1	10,2
Mexico	37,3	18,1	41,7	36,9
Spain	39,9	0,0	59,7	19,8
Sweden	7,9	0,0	91,9	5,3
Taiwan	6,5	0,0	93,4	9,7
United Kingdom	34,2	0,7	64,8	32,8
United States	31,1	56,2	11,3	51,1

Source: Authors' calculations based on data from OCDE and DataIntl.

4.3. Results at a desegregated level for NAFTA

Figure n° 3 reveals the evolution of the traditional GL index and the share of trade types by sub-sectors between member countries of NAFTA. The study of the evolution of the traditional GL index shows the high importance of intra-industry trade for NAFTA. For final products we can distinguish two groups:

(a) The first group is characterised by an important IIT. The figure of "Tractors" provides a high level in GL, clearly superior to 60 % for all the considered periods. However, "motor vehicles for the transport of goods", "motor vehicles", "other vehicles" display a share of IIT around 40 %.

(b) The second group is characterised by a significant level of one-way trade. In the public transport vehicles, about two thirds of total trade are one-way trade.

For intermediate products we can also distinguish two groups:

- a) The first group, "bodies" and "parts and access" displays a high level in GL, clearly superior to 60 % for all the considered periods.
- b) The second group represented by "Chassis fitted with engine" knew a significant growth of the GL index since 1994. This indicator was around 18 % at the beginning of 1990s and achieved 26 % during the last period considered.

After having presented the evolution of the traditional GL indicator, we will now analyze the three trade types in order to differentiate the pattern of trade according to the nature of goods. We can distinguish two groups of sub-sectors (final and intermediate products) on the basis of their intra-NAFTA trade types between 1992 and 1999:

(a) The first group is characterized by a high share of horizontal two-way trade differentiated by its varieties. The sectors concerning "motor vehicles", "motor vehicles for the transport of goods" and "tractors" represent more than 70 % of intra-industry trade differentiated by their varieties during the period considered. A relative stability can be found in the evolution of sectors characterized by an important share of horizontal two-way trade in varieties. However, when considering only the "motor vehicles for the transport of goods" sector, two-way trade in quality increases at the expense of two-way trade in varieties. The former grew from about 2 % in 1996 to 17 % in 1998.

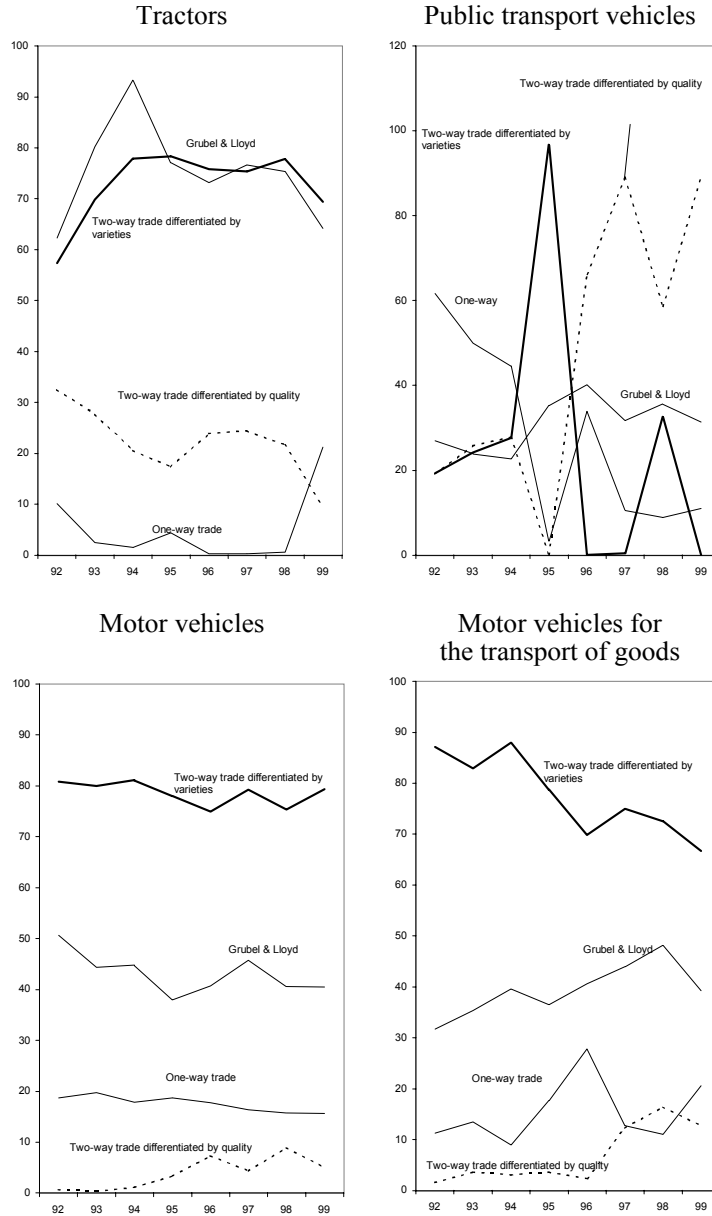
(b) In contrast, "parts and access of the motor vehicles", "bodies" and "chassis fitted with engine" are characterized by an important share of two-way trade in quality. For "bodies", the share of this kind of trade is particularly high and stable around 80 %. The "parts and access of the motor vehicles" sector experimented a rapid growth of intra-industry trade in varieties since 1997. Nevertheless, trade in quality remained significant and important with a rate around 40 % for the considered period.

