Horizontal and Vertical Intra-industry Trade

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Abstract

From the beginning of the 1980s, the first theoretical analysis of intra-industry trade showed that the determinants and consequences of this type of trade are different, depending on whether the traded products differ in quality. When the products are subject to intra-industry trade between two countries with distinct quality, this trade is vertically differentiated. Otherwise, it is called horizontal differentiation. There is a method for distinguishing intra-industry trade between two countries in vertical differentiation from those in horizontal differentiation. This method compares the unit value of exports to that of imports for each industry's intra-industry trade. It considers the intra-industry trading carried out in this industry as vertical differentiation when the unit value of exports differs significantly from that of imports.

Keywords: Intra-Industry Trade, Horizontal Differentiation, Vertical Differentiation

1 Introduction: Existing Approaches

From the beginning of the 1980s, the first theoretical analysis of intra-industry trade showed that the determinants and consequences of this type of trade are different, depending on whether the traded products differ in quality. When the products are subject to intra-industry trade between two countries with distinct quality, this trade is vertically differentiated. Otherwise, it is called horizontal differentiation. Abd-el Rahman (1986) proposed a method for distinguishing intra-industry trade between two countries in vertical differentiation from those in horizontal differentiation. This method compares the unit value of exports to that of imports for each industry's intra-industry trade. It considers the trade carried out in this industry as vertical differentiation when the unit value of exports differs significantly from that of imports.

The principle of comparing the unit values of exports and imports, introduced by Abd-el Rahman (1986), is used in most empirical work about separating intra-industry trade in vertical differentiation from horizontal differentiation. These works also use two different methods to measure intra-industry trade flows in vertical and horizontal differentiation: one proposed by Greenaway et al. (1994) and another developed by Fontagné et al. (1997). But These two methods measure intra-industry trade in two different ways. The first method is about the trade recovery approach (B-G-L) and the second one retains the type of trade approach (A-R-V). These two approaches are in Balboni (2007). Nevertheless, concerning the separation of exchanges in horizontal and vertical differentiation, the methods of Greenaway et al. (1994) and Fontagné et al. (1997) apply the same core idea due to Abd-el Rahman (1986), consisting of comparing the unit value of exports with that of imports.

2 Underlying Assumptions

The unit value of a trade flow indicates the ratio of its trade value to physical volume. Concerning the physical volume of trade, international trade statistics identify, for a set of categories of products, the number of products exported or imported, and for others, the weight of these products. The method proposed by Abd-el Rahman (1986) assumes that a significant difference observed at the level of a given industrial disaggregation between the unit value of exports and imports reflects a difference in quality between the products exported and those imported. On closer examination, this assumption comprises three nested hypotheses. Those are:

- Hypothesis 1: the unit value of exports (imports) observed in an industry reflects the average price of exported (imported) goods belonging to this industry.
- Hypothesis 2: the prices of goods exported by a given country and belonging to the same industry do not differ significantly. In other words, the dispersion of these prices around their mean is low.
- Hypothesis 3: the price of a product reflects its quality.

We now discuss these hypotheses and the issues related to each of them.

2.1 Discussion of Hypothesis 1

Among these hypotheses, the first is, from a theoretical and empirical point of view, the most robust. Nevertheless, we emphasize that the relationship between the unit value of a commercial flow and the average price of the products subject to this flow could not be strictly increasing, in particular in the following case. When, for a given industry, exchanges in volume are counted only in terms of weight, the unit value of the flows relating to this industry corresponds to the average price per ton of the items exchanged and not to their average unit price. In this case, if the prices of exported and imported goods are expressed by unit (and not by weight), a unit value of exports lower than that of imports will not necessarily reflect an average price of exported objects lower than that of products. imported. Greenaway et al. (1994) consider the following example. For some products, greater weight may imply greater impact resistance, i.e. longer life. Thus, the unit price of these products increases with their weight, reflecting the better quality of the heaviest objects62. In this context, it is possible that the products exported by a country are characterized by an average value per ton lower than or equal to that of the imported products, even if their average price is higher than that of the latter. This case may arise, in particular, when the country in question imports lighter and cheaper products (in terms of unit price) compared to the products it exports. Thus, the unit value of a commercial flow, when measured in terms of value per ton, is not a completely reliable indicator of the average price of the products subject to this flow.

