

# The Delimitation Between the Concepts Intra-Industry Trade and Inter-Industry Trade

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# The Delimitation Between the Concepts Intra-Industry Trade and Inter-Industry Trade

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**Abstract.** With a view to understanding the character of the foreign trade it is necessary to make a well-defined delimitation between the concepts intra- and inter-industry trade. The extent of intra-industry trade is smaller by a bilateral estimation than by a multilateral estimation. Correspondingly by a regional estimation in relation to an estimation on country level. Finally, there is not any reason to to adjust the Grubel-Lloyd index for a trade imbalance. The most pressing methodical problem is how narrowly a part of a product category, the two types of foreign trade have to be related to. If we relate the foreign trade to that part of a product category that includes foreign trade in quality varieties between countries with identical factor endowments, the intra-industry trade gets a much more substance. Thereby the inter-industry trade makes up a far larger share of the total foreign trade, than is normally assumed.

## I. INTRODUCTION

Uptil the 1960s the world was plain and simple regarding the understanding of those factors, which explain the trade between countries. The countries were assumed to produce and export products, which are intensive as regards those factors of production, the countries were abundant with, and import products, which are intensive as regards those factors of production, the countries were poor in. Hence, differences in the countries' factor endowments were the incentive for the foreign trade, which was characterized by inter-industry trade, i.e. one-way trade. The products were homogeneous and we had perfect competition. Centrally for the understanding of this trade were the contributions from Heckscher (1919) and Ohlin (1933), the so-called Heckscher-Ohlin model.

Since then the world is obviously no more so simple. Today 60% of the world trade is made up by the OECD-countries' mutual trade and is characterized by intra-industry trade, i.e. two-way trade, where we have both export and import of different varieties inside a differentiated product category. A central factor behind this type of trade is the single consumer's preferences regarding alternative product varieties. These preferences may be due to the wish of *partly* variation in the consumption (Dixit and Stiglitz, 1977) - the so-called "Love of Variety Approach" - and *partly* to get the product which best fulfils the characteristics demanded (Lancaster, 1979; 80) - the so-called "Ideal Variety Approach". In both models we assume monopolistic competition.

At identical factor endowments between two countries there is no inter-industry trade in differentiated goods, as there are no comparative advantages in this production. If, on the contrary, we have differences in the countries' factor endowments and if a capital-abundant country has a comparative advantage in the production of a differentiated good, the country does have the largest market share and will become a net exporter of this good. The part of the foreign trade, which is intra-industry, determines that each country specializes in part of the product group that is in the production of some of the good varieties. The remaining part of the foreign trade consists of the capital-abundant country's inter-industry export of this production to the labour-abundant country. Consequently it is a question about both intra- and inter-industry trade in differentiated goods. We thus get different shares of intra-industry trade, where this share indicates the part of foreign trade that is characterized by being intra-industry trade.

Grubel and Lloyd (1975) formulate the share of intra-industry trade as

$$\bar{B}_i = \frac{\sum_i (X_i + M_i) - \sum_i |X_i - M_i|}{\sum_i (X_i + M_i)} \quad (1)$$

$X_i$  and  $M_i$  are the value of the export respectively import inside product category  $i$ ,  $|X_i - M_i|$  is the net trade,  $(X_i + M_i)$  is the value of the total trade, and  $i = 1, 2, 3, \dots, n$ , where  $n$  is the number of product categories at the chosen level of aggregation. Accordingly, the part of foreign trade that is characterized by being inter-industry trade is the residual of equation (1).

The share of intra-industry trade for the seven most important countries in the OECD is shown in table 1. The table gives the impression that the intra-industry trade is increased in all the countries, and that the intra-industry trade in the end of the analysed period makes up a considerable part of the total foreign trade. This fact may imply the conclusion that the trade between the industrialised countries is dominated

by two-way trade conditioned by product differentiation. If so the Heckscher-Ohlin model is imputed a minor importance in the explanation of the trade between the industrialised countries.

*Table 1.* The share of intra-industry trade. 1970-1991. Percent.

	1970	1980	1991
USA	49,1	56,7	66,1
Japan	30,4	25,7	35,1
Tyskland	58,7	64,7	79,9
Frankrig	75,7	78,1	80,9
Italien	59,9	61,5	63,3
Storbritannien	65,1	76,0	81,3
Canada	52,5	55,9	61,4

Source: OECD, 1994.

Accordingly, a split of the foreign trade into intra-industry trade and inter-industry trade, respectively, gives an impression of those factors which are central for the foreign trade. Hence, it is of great importance that *the concept intra-industry trade is delimited sharply in relation to the concept inter-industry trade*. A central question in this connection is, how far a characterisation of the foreign trade as intra-industry trade, as for instance is an expression of table 1, gives the correct picture of the character in the foreign trade.