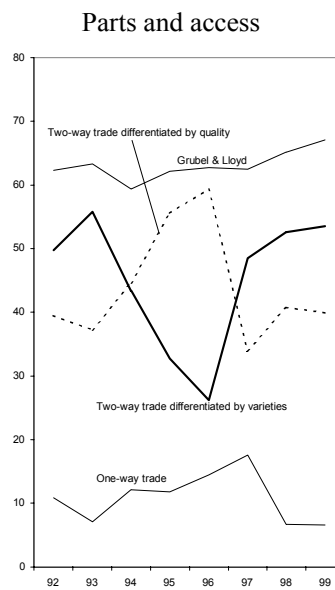
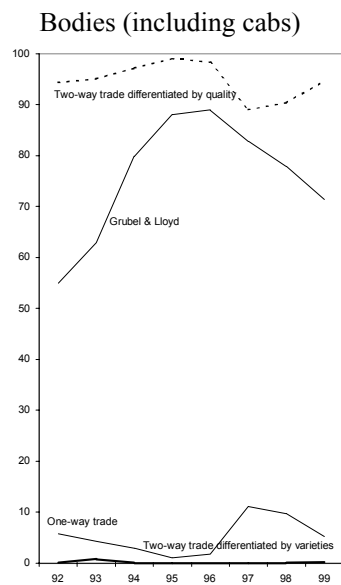
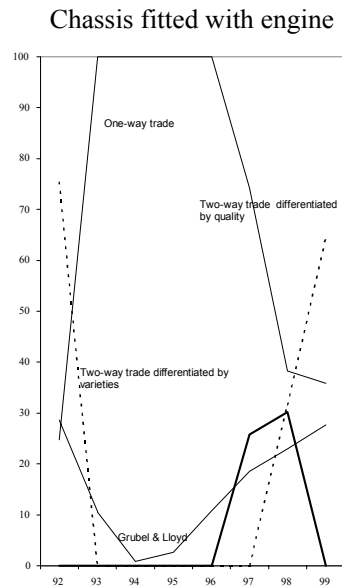
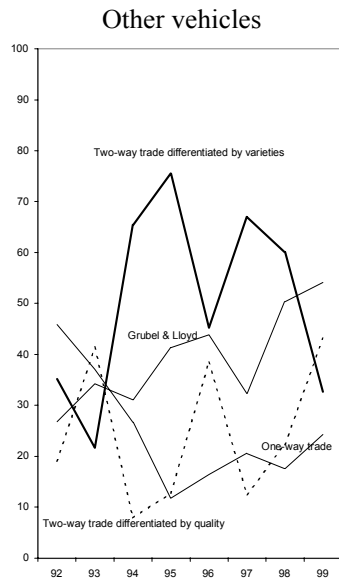
We can thus suggest that for the first group the consumers' preferences for diversity have a significant role on the development of horizontal two-way trade. For the second group, the demand depends rather on the production standards of firms, thus trade in these goods might suggest a quality-exchange between affiliates.