We note that the comparison of unit values per ton of exports and imports can also provide biased information concerning the difference between the average prices of exported and imported products, in the opposite case to that considered by Greenaway et al. (1994). In some industries (for example, those corresponding to electronic products), generally, the lighter products represent higher prices (and quality) than those of the heavier products. In this case, the differences between the per tonne values of exports and imports are much more than the differences between the average prices of exported and imported products. In other words, the difference between the values per ton of exports and imports is, in this case, an "exaggerated" indicator of the difference between the average prices of the products subject to these trade flows.

2.2 Discussion of Hypothesis 2

Authors who use the unit value to separate intra-industry trade in vertical differentiation from horizontal one consider that all intra-industry trade observed in a given industry is either an exchange of horizontally differentiated products or vertically differentiated products. In the first case, the authors assume de facto that the exported products belonging to the industry considered have a quality similar to that of the imported products. In the second case, the exported products are either higher or lower quality than imported products.

Hypothesis 2 plays a crucial role in comparing unit values of two trade flows, and the relative quality of all the products subject to these flows. This reasoning develops from hypothesis 1 i.e., the unit value of a trade flow reflects the average price of the products covered by this flow, and ends with hypothesis 3, according to which the prices of the products reflect their quality. The sequence of these two hypotheses has thus connected hypothesis 2. The relevance of hypothesis 2 depends on the dispersion of prices of the exported or imported products around their average. The greater the standard deviation of

these prices, the less their average is significant as an index of the quality of exported (or imported) products in the industry considered.

When the prices of exported (or imported) products belonging to a given industry are very dispersed around their average, it is inaccurate to deduce the average price of exported products and imported products that the former is of a higher or lower quality than the latter. It is also incorrect to conclude that the exported products are similar in quality to the imported products. Indeed, whatever the difference between the average prices of exported and imported products, it is possible that given the significant standard deviation of individual prices, certain exported products (belonging to the industry considered) have prices substantially lower than those of certain imported products. While, other exported products (belonging to the same industry) have higher (or equal) prices than other imported products.

The problems raised by hypothesis 2, unlike those underlying hypotheses 1 and 3, are little debated by economists interested in measuring the relative quality of products subject to international trade. In general, when the very disaggregated classifications empirically define the industries, the products included in that same industry are relatively homogeneous between them. Therefore, the assumption is the prices of the different products belonging to the same industry and exported by the same country are not very dispersed around their averages. This assumption makes it possible to assume (when analyzing bilateral export and import flows relating to a given industry) that the unit value of each flow is a significant indicator of prices (and therefore of quality) of all the products subject to this flow. On this subject, the terminology used by Abd-el Rahman (1987) clearly shows that this author assumes a substantial qualitative homogeneity of the products subject to the same commercial flow. According to this author, a significant difference between the (average) export and import price "suggests that the exported product and the imported product correspond to different qualities" The expressions "exported product" and "imported product" prove that Abd-el Rahman (1987) does not take into account the possibility that the same commercial flow (exports or imports) includes varieties of products with prices (and therefore different qualities).

The potential heterogeneity of the products imported by a country in a given industry is even higher if we consider the multilateral trade of a country with different countries in the rest of the world instead of bilateral trade between two countries. Because, the prices of products (belonging to a given industry) imported from several countries are probably characterized by a higher standard deviation than that of the prices of products imported from a single country. Thus, the average price level of imported products is generally considered to be a more reliable indicator of the quality of imported products when they come from a single country, i.e. when bilateral trade is considered (Fontagné et al., 1997).

Given the potential heterogeneity of the products included in the same industrial classification, it is likely that the prices of products belonging to the same industry, exported by a given country, are sometimes very dispersed around their averages. This conclusion is more than a simple conjecture as it can be confirmed through an analysis of the prices of products listed under the same industrial category.