The purpose of this article is to draw attention to problems connected with the delimitation between the concepts intra- and inter-industry trade. The discussion is split into three subjects. The first subject is treated in section II and deals with problems connected with a statistically delimitation between intra- and inter-industry trade, whereas the second subject in section III is focused on the correct method of estimation of this delimitation. In section IV the last subject includes a discussion of how close a part of a product category, the two types of trade have to be related to.

## II. STATISTICALLY DELIMITATION BETWEEN INTRA- AND INTER-INDUSTRY TRADE

Problems connected with the choice of the level of aggregation, bilateral versus multilateral trade, regional versus national trade and the duration of the production season are in the following outlined shortly.

### *The Level of Aggregation*

Grubel and Lloyd (1975) find in their empirically analyses that a lower level of aggregation determines a smaller estimate of the share of intra-industry trade. This is of importance if we have to compare the index over different levels of aggregation. However, Grubel and Lloyd also find that the intra-industry *pattern of trade* remains intact, whereby analyses of differences among the industries are not sensitive to the chosen level of aggregation. We have corresponding results in Petersson (1987) and Clark (1993). Hence, the chosen level of aggregation does not have any implications, when we on the *same* level want to analyse the share of intra-industry trade over time or across countries.

Upturned, this discussion also indicates that there is a risk of overevaluating the extent of the intra-industry trade, the higher a level of aggregation, we chose. This fact becomes important in connection with an analysis of the character in the foreign trade, because of the fact that the lower the chosen level of aggregation is, the easier we are able to separate meaningfully the single factors behind the foreign trade, whereby the intra-industry trade appears in a more proper form. This relationship is object of discussion in section IV.

### *The Production Season*

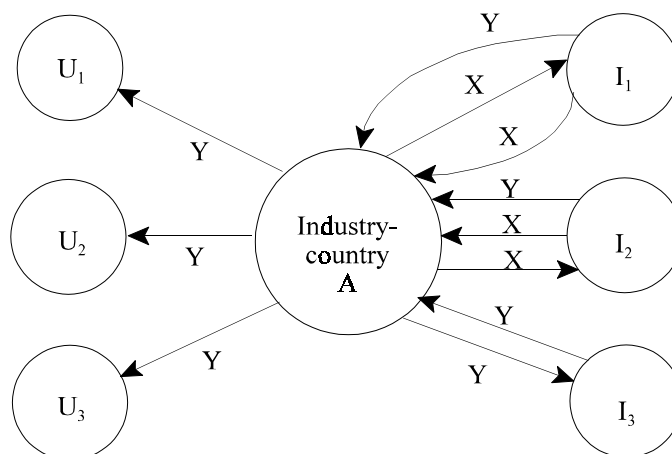
The delimitation between intra- and inter-industry trade depends on the duration of the production season, too. This applies to products as electricity, fresh fruit and vegetables. The production is in the peak season larger than the sale to the home market, and hence the surplus production is exported, whereas we have import for the rest of the year. That is that estimated on a *yearly* basis we have intra-industry trade in these products, and estimated on a *season* basis we have inter-industry export in the peak season and inter-industry import the rest of the year. Because the “raw material intensity”/“fruit intensity” is high in the peak season and low the rest of the year, we have a nature and season based *comparative advantage* in the production of these products. Hence, if the foreign trade is related to that time period, the production season makes up, the trade has character of inter-industry trade. Accordingly, the share of intra-industry trade becomes smaller, whereby an analysis on an yearly basis - that is an analysis related to a longer time period than the production season makes up - determines an *overevaluation* of the extent of the intra-industry trade.

### *Bilateral Versus Multilateral Trade*

The intra-industry trade is by a bilateral estimation *smaller* than by a multilateral estimation. This is illustrated in figure 1, where the industrialised country (A) is trading with three developing countries (U)

and three other industrialised countries (I) for to products, x and y.

Figure 1. An example of intra-industry trade flows.



Source: Based on Hansen (1988).

If the total foreign trade of the industrialised country is estimated, we have intra-industry trade in both product x and product y. If we split the total trade into trade with the developing countries and the industrialised countries, respectively, we only have intra-industry trade with the three others industrialised countries and only inter-industry trade with the developing countries. If we further split the foreign trade with the three industrialised countries into each country, we only have intra-industry trade in product y with the country I<sub>3</sub> and in product x with the countries I<sub>1</sub> and I<sub>2</sub>. The example illustrates that a multilateral estimation may disguise important circumstances that we are only able to uncover by a bilateral estimation.

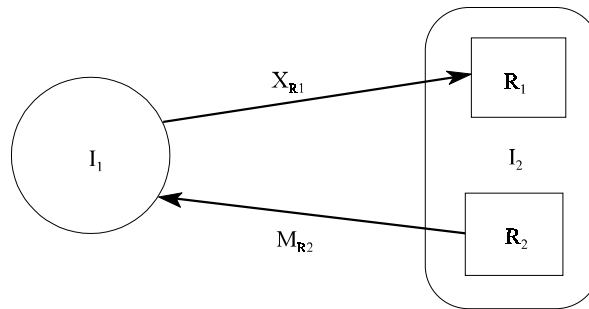
### *Regional Versus National Trade*

However, with a view to finding out the character in the foreign trade, it is not enough to analyse the intra-industry trade at the country level, because this level may disguise important regional differences. It may be differences as regards factor endowments or standard of living, which demand that the intra-industry trade *varies* over the analysed regions. The greater a country is, the more regions it constitutes, and accordingly the greater is the likelihood for regional differences. Hence we have the same problem as above.