5. VARIABLES AND MODEL

We propose to analyse the impact of regional integration on the nature of intra and inter-NAFTA trade in the automobile industry. We estimate a fixed effect model for the value of intra-industry trade. Our econometric analysis takes into account final and intermediate products. Thus, the dependent variables are the value of bilateral trade types (horizontal two-way trade in quality and

Figure n° 3: Evolution of the share of trade types and the GL indicator in intra-NAFTA trade by sectors, 1992-1999





varieties). Equations for the two categories of horizontal intra-industry trade differentiated by quality and varieties have been estimated separately. The explanatory variables are country specific, integration and market structure variables.

5.1. Explanatory variables

Variables are the following:

**Table n° 2: Explanatory variable and expected signs
(sources in brackets)**

Variables	Intra-industry trade	
	Differentiation in varieties	Differentiation in quality
Market size Average of GDP in current dollars (CHELEM, CEPII, 1992-1999)	+	+
Difference in market size (DGDP) Normalized differences in GDP	-	+
Standard of living Average per capita income (CHELEM, CEPII, 1992-1999)	+	+
Economic distance (PCID) Difference in PCI	-	+
Geographic distance (Dist) Distance between capital (CEPII, distances géodésiques)	-	-
Regional integration process (DNAFTA) Dummy (1 when agreement, else 0)	+	+
Minimum efficient scale (MES) Relative productivity of larger firms (French comity of Automobile Constructors and STAN OCDE, 1992-1999)	+/-	+/-
Exchange rate (EXR) Bilateral of exchange rate (CHELEM, CEPII, 1992-1999)	+/-	+/-

5.2. Market size

$GDP_{ij,kt}$ (Average of GDP in current dollars) is an indicator of the size of the economies. The explanatory variable is measured on a bilateral basis using the average GDP (in current US\$) of the declaring country i and its partner j , following the methodology put forward by Bergstrand (1990). The main hypotheses state that the bilateral volume of intra-industry trade is positively related to the averages of country size (proxied by GDP). In this way, a large market size must increase the potential to produce great varieties and indicates a more diverse demand. Therefore, market size may have a positive impact on intra-industry trade.

5.3. Difference in market size

The variable DGDP (Normalized difference in GDP) represents the difference in market size between countries. We presume that the bigger the difference of market size is, the lower the intra-industry trade in varieties will be. In contrast, the correlation between the difference of market size and the share of horizontal two-way trade in quality has to be positive because products come from different production functions. The logic of comparative advantages applies to horizontal two-way trade in quality as well as to one-way trade. In accordance with Balassa (1986), Balassa and Bauwens (1987) and Somma (1994), the following ratio is used:

$$DGPD_{ij} = 1 + \frac{[w \ln w + (1 - w) \ln(1 - w)]}{\ln 2}$$

where $w = \frac{GDP_i}{GDP_i + GDP_j}$.

5.4. Standard of living

Per capita income PCI_{ij} ³ expressed as a bilateral average is positively associated with intra-industry trade. Per capita income represents a proxy of capital-labor ratio. In Helpman and Krugman (1985), the differentiated good is assumed to be capital-intensive in production. One can assume that a country characterized by high income specializes in capital-intensive products because they benefit from a higher capital-labor ratio. In addition, following Bergstrand's model (1990), we assume that higher levels of per capita income suggest a higher level of economic development. The average per capita income can be also interpreted as an indicator of demand structure. In this context, demand for variety is assumed to increase with the income level.