2.3 Discussion of Hypothesis 3

Hypothesis 3 is generally justified through the following arguments by Greenaway et al. (1994). On the one hand, in a context of perfect information for economic agents, when two varieties of the same product differ in quality, the higher quality variety is necessarily sold at a higher price. On the other hand, Stiglitz (1987) shows that even in the context of imperfect information, prices reflect the relative quality of differentiated products. However, economic theory suggests, on the one hand, goods vertically differentiated products are necessarily sold at different prices. Then it teaches, on the other hand, that horizontally differentiated products can also be sold at different prices. In fact, in the context of a monopolistic competitive or differentiated oligopoly market, the prices of differentiated goods of similar quality may be different in equilibrium.

In a monopolistic competitive market, such as that described by Chamberlin (1949), each producer has limited monopoly power, enabling him to set the price of his product above those practised by his competitors, without losing all its customers. In a duopolistic market where competitors produce a horizontally differentiated good, it is assumed that the demand functions addressed to the two firms are symmetrical, presenting the similar direct and cross-price elasticities and that the two firms have identical cost functions. In this context, if the two firms simultaneously determine the quantities produced or the prices, the equilibrium prices of the two goods will be identical. On the other hand, if one of the two firms is in a dominant position (which allows it to set its price, or its quantity, by knowing the reaction function of the other firm), the equilibrium prices of the two goods will be different.

We deduce that prices can be considered, at best, as imperfect indicators of product quality.

3 Empirical Approaches

The method initially proposed by Abd-el Rahman (1986) to separate intra-industry trade in vertical differentiation from those in horizontal differentiation was reformulated and simplified by this same author in later works (Abd-el Rahman, 1987, 1991). The basis of two versions of this method is on the comparison between the unit value of exports and that of imports. These unit values are calculated from bilateral trade flows and listed using very detailed industrial classifications. As we anticipated in the previous subsection, for each industry i, the unit value of exports (imports), denoted VUX_i (VUM_i), is calculated as the ratio between exports (imports) in trade value, denoted X_i (M_i) and exports (imports) in volume, denoted x_i (m_i).

$$VUX_I = \frac{X_i}{x_i} \tag{1}$$

$$VUM_i = \frac{M_i}{m_i} \tag{2}$$

The comparison between the unit values of exports and imports is established by calculating their ratio, which we note r_i:

$$r_i = \frac{VUX_i}{VUM_i} \tag{3}$$

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The idea underlying the method of Abd-el Rahman (1986, 1987, 1991) is that a ratio r_i close to 1 reflects a qualitative similarity of the exported and imported products belonging to the industry i. While that ratio r_i moving towards 0 or ∞. testifies to a qualitative difference between the products exported and those imported.

For each industry i, the ratio r_i is confronted with a norm to establish whether the intra-industry trade carried out in this industry must be considered as trade in horizontal or vertical differentiation. On this subject, the approaches followed by Abd-el Rahman (1986) and Abd-el Rahman (1987, 1991) are different. We present only the second method as it has established itself in the discipline of international trade as the reference method for separating the intra-industry trade into horizontal and vertical differentiation.

After separating the industries characterized by inter-industry (one-to-one) trade from intra-industry (crossed) trade, the method of Abd-el Rahman (1987, 1991) subsequently distributes the second group of industries into two sets. In the first set, the industries having the difference between the unit value of exports to imports is higher than an arbitrary threshold percentage, set by the author at 15%, are taken into account. In the second set, industries having the difference between the unit values of exports and imports is less than or equal to 15%. The trade carried out in those industries belonging to the first set is then considered as intra-industry trade in vertical differentiation, while the industries of the second set are defined as intra-industry trade in horizontal differentiation.

3.1 Arbitrary Threshold

The criterion proposed by Abd-el Rahman (1987, 1991) to separate industries carrying out intra-industry trade in horizontal differentiation from those in vertical differentiation is applied in two slightly different ways by Greenaway et al. (1994) and Fontagné et al. (1997). After defining an arbitrary threshold α (generally set at 15% or 25%), beyond which the difference between the unit value of exports and imports is considered to be signs of a difference in quality between the exported and imported products, these authors proceed as described below.