We can think of several possible trade patterns between to countries' regions. With a view to illustrating the problem three interesting and representative cases are in the following selected. Through the cases we

have a continuously smaller difference between two of the countries regions. In figure 2 is illustrated the case, where we on the country level have pure intra-industry trade in a given product, whereas we on the regional level have pure inter-industry trade in that product.

*Figure 2.* On the country level pure intra-industry trade and on the regional level pure inter-industry trade

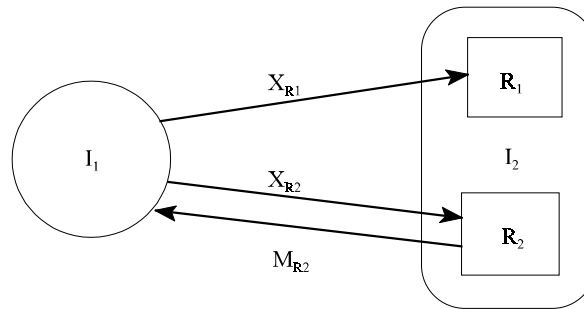


Note:  $I_1$  and  $I_2$  denote industrialised countries.  $I_2$  is the largest country and consists of the two regions,  $R_1$  and  $R_2$ .  $X_{R1}$  denotes the export from  $I_1$  to  $I_2$ , and  $M_{R2}$  denotes the import from  $I_2$  to  $I_1$ .

The trade between the two industrialised countries,  $I_1$  and  $I_2$ , is split into regions. We assume that country  $I_2$  is the largest country and that it consists of the two regions,  $R_1$  and  $R_2$ , whereas country  $I_1$  is so small that it only makes up one region. How far the countries are split up into a greater number of regions, is for the examples analytical relevance unimportant. The export from country  $I_1$  to country  $I_2$ ,  $X_{R1}$ , corresponds to the import from country  $I_2$ ,  $M_{R2}$ , whereby we have pure intra-industry trade on the country level. But the export from country  $I_1$  only goes to the one of country  $I_2$ 's regions,  $R_1$ , whereas the import comes from country  $I_2$ 's other region,  $R_2$ . Hence we have pure inter-industry trade on the regional level. As regards factor endowments or the standard of living - that is the economic level of development - , country  $I_1$  is on a level right between country  $I_2$ 's regions. Furthermore we have considerable difference in this level of development between country  $I_2$ 's regions, because no one of these regions have intra-industry trade with country  $I_1$ .

The case where we have pure intra-industry trade on the country level and pure inter-industry trade in relation to one region and intra-industry trade in relation to an another region is illustrated in figure 3.

*Figure 3.* On the country level pure intra-industry trade and pure inter-industry trade in relation to one region and intra-industry trade in relation to another region



Note:  $X_{R1}+X_{R2}$  denotes the total export from  $I_1$  to  $I_2$ . See also figure 2.

The total export from country  $I_1$  to country  $I_2$ ,  $X_{R1}+X_{R2}$ , corresponds to the import from region  $R_2$  in country  $I_2$ ,  $M_{R2}$ , and hence we have pure intra-industry trade on the country level. We have pure inter-industry export in relation to region  $R_1$ , whereas we have both intra-industry trade and inter-industry trade in relation to region  $R_2$ , and accordingly no pure intra-industry trade. This means that the pure intra-industry trade on the country level can be split up into both an inter-industry part and an intra-industry part. Again we see that the share of intra-industry trade is smaller on the regional level than on the country level. Regarding the economic level of development  $I_1$  is closer to  $R_2$  than was the case in figure 2.

Figure 3 can also be used to illustrate the case, where we have pure intra-industry trade between two regions, whereas the foreign trade on the country level consists of inter-industry trade, too. If the total export from country  $I_1$  to region  $R_2$ ,  $X_{R2}$ , corresponds to the import from this region,  $M_{R2}$ , we have pure intra-industry trade between these regions. In relation to region  $R_1$  we still have pure inter-industry export, and hence we do not have pure intra-industry trade on the country level. This means that even though we do not have pure intra-industry trade on the country level, this can cover the fact that we on the regional level have partly pure inter-industry trade and partly pure intra-industry trade. In that case the share of intra-industry trade is greater by an estimation on the regional level than by an estimation on the country level. The economic level of development in country  $I_1$  corresponds to the level in region  $R_2$ , and thereby we have a continuously smaller difference between  $I_1$  and  $R_2$  through the three cases.