5.5. Economic distance

The economic distance (difference in PCI between two trading partners) is represented by the difference between PCI_i and PCI_j . We assume that a lower difference in per capita income leads to intra-industry trade in varieties. Per capita income may influence the nature of trade through both demand and supply sides. Following Linder (1961), per capita income represents an indicator of demand structure; a greater equality in per capita income implies that demand structure becomes similar in the two trading countries. In this way, the potential for intra-industry trade increases. Moreover, if we consider that differences in per capita income reflect the disparity in capital-labor endowment, this variable

³ Authors' calculations based on data from CHELEM, CEPII, 1992-1999, for the Gross Domestic Product and the Population.

should then be positively associated with the differentiation in quality and negatively with the differentiation in varieties.

5.6. Geographic Distance

For the geographic distance⁴, we use the kilometer distance between capitals of NAFTA members with their main partners. This variable represents a proxy of transport costs. Krugman (1980) argues that intra-industry trade decreases with the rise of transport costs. This results from the fact that transport and transaction costs may be particularly high for some products. In this context, geographic proximity reduces transport costs and facilitates the intensification of trade and notably two-way trade. Therefore, the distance between producers should lead to a reduction in two-way trade. Thus, a negative relationship is to be expected.

5.7. Regional integration

Subsequent to the regional integration process, the decreasing tariff barriers between member countries can intensify intra-industry trade, facilitating a growing production specialization and a better use of scale economies. Trade liberalization, by expanding the market, will lead to a rising variety of products. As the automobile industry takes advantage on scale economies and a high potential of goods differentiating, we can assume a revealing increase in intra-industry trade. It seems particularly interesting to analyze the development of intra-industry trade in order to determine break and continuity periods of the process. NAFTA intensified the trade between partners. This rapid growth of trade may have induced a change in its nature.

5.8. Minimum Efficient Scale

In order to represent the scale economies, an index can be used which captures the relative productivity enjoyed by larger firms over smaller firms such as that used by Greenaway, Melnon and Milner (1999):

$$MES_i = \frac{OT_i/N_i(5)}{OT_i/N_i(n-5)}$$

where OT is the total output in the country i , $N_i(5)$ represents the number of employees of the five largest firms, and $N_i(n-5)$ is the number of employees for the rest. It was calculated for each NAFTA country (Canada, Mexico and the United States). The index was only constructed for the final goods because of the availability of data. Numerous works on intra-industry trade consider that

⁴ Data construed by Guillaume Gaulier and Soledad Zignago for the CEPII databasis on geodetic distances.

increasing returns to scale should reinforce the intra-industry trade. Nevertheless, a low number of firms and a very large level of scale economies characterize the automobile industry. In addition, we only analyze the horizontal intra-industry trade, which doesn't concern the trade of products at different stages of production. Thus, we should expect a negative relationship between two-way trade and minimum efficient scale. In the same way, Greenaway, Melnon and Milner (1999) consider that a larger minimum efficient scale encourages vertical intra-industry trade. Hence, when scales economies are very large, production is likely to be concentrated in few plants thus reducing IIT (as predicted by Somma, 1994).

5.9. Exchange rate

In theory, there is no relationship between the exchange rates and the nature of trade. However, according to Bergstrand (1990), the exchange rate EXR_{ij} might have an effect on the volume of trade. It appears that countries, notably Mexico, were confronted to large variations in exchange rate during the considered period. Indeed, after having analyzed the evolution of the nature of trade, we noticed extreme fluctuations between two periods. So, neglecting the potential role of exchange rates on trade could lead to some bias in the estimates.