Greenaway et al. (1994) consider that the products traded in an industry i are horizontally differentiated when the following condition is maintained.

$$1 - \alpha \leq r_i \leq 1 + \alpha \tag{4}$$

Otherwise, they consider that the products traded in industry i are vertically differentiated.

Fontagné et al. (1997) notice that the right-side term of the condition (4) is inconsistent with the left-side one. This inconsistency increases with the value of the arbitrary threshold α. Taking condition (4) into account implies the possibility that trade in an industry (denoted i) for which the VUX_i/VUM_i ratio is equal to the VUM_j/VUX_j ratio of another industry (denoted j), is not considered to be similar (horizontal or vertical) as trade in the industry j. Whereas, it would be logical to attribute the similar nature to trade in both industries.

To illustrate this problem, we assume that the threshold α is set at 15%. For industry 1, the unit value of exports is equal to 1.16 and that of imports is equal to 1. Whereas, for industry 2, the unit value of imports is equal to 1.16 and that of exports to 1. In this context, the ratio between the price of export to import for industry 1 is identical to the

ratio between the price of import to export in industry 2. It would therefore be logical to attribute the same nature (horizontal or vertical) to the trade flows of these two industries. On the other hand, when condition (4) is taken into account, the intra-industry trade in industry 1 is considered as vertical differentiation, while that of industry 2 is defined as a trade of horizontal differentiation. Indeed, with the data of this example, the ratios r_1 and r_2 take the following values: $r_1 = VUX_1/VUM_1 = 1.16$; $r_2 = VUX_2/VUM_2 = 0.86$. Since $r_1 \in (0.85; 1.15)$ and $r_2 \in (0.85; 1.15)$, condition (4) is satisfied in industry 2 while it is not in industry 1.

Given the inconsistency inherent in the condition (4), Fontagné et al. (1997) consider that the products exchanged in an industry i are horizontally differentiated when the following condition is respected.

$$\frac{1}{1+\alpha} \leq r_i \leq 1+\alpha \tag{5}$$

When the condition (5) is not satisfied, these authors consider that the products traded in industry i are vertically differentiated. When taking into account condition (5) in the context of the numerical example developed above, the intra-industry trade of industry 2 is considered as an exchange of vertical differentiation, like that of industry 1. Indeed, according to the condition (5) (with $\alpha = 15\%$), the interval in which the ratio of unit values r_i must lie to attribute a horizontal nature to trade in industry i is $(0.87; 1.15)$. Consequently, the ratio $r_2 = 0.86$ does not belong to this interval, which implies the assignment of a vertical nature to the intra-industry trade carried out in industry 2.

3.2 Horizontal & Vertical Differentiation

We have seen above that Greenaway et al. (1994) and Fontagné et al. (1997) apply in two slightly different ways the criterion initially suggested by Abd-el Rahman (1987, 1991) for distinguishing industries performing intra-industry trade in horizontally differentiated products from those developing intra-industry trade in vertically differentiated products.

A more fundamental difference between the approaches proposed by Greenaway et al. (1994) and Fontagné et al. (1997) concerns how intra-industry trade flows are measured in horizontal and vertical differentiation and their respective shares in total trade. These approaches are based on two different measurement of intra-industry trade, presented and discussed in Balboni (2007): the approach of recovery of trade (B-G-L) and type of trade (A-R-V). Greenaway et al. (1994) adopt the B-G-L approach to the measurement of inter- and intra-industry trade, while Fontagné et al. (1997) apply the A-R-V approach (and more precisely the method proposed by Abd-el Rahman (1987, 1991) so to distinguish inter-industry (or one-to-one) trade from intra-industry (or crossed) trade. We also find that the "B-G-L" and "A-R-V" approaches are characterized by two different definitions of intra-industry trade.