The examples illustrates that an analysis of intra-industry trade on the country level may disguise important geographical differences on the regional level. Expressed in another way the data on the country



level become to aggregated, and this the greater the country is. Hence we ought not only to analyse the intra-industry trade bilaterally between the countries but bilaterally the countries regions, too.

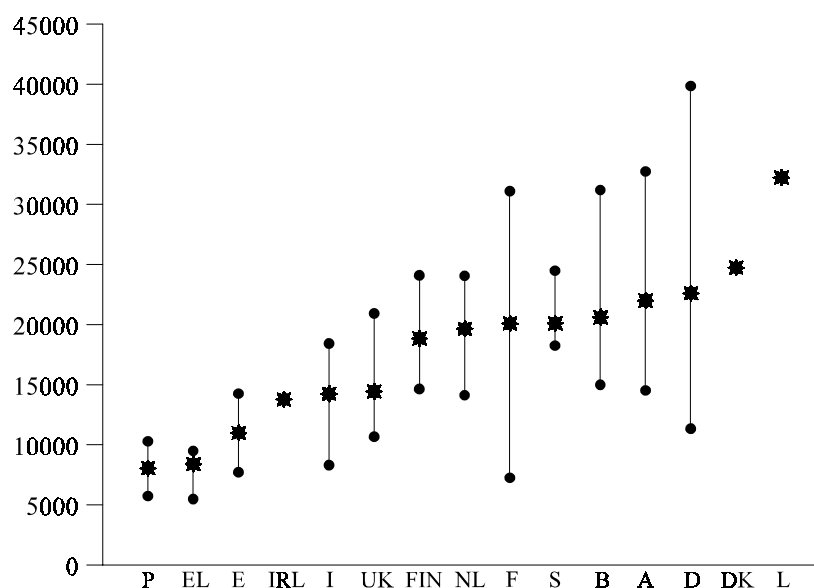
For example this delimitation is relevant when we want to analyse the intra-industry trade between the EUR15-countries. 12 of these countries are split into regions<sup>1</sup>, which for the most of the countries are characterized by great differences in the economic level of development. For example this applies to Italy, which is characterized by a rich north and a poor south, which corresponds to the illustrated case in figure 2. The regional dispersion in the economic level of development among the EUR15-countries is in figure 4 approximated by the dispersion in GDP per capita. The figure shows the GDP per capita for each country as a whole as well as the average GDP per capita in the country's poorest and richest region, respectively. The figure ranks the countries, from left to right, according to the GDP per capita for the country as a whole.

Denmark and Luxembourg have the highest level of GDP per capita, whereas Portugal, Greece and Spain constitute the relatively poorest countries in the EU. The spread in GDP per capita between regions is remarkable. The figure thus shows a large difference in GDP per capita between the richest and poorest regions in both Germany and France. Thus, standards of living in the richest region in Germany is above the standards of living in Luxembourg and Denmark. Similarly, the poorest region in Sweden is richer than the richest region in Spain. However, caution should be used when making such comparisons. The chosen division into regions may influence results significantly. If the division into regions is very detailed the likelihood of identification between very poor and very rich regions will be larger, and this will lead to the recording of a large regional spread in GDP per capita.

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1. The regional distribution follows the NUTS<sup>1</sup> classification. NUTS is derived from "The Nomenclature of Territorial Units for Statistics". Each NUTS<sup>1</sup> region consists of a number of NUTS<sup>2</sup> regions, and each NUTS<sup>2</sup> region in turn consists of a number of NUTS<sup>3</sup> regions. The small EU countries, Denmark, Ireland and Luxembourg, only make up one region at the NUTS<sup>1</sup> level. For a more detailed description of regional units in the EU, see Eurostat (1996).

Figure 4. High and low GDP per capita in ECU. Market prices. 1995.



Note: An asterix denotes the average GDP per capita, and dots denote highest and lowest GDP per capita

Source: Eurostat, Statistics in Focus - regions, 1998-1, Table 2, Authors calculations.

The approach is relevant by industry agglomeration, too. In this case we have clusters of firms inside a geographically bounded area, which are connected with the production of a given product. The probability for industry agglomeration is greater, the smaller the trade barriers are between the trading countries (Krugman and Venables, 1990, 95 and 96). Thereby economic integration creates the conditions for industry agglomeration and hence makes the capital-abundant countries more different. If an industrialised country specialises in the production of a capital intensive differentiated final good, we have inter-industry export in this good to both other industrialised countries and developing countries. Conversely we have inter-industry import of other capital intensive goods from the industrialised countries and inter-industry import of labour intensive goods from developing countries. The greater the clusters of firms inside a country are, the greater a share the inter-industry trade accordingly makes up of the total foreign trade, whereby the share of intra-industry trade *falls*. Hence, in this case a region has to be defined by such a geographical bounded area.