5.10. The model

After having presented the explanatory variables we can now introduce the model. The estimation of the model was made with Ordinary Least Squares with country fixed effects. The dependent variables are the value of the three trade types in bilateral NAFTA with their partners by sectors of the automobile industry from 1992-1993 to 1998-1999. Following the literature on the determinants of intra-industry trade (IIT), we estimate a regression model of the following form, which distinguishes the differentiation in quality and varieties. The model integrates gravity variables and variables of Bergstrand's model. These models are used to explain the nature of trade.

$$IIT_{IJ} = \alpha_{i0} + \sum_m \alpha_{im} Z_{ijm} + U_{ij}$$

We try to determine the explanatory variables on value intra-industry trade distinguishing between the automobile industry, horizontal intra-industry trade differentiated by quality and variety. Following each type of trade, the intra-industry trade index IIT_{hj} ($i=h$) between a country (i) and its trading partner country (j) depends on a set of country characteristic variables Z_{hjm} , which are the conventional country factors influencing intra-industry trade and which are presented above. Thus, the equations of the model for the horizontal intra-industry trade differentiated by quality and varieties are the following, using a log-log specification:

$$IIT_{ij}^{BF} = \alpha_1 GDP + \alpha_2 DGDP + \alpha_3 PCI + \alpha_4 PCID + \alpha_5 Dist + \alpha_6 DNAFTA + \alpha_7 EXR + \alpha_8 MES + \varepsilon$$

$$IIT_{ij}^{BI} = \alpha_1 GDP + \alpha_2 DGDP + \alpha_3 PCI + \alpha_4 PCID + \alpha_5 Dist + \alpha_6 DNAFTA + \alpha_7 EXR + \varepsilon$$

where IIT_{ij}^{BF} represents the horizontal intra-industry trade differentiated by quality and varieties for the final products, and IIT_{ij}^{BI} is the horizontal intra-industry trade differentiated by quality and varieties for the intermediate goods.

6. RESULTS

For the automobile industry, the results of the estimation for horizontal two-way trade in quality and variety for final products are stated in table 3, and results of the estimation for horizontal two-way trade by quality and variety illustrated for intermediate goods are given in table n° 4.

Table n° 3: Fixed effects model: results for values of bilateral trade types of final goods in the automobile industry (1992-1999)

	Intra-Industry Trade					
	Differentiation in varieties			Differentiation in quality		
	Parameter	Stand Err	Sign. Level	Parameter	Stand Err	Sign. Level
GDP	2,95016	0,51639	0,0001	4,35418	0,57350	0,0001
GDPD	-2,23029	0,91971	0,0159	-4,28692	1,02143	0,0001
PCI	0,43073	0,64524	0,5050	1,89805	0,71660	0,0085
PCID	-0,62442	0,27812	0,0255	-0,92189	0,30888	0,0031
Dist	-3,83489	0,62263	0,0001	-2,24628	0,69149	0,0013
EXR	-0,00018	0,00024	0,4367	0,00050	0,00026	0,0579
DNAFTA	2,97289	1,31091	0,0241	5,18288	1,45589	0,0004
MES	-33,54363	8,83939	0,0002	-16,98697	9,81700	0,0847
N	291			291		
adj R2	0,5676			0,6841		
Fa value	35,73			58,21		
Prop>F	0,0001			0,0001		

6.1. IIT in quality

For the differentiation in the quality of final goods, all variables are significant, whereas for intermediate goods, nominal exchange rate and per capita income are not significant. For the final and intermediate goods in the automobile industry, the size of countries approximated by GDP and the standard of living represented by PCI have a positive (especially for GDP explanatory) impact on intra-industry trade differentiated by quality. On the one

hand, a large market increases opportunities to produce different qualities; on the other hand, a large income raises the demand for differentiation. The differences in PCI are supposed to be a proxy for economic distance and should be associated with a negative sign on horizontal intra-industry trade differentiated by variety. As economic distance represents a proxy of difference in comparative advantages, we should expect an intensification of the horizontal intra-industry trade differentiated by quality. However, for the intermediate and final goods, the parameter is negative. The differences in market size (DGDP) do not indicate the expected sign, but we can note the high level of this indicator for intermediate goods.