The methods of Greenaway et al. (1994) and Fontagné et al. (1997) make it possible to measure the importance and the evolution of intra-industry trade in horizontal and vertical differentiation between two countries, are presented below. We denote these methods, respectively, GHM and FF. We present the approaches followed by these authors to measure the relative shares of intra-industry trade in horizontal and vertical differentiation in the total trade observed between two countries, in a group (denoted I) of n industries,

indexed by i. Here IIT_I, $HIIT_I$, and $VIIT_I$ are the respective shares of intra-industry trade, intra-industry trade in vertical differentiation (Vertical Intra-Industry Trade), and intra-industry trade in horizontal differentiation (Horizontal Intra Industry Trade) in the total trade observed in the group of industries I. As the GHM and FF methods break down intra-industry trade into two parts, trade in horizontal and vertical differentiation, the results obtained through these two methods always respect the following identity. $ITT_I = HIIT_I + VIIT_I$

4 Conclusion: Two Parts of Vertical Intra-industry Trade

We can add a step to the GHM and FF methods to divide the share of intra-industry trade in vertical differentiation (VIIT) into two parts. The first part corresponds to intra-industry trade flow when a country exports higher quality products than those imported; the second part refers to intra-industry trade for which a country exports lower quality products than imported products. These two sub-parts of the VIIT part are generally noted through the respective acronyms HQVIIT and LQVIIT. The acronym HQVIIT (LQVIIT) is the acronym for the expression of High Quality (Low Quality) Vertical Intra-Industry Trade.

First, following the GHM method, we define the set VIIT comprising the industries for which the ratio of unit values r does not satisfy the condition (4). Then, we distinguish, within this set, two groups of industries. The first, denoted HQVIIT, includes the industries for which $r_i > 1 + \alpha$. The second, denoted LQVIIT, includes the industries for which $r_i < 1 - \alpha$. Thus, in the industries of group HQVIIT, the exports of the country considered have unit values higher by at least $\alpha\%$ than the unit values of imports. Whereas in the industries belonging to group LQVIIT, the exports have unit values lower by at least $\alpha\%$ than imports. Finally, we calculate the respective shares of intra-industry trade carried out in these two groups of industries in the total trade of the set of industries. By construction, we then have $HQVIIT^{GHM} + LQVIIT^{GHM} = VIIT^{GHM}$, where $VIIT^{GHM}$ is the share of intra-industry trade in vertical differentiation measured by the indicator of Greenaway et al. (1994). Similarly, it is possible to divide intra-industry trade in vertical differentiation calculated using the FF method of Fontagné et al. (1997) into two parts, corresponding respectively to trade for which the exported products have a higher quality than the imported products and those for which the exported products are of lower quality than the imported products.

References

Abd-el Rahman, K. (1991). Firms' competitive and national comparative advantages as joint determinants of trade composition. *Review of World Economics*, 127(1):83–97.

Abd-el Rahman, K. S. (1986). Réexamen de la définition et de la mesure des échanges croisés de produits similaires entre les nations. *Revue économique*, pages 89–115.

Abd-el Rahman, K. S. (1987). Hypothèses concernant le rôle des avantages comparatifs des pays et des avantages spécifiques des firmes dans l'explication des échanges croisés des produits similaires. *Revue d'économie politique*, pages 165–192.

Balboni, A. (2007). *Le commerce intra-branche en différenciation verticale: Modélisation et mesures empiriques*. PhD thesis, Paris 9.

Chamberlin, E. H. (1949). *Theory of monopolistic competition: A re-orientation of the theory of value*. Oxford University Press, London.

Fontagné, L., Freudenberg, M., et al. (1997). *Intra-industry trade: methodological issues reconsidered*, volume 97. CEPII Paris.

Greenaway, D., Hine, R., and Milner, C. (1994). Country-specific factors and the pattern of horizontal and vertical intra-industry trade in the uk. *Weltwirtschaftliches archiv*, 130(1):77–100.

Stiglitz, J. E. (1987). The causes and consequences of the dependence of quality on price. *Journal of economic literature*, 25(1):1–48.