### III. TRADE IMBALANCE

According to Grubel and Lloyd (1975) an aggregate trade imbalance creates a biased downward measure

of the mean of intra-industry trade, and hence they adjust for this imbalance by expressing intra-industry trade as a proportion of total export plus total import less the trade imbalance. However, there is no agreement on how such an adjustment ought to be done, and because of that Aquino (1978), Balassa (1979 and 86) and Bergstrand (1983) has proposed alternative methods. In the following these methods are analysed and in this connection we evaluate, how far it is necessary at all to adjust for a trade imbalance.

#### *Adjustment for a Trade Imbalance*

Aquino (1978) simulates balanced trade by estimating what the values of exports and imports at the industry level would have been, if the total industry export corresponded to the total industry import. By that the effect of adjustment is equiproportional in each single industry. However, this equiproportionality has some disadvantages. Firstly, we can not assume that an accidentally estimated trade imbalance is consistent with a simulated expression for the size of the trade imbalance, and that the trade imbalance is distributed equiproportionally over all industries. Secondly, it is important to get analysed what actually happens on the industry level, because intra-industry trade among other things is a function of industry factors as increasing returns to scale, product differentiation and research and development.

Balassa (1979 and 86) adjusts the export- and importvalues at the chosen industry level for the total trade imbalance and not only for the industry trade imbalance. Thereby Balassa is trying to take into account the inter-industry specialisation between primary products and industry products. Thereby Balassa adjusts for the total trade imbalance, whereas Aquino only adjusts for the industry trade imbalance.

Bergstrand (1983) adjusts for a country's total trade imbalance, too, but contrary to Balassa he chooses to include the trade figures of the trading partner. Furthermore Bergstrand adjusts the actual trade figures in a manner that makes them a reflection of the isolated patterns of specialisation, whereby they are not influenced by the made economic policy. The disadvantage of Bergstrands adjustment is that we need data for the focus country, its trading partners, and the trading partner's other trading partners. Hence we have a very demanding procedure in terms of data processing.

#### *Do We Have to Adjust for a Trade Imbalance?*

The problem with an adjustment for a trade imbalance is, how far the patterns of specialisation meaningfully can be separated from the macroeconomics factors. Because of the fact that we do not have trade imbalance in the long run, it is inappropriate to adjust for a trade imbalance, if it is the *long-termed*

structural trade conditions, we wish to analyse. However it is doubtful that we in the long run have equilibrium on the industry trade balance. This becomes important for the adjusted indexes of Grubel and Lloyd and Aquino, which only adjust for an industry trade imbalance. We do not have any theoretical arguments for that we in the long run have industry trade balance and neither for that the economic policy is accommodated to this balance. Many countries have over long time periods an industry trade deficit and at the same time a surplus on the others balances of trade.

If we want to analyse the pattern of trade *in the short run*, it is doubtful whether it is appropriate to adjust for a trade imbalance at all. By inter-industry trade we normally look at the specialisation over industries in a certain time. If we look over several time periods, a trade imbalance may be an expression of a specialisation over time. A deficit on the trade balance may for example be caused by the fact that the country increasingly is specialising in the future production than in the present production. The problem becomes much more distinct, if the disequilibrium on the aggregated trade balance is a consequence of the fact that *the country* has a high degree of specialisation. A high degree of specialisation in the form of the fact that the country's export is concentrated on a few products or countries, may easily result in a trade imbalance, because the export provenu in that case is very unstable. If we for an example have a failing sale, this specialisation may result in a marked trade deficit.

Hence it is difficult to find sufficient arguments for an adjustment for a trade imbalance, and this in particular if it is not the long-termed structural trade conditions, we want to analyse. Accordingly, on these grounds the unadjusted Grubel and Lloyd index is the preferred index.

#### *A Comparative Empirical Analysis*

In the following we make a comparative empirical analysis of Grubel and Lloyds unadjusted and adjusted indexes and the adjusted indexes of Aquino, Balassa and Bergstrand. For that purpose we analyse the danish intra-industry trade with Germany, Sweden and Greece, respectively. The aim is to work out, partly how far the single adjusted Grubel-Lloyd indexes differ from the unadjusted Grubel-Lloyd index dependent on the chosen form of trade imbalance, and partly how far the single indexes varies together and thereby describes the same pattern of trade.