In order to estimate the effect of regional integration on the intra-industry trade of automobile industry, we have to bring the dummy DNAFTA into play in the equation; it illustrates the membership of the countries to a preferential agreement, and has a positive and significant impact on the values of horizontal intra-industry trade differentiated by quality. This result confirms trade intensification with their main partner after the formation of a free trade area. In the automobile industry, the impact of regional integration seems to be more prevalent for final goods than for intermediate products. Geographic distance has the negative sign as expected.

The Minimum efficient scale is a measure of the difference in scale of the largest relative to the other firms in the automobile industry. Our results reveal a negative correlation between horizontal intra-industry trade differentiated by quality and MES.

Table n° 4: Fixed effects model: results for values of bilateral trade types of intermediate goods in the automobile industry (1992-1999)

	Intra-Industry Trade					
	Differentiation in varieties			Differentiation in quality		
	Parameter	Stand Err	Sign. Level	Parameter	Stand Err	Sign. Level
GDP	3,73510	0,43899	0,000	3,73946	0,42790	0,000
GDPD	-6,30948	0,79132	0,000	-4,28692	0,77133	0,000
PCI	0,75748	0,55153	0,170	0,80516	0,53760	0,135
PCID	-0,54426	0,24425	0,026	-0,92189	0,23808	0,007
Dist	-1,93900	0,53826	0,000	-2,24628	0,52466	0,000
EXR	-0,00028	0,00020	0,166	0,00050	0,00020	0,176
DNAFTA	3,40414	1,13375	0,002	3,07309	1,10511	0,005
N	291			291		
adj R2	0,704			0,679		
Fa value	77,92			69,5		
Prop>F	0,0001			0,000		

6.2. IIT in varieties

Turning to two-way trade in varieties, we obtain the following results. For final and intermediate goods differentiated by variety, all variables are significant except for per capita income and nominal exchange rate. Trade based on exchanges in varieties may increase with the size of countries and income. In this case, the market size has an important effect on the development of trade. Thus, market size has the positive sign as expected, although the correlation between differences in market size and the intra-industry trade differentiated by varieties is negative. Moreover, differences in size of countries weaken trade in varieties since the potential for gains in variety is reduced. In contrast, it seems that standard of living doesn't help to explain two-way trade in varieties. After a regional integration process, the expected convergence of member countries of NAFTA should lead to a rise in this structure of trade. Besides the dummy NAFTA has a high and significant impact on the trade of products distinguished by their varieties. The geographic distance representing a proxy of transport costs has a negative effect on this nature of trade. The negative effect of minimum efficient scale on intra-industry trade is higher for the intra-industry trade differentiated by varieties.

7. CONCLUSION

Our first results reveal the importance of intra-industry trade in NAFTA which favors exchanges in varieties and which represents in fact about 70 % of the total trade in the automobile industry. We can observe a very interesting result, confirming economic predictions. Intra-industry trade is higher between members of NAFTA (Canada, Mexico and United States) than with other partners, illustrating the significant role of regional integration on the intensity of intra-industry trade.

Canada and the United States favor intra-industry trade in their varieties (trade in varieties representing more than 55 % of total trade), for example, they export a variety of automobiles and they import another variety. In contrast, IIT between Mexico and NAFTA is constituted mainly by two-way trade in quality. Following the specialization process over the quality spectrum, Mexico exports a quality and imports another quality. Exterior countries to the regional block develop essentially one-way trade with a share superior to 60 %. Thus, we can assume that IIT is highly developed between member countries of regional blocks and that external countries favor inter-industry trade with NAFTA. It seems that for the automobile industry, the free trade agreement accompanied with the geographic proximity may have a decisive effect on the pattern of trade.

The main results of our regressions highlight the great importance of the country-specific variables, especially, following the theory; the criteria of market size and standard of living seem to play a key role. Moreover, the market

structure seems to have a negative impact on the horizontal intra-industry trade. The regional integration seems to have an important and significant impact on the nature of trade for NAFTA. Nevertheless, the estimation of the free trade agreement can be improved in future studies by bringing into play variables such as tariff and non-tariff barriers.