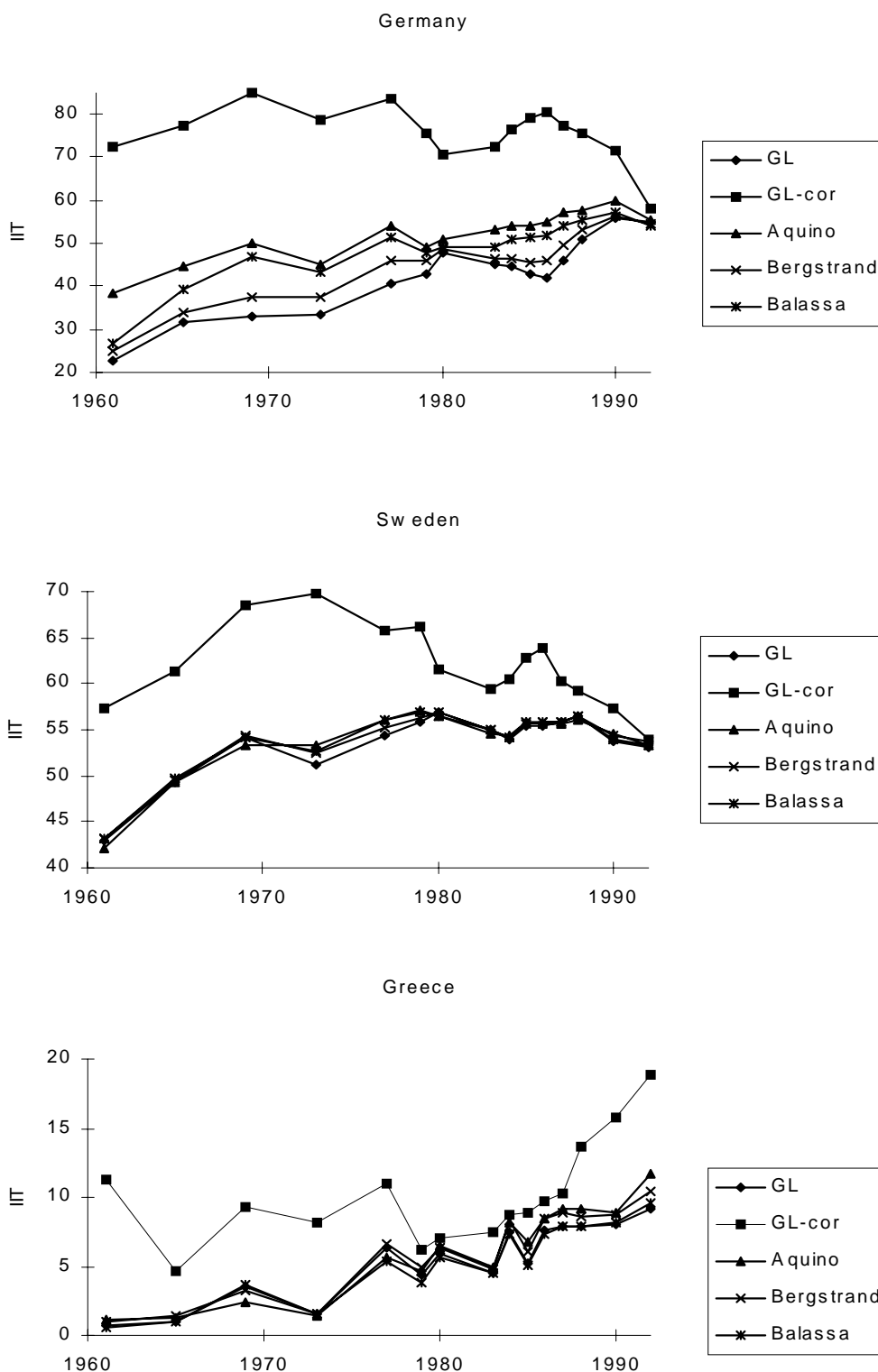
The choice of trading partner countries are in the case of Germany and Sweden due to their great importance for the danish foreign trade. Thus the trade with Germany makes up around 24% of the total danish foreign trade, whereas the trade with Sverige makes up more than 10%. The purpose in including

Greece in the analysis is to analyse how far the results are influenced by the fact that the indexes are estimated in relation to a country partly of a minor importance to the danish foreign trade, and partly at a considerable lower economic level of development than Denmark, Germany and Sweden (see figure 4). In this connection it can be stated that over 40% of the Greek employment is inside agriculture, and that the danish trade with Greece makes up only around 0.4% of the total danish foreign trade.

By the means of the five above mentioned indexes, figure 9 illustrates the development in the danish intra-industry trade with Germany, Sweden and Greece from 1961 to 1992. Two marked trends are immediately to observe. *Firstly*, we have a high degree of correlation between on the one side Grubel and Lloyds unadjusted index and on the other side the adjusted indexes of Aquino, Bergstrand and Balassa. Moreover these estimates are almost of the same value. *Secondly*, it is striking that the estimate by the use of Grubel and Lloyds adjusted index not only *differ markedly* from the other adjusted indexes, but also is *falling* through the analysed period. In this way the estimate at the beginning of the period is unrealistic high, in particularly for the trade with Germany and Sweden, whereupon the estimate is falling until the end of the period. So, besides that the share of intra-industry trade at the beginning of the period is unrealistic high *before* the industrial boom in the beginning of the 1960s, the estimate indicates that the intra-industry trade is reduced through the 1970s and 1980s to 1992, where for the periode as a whole it ought to be increased, as the others estimates indicates.

To receive an impression of the degree of correlation between the single indexes, the correlation coefficient two by two for all the indexes is estimated. The correlation coefficient is *at least 0.89*, and all estimates are significant different from zero. For the danish trade with Sweden and Greece is the coefficients almost or equal to 1. Furthermore there is no correlation between on the one side the adjusted Grubel and Lloyd index and on the other side the others indexes, and the estimates are not significant different from zero.