REFERENCES

- Abd-El-Rahman K.S., 1986, "Réexamen de la définition et mesure des échanges croisés de produits similaires entre les nations", *Revue Economique*, n° 1, Paris.
- Aturupane C, Djankov S., Hoekman B., 1999, "Horizontal and Vertical Intra-Industry Trade between Eastern Europe and the European Union", *Weltwirtschaftliches Archiv*, Vol. 135, n° 1.
- Balassa B., 1986, "Intra-Industry Specialisation: a Cross-Section Analysis", *European Economic Review*, Vol. 30, n° 1.
- Balassa B., Bauwens L., 1987, "Intra-Industry Specialization in a Multi-Country and Multilateral Framework," *The Economic Journal*, n° 97.
- Bergstrand J., 1990, "The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bi-Lateral Intra-Industry Trade", *The Economic Journal*, n° 100, December.
- Berry T, Lopez de Silanes F., Grilli V., 1992, "The Automobile Industry and the Mexico-US Free Trade Agreement", *NBER*, n° 4152.
- Brander J.A., Krugman P., 1983, "A Reciprocal Dumping Model of International Trade", *Journal of International Economics*, 15 November.
- Carillo J., 2000, "The Integration of the Mexican Industry Automobile to the USA: between Policies and Corporate Strategies", *Actes du Gerpisa*, n° 28, February.
- Chudnovsky D, Lopez A., Porta F., 1996, "Intra-Industry Trade and Regional Integration, the Case of the Auto Industry in Argentina", CENIT.
- Clark D.P., 1993 "Recent Evidence on Determinants of Intra-Industry Trade", *Weltwirtschaftliches Archiv*, Vol. 129, n° 1.
- Falvey R.E., Kierzkowski H., 1987, "Product Quality, Intra-Industry Trade and Imperfect Competition" in Kierzkowski H. (ed.) 1987, *Protection and Competition in International Trade*, Clarendon Press, Oxford.
- Flam H., Helpman E, 1987, "Vertical Product Differentiation and North-South Trade", *American Economic Review*, n° 775.

- Fontagné L., Freudenberg M., 1997, "Intra-Industry Trade: Methodological Issues Reconsidered", *CEPII*, n° 97-01.
- Fontagné L., Freudenberg M., 1997, "Trade Patterns inside in the Single Market", *CEPII*, n° 97-07, April.
- Fontagné L., Freudenberg M., Périidy N., 1998, "Commerce international et structures de marché : une vérification empirique", *Economie et Statistiques*, n° 135.
- Globerman S., 1992, "North American Trade Liberalization and Intra-Industry Trade", *Weltwirtschaftliches Archiv*, Vol. 128, n° 3.
- Gordo E., Martin C., 1996, "Integracion economica, comercio intra-industrial y costes de ajuste", *Revista de Economia Aplicada*, Vol. IV, n° 12.
- Greenaway D., Hine R., Milner C., 1995, "Vertical and Horizontal Intra-industry Trade: a Cross Industry Analysis for the United Kingdom", *The Economic Journal*, n° 105, November.
- Greenaway D., Hine R., Milner C., 1994, "Country-Specific Factors and the Pattern of Horizontal and Vertical Intra-Industry Trade in the UK", *Weltwirtschaftliches Archiv*, Vol. 130, n° 1.
- Grubel H.G., Lloyd P.J., 1975, *Intra-Industry Trade*, The Macmillan Press Ltd., London.
- Helpman E., Krugman P.R., 1985, *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and International Economy*, MIT Press, Cambridge Mass.
- Hu X., Ma Y., 1999, "International Intra-Industry Trade of China", *Weltwirtschaftliches Archiv*, Vol. 135, n° 1.
- Krugman P.R., 1981, "Intra-Industry Specialisation and the Gains from Trade", *Journal of Political Economy*, Vol. 89, October.
- Krugman P.R., 1980, "Scale Economies, Product Differentiation, and the Pattern of Trade", *American Economic Review*, n° 70.
- Krugman P.R., 1979, "Increasing Returns, Monopolistic Competition and International Trade", *Journal of International Economics*, n° 9.
- Lassudrie-Duchêne B., Mucchielli J.L., 1979, "Les échanges intra-branche et la hiérarchisation des avantages comparés dans le commerce international", *Revue Economique*, 3, May.
- Linder S.B., 1961, *An Essay on Trade and Transformation*, John Wiley and Sons, New York.