Figure 9. The development in Grubel and Lloyds unadjusted and adjusted index and the adjusted indexes of Aquino, Balassa and Bergstrand



Note: "GL-cor" denotes Grubel and Lloyds adjusted index.

Source: Authors calculations based on the IKE-database, Ålborg Universitet, Denmark.

Hence it appears that not all the different adjustments for trade imbalance have the intended effect. Because of that we analyse in the following, how the applied trade imbalances affect the single indexes. This is done by relating on the one side the single indexes' difference to the unadjusted Grubel and Lloyd index to on the other side the trade imbalance, which is corrected for. By that Grubel and Lloyds adjusted index and Aquinos index are related to the industry trade imbalance, whereas Bergstrands and Balassas index are related to the total trade imbalance. The industry trade imbalance is denoted "unequally fraction", and the total trade imbalance is denoted "total unequally fraction". The respective trade imbalances are expressed *relatively* for several reasons. Firstly, we get the same unit of measurement as by the intra-industry indexes. By that we obtain the advantage, the indexes have, too, because the development in the current prices are picked out. Finally, it is not sufficient to relate the indexes to the absolute value of a trade imbalance, because this imbalance has different implications on small and big economies, respectively. In table 2 is shown the coefficient of determination ( $R^2$ ) and the linear relationship between the single difference and the relevant relative trade imbalance.

*Table 2.* The difference to the unadjusted index and the relative trade imbalance

		Unequally fraction/total unequally fraction		
		Germany	Sweden	Greece
The difference between Grubel and Lloyds adjusted index and the unadjusted Grubel and Lloyd index	$R^2$	0,97	0,98	0,55
	Significance	0,01	0,01	0,14
	Slope	0,82	0,66	0,09
The difference between Aquinos index and the unadjusted Grubel and Lloyd index	$R^2$	0,85	0,05	0,09
	Significance	0,01	42,3	27,7
	Slope	0,27	0,02	-0,01
The difference between Bergstrands index and the unadjusted Grubel and Lloyd index	$R^2$	0,83	0,19	0,09
	Significance	0,01	10,2	26,6
	Slope	0,17	0,03	-0,01
The difference between Balassas index and the unadjusted Grubel and Lloyd index	$R^2$	0,89	0,07	0,44
	Significance	0,01	32,8	0,7
	Slope	0,45	0,04	0,01

Source: See figure 9.

The table shows that more than 97% of the variation in the difference between Grubel and Lloyds adjusted and unadjusted index in relation to Germany and Sweden is caused by the size of the relative industry trade

imbalance. We have a significant slope, which is considerable greater than the others slopes, why trade imbalances influence marketly on this difference. By that the the slope is around 7 times greater than by Bergstrands adjustment, and about 4 times greater than by Aquinos adjustment, whereas it is about twice as big as by Balassas adjustment.

Hence, again we see an indication of an overadjustment for a trade imbalance by the use of Grubel and Lloyds adjusted index. The difference between Grubel and Lloyds adjusted and unadjusted index react up to *7 times as powerful* on a trade imbalance as the others differences do. For the three others differences between 83% and 89% of the variation for the trade with Germany is caused by the size of the relative trade imbalances. Furthermore we have significant slopes, but on a considerably lower level than by Grubel and Lloyds adjustment. Especially by the use of Aquinos and Bergstrands adjusted indexes we have that the trade imbalance has a minor effect.

In relation to Sweden the relationship between on the one side the differences from Aquinos, Bergstrand and Balassas indexes, respectively, to Grubel and Lloyds unadjusted index and on the other side the respective relative trade imbalances is not significantly different from zero. This indicates that the differences can *not* be explained by the relative trade imbalance. For Aquinos and Bergstrands indexes the relationship is neither significantly different from zero in relation to Greece. Furthermore both Grubel and Lloyds and Balassas adjusted indexes in relation to Grubel and Lloyds unadjusted index has a significant but extremely little slope, and the development in the relative trade imbalance can only explain half of the differences in question. Hence we can conclude that neither in the light of *a comparative empirical* analysis we can find any reason to adjust Grubel and Lloyds index for a trade imbalance.

#### IV. FOREIGN TRADE IN DIFFERENTIATED PRODUCTS

As mentioned by way of introduction intra-industry trade is traditionally defined by both export and import of different varieties inside a differentiated product category. This applies to both qualitatively identical varieties, that is horizontally differentiated products, and qualitatively different varieties, that is vertically differentiated products. In this connection we have a problem, which in the available theoretical and empirical literature is insufficiently clarified. The problem is *divided into two parts* and concerns *partly* how horizontally and vertically differentiated products have to be delimited from each other, and *partly* how far foreign trade in vertically differentiated products is to be characterized as intra-industry trade or



inter-industry trade.