- Lundberg L., 1992, "Economic Integration, Inter- and Intra-Industry Trade: the Case of Sweden and the EC", *Scandinavian Journal of Economics*, Vol. 94, n° 3.
- Martin J.A, Orts W., 2001a, "A Two Stage Analysis of Monopolistic Competition Models of Intra-Industry Trade", *Investigaciones Economicas*, Vol. 252.
- Mazerolle F., Mucchielli J.L., 1988, "Commerce intra-branche et intra-produit dans la spécialisation internationale de la France : 1960-1985", *Revue Economique*, 6 November.
- Menon J., Greenaway D., Milner C., 1999, "Industrial Structure and Australia-UK Intra-Industry Trade", *The Economic Record*, Vol. 75228.
- Nilson L., 1999, "Two-Way Trade between Unequal Partners: the EU and the Developing Countries", *Weltwirtschaftliches Archiv*, Vol. 135, n° 1.

**INTÉGRATION RÉGIONALE ET COMMERCE INTRA-BRANCHE :
UNE ANALYSE DES ÉCHANGES DU SECTEUR AUTOMOBILE
AU SEIN DE L'ALENA**

Résumé - Dans cet article, nous étudions le commerce intra-branche de l'industrie automobile au sein de l'Accord de Libre Echange Nord Américain. Nos résultats soulignent une hausse du commerce croisé de biens similaires depuis le début des années 1990. L'importance de ce commerce est évalué avec l'indice de Grubel et Lloyd (1973). Nous considérons uniquement le commerce intra-branche horizontal pour les biens finals et intermédiaires. Nous distinguons les biens qui sont différenciés par la qualité (différences de valeurs unitaires) et ceux par la variété (valeurs unitaires similaires). Nous cherchons donc à analyser la nature du commerce intra-branche et plus précisément à définir les déterminants au sein de cette industrie. Nous proposons un modèle gravitationnel qui intègre à la fois les variables spécifiques aux pays concernés et celles associées au secteur. La distance économique et la taille de marché ont une influence prédominante sur le commerce intra-branche horizontal. En outre, notre analyse économétrique confirme également le rôle significatif de l'intégration régionale sur l'intensité du commerce intra-branche.

**INTEGRACIÓN REGIONAL Y COMERCIO
ENTRE RAMAS DE INDUSTRIA:
UN ANÁLISIS DE LOS INTERCAMBIOS DEL
SECTOR AUTOMÓVIL EN EL TLC**

Resumen - En este artículo estudiamos el comercio entre ramas de la industria automóvil dentro del Tratado de Libre Comercio. Nuestros resultados muestran una aumentación del comercio cruzado de bienes similares desde el principio de los años 90. Evaluamos la importancia de este comercio con el índice de Gruber y Lloyd (1973). Consideramos sólo el comercio entre ramas horizontal para los bienes finales e intermediarios. Distinguimos los bienes que son diferentes por la cualidad (diferencia de los valores unitarios) y los que lo son por la variedad (valor unitario similar). Entonces Intentamos analizar la naturaleza del comercio entre ramas y más precisamente definir los determinantes dentro de esta industria. Proponemos un modelo gravitatorio que integra no sólo los variables específicos a los países implicados y los asociados al sector de actividad. La distancia económica y el tamaño del mercado influyen mucho en el comercio entre rama horizontal. Además nuestro análisis econométrico confirma también el papel significativo de la integración regional sobre la intensidad del comercio entre rama.