### *The Distinction Between Horizontally and Vertically Differentiated Products*

In newer empirically analyses as e.g. Abd-el-Rahman (1991), Greenaway et. al (1995) and Aturupane et. al (1999) - see Greenaway and Torstensson (1997) for a survey - the intra-industry trade is split into a part, which consists of horizontally differentiated products and a part, which consists of vertically differentiated products by the use of unitvalues in the export in relation to unitvalues in the import of a given product category. Relative minor differences between these unitvalues are taken as an expression of horizontal product differentiation, whereas relative large differences are taken as an expression of vertical product differentiation.

Usually vertically differentiated products are separated from horizontally differentiated products by a dispersion factor set to 15% or 25%. However, this is in a certain matter an arbitrary dispersion. The method has as a fundamental assumption that differences in the unitvalues reflect quality differences. The fact that we at all set a limit for how big the difference in the unitvalues have to be to reflect a quality difference, indicates that one thing is theory and another thing is practice, what this may imply of unprecise methods of estimation. That the method can be unprecise are pointed out by Greenaway and Torstensson (1997: 264-265), too.

In this connection differences in the unitvalues correspond to differences in the prices, and in a number of empirically analyses the relationship between price and quality has been analysed. Gerstner (1985) examines this relationship for consumer goods in USA by the use of various issues of "Buying Guide" from 1980 to 1982. The data set covers 145 products that are qualitatively ranked according to points based on laboratory tests, controlled-use tests, expert judgment of purchased samples, and user opinion surveys. The findings indicate that for many products the relation between quality and price is weak. The findings also indicate that quality-price relations are product-specific, with frequently purchased items displaying weaker relations than nonfrequently purchased items. In a time series analysis Curry and Riesz (1988) examines the relationship between price and quality for consumer durables in USA. They collected all comparative product test studies with five or more brands, excluding automobiles, reported in "Consumer Reports Magazine" from January 1961 through December 1980. 62 products were delimited as consumer durables, and of these, 41 are product forms for which 10 or more years of data are available and 21 are product forms for which less than 10 years of data are available. One of the findings is that the relationship between price and quality tend to correspond less strongly over time. Finally, Chang and Wildt (1996) examine the

relationship between price and perceived quality in a study of the goods apartments and personal computers, respectively. The findings indicate that the utilization of price as a quality cue diminishes in relation to the quantity and quality of intrinsic attribute information. Accordingly, we can conclude that price differences only are a rough indicator for quality differences.

We can alternatively ask the question: if differences in the unitvalues reflects quality differences, why then separate the products by a dispersion factor set to 15%? Where do we have to set the limit? Are we going to use the same dispersion factor by different types of products, or is the dispersion factor product dependent, too? Do we have to set a limit at all, if we find that differences in the unitvalues reflects quality differences? In the extreme case, where we do not set any limit, almost all differentiated products can be characterized as vertically differentiated!!! The point of view may be that it is not realistic that a number of product varieties functionally are identical, as a characterisation by horizontal product differentiation implies. This means that a product category, which is characterized by even minor quality differences can be characterized as vertically differentiated, too.

Greenaway et al. (1995: 1510) find that with a dispersion factor set to 15%, intra-industry trade in vertically differentiated products accounts on average for about *two-thirds* of the total intra-industry trade in UK trade. Using the broader wedge of 25%, intra-industry trade in vertically differentiated products turns out to be *as important as* intra-industry trade in horizontally differentiated products. Keeping the above mentioned reservations in mind it is striking how mayor a part of the intra-industry trade which consists of products with a dispersion factor set to 25%. The part of the intra-industry trade, which takes place in vertically differentiated products, thereby clearly dominates over the part, which takes place in horizontally differentiated products, and this the more, the lower the dispersion factor is set. This support the view that differentiated product categories mainly consist of qualitatively different varieties. Hence, *a considerable part of the intra-industry trade takes place in vertically differentiated products*. In the following section we discuss, how the foreign trade can be explained, and in this connection how far this trade has character of intra- or inter-industry trade.

#### *The Character in the Foreign Trade in Vertically Differentiated Products*

Linder (1961) is one of the first economist, who analyses the foreign trade in qualitatively different product varieties. Linder assumes that the preference structure is identical among the countries, and that the demand for quality inside a given product category is increasing with the income per capita. That is that a higher income per capita makes the consumers to change from traditional products to more sophisticated

products. The income per capita is determined by the capital intensity, thus the capital-abundant countries have a relative high income per capita, and the labour-abundant countries have a relative low income per capita. Thereby differences in the countries' income per capita are explained by minor differences in the countries' factor endowments. Furthermore Linder assumes that inside the single countries we have a certain dispersion in the income distribution.

Falvey (1981) and later by Falvey and Kierzkowski (1987) explain intra-industry trade in vertically differentiated products by differences in the countries' factor endowments. Capital-abundant countries produce and export high-quality varieties, whereas labour-abundant countries produce and export low-quality varieties. Hence a product variety's quality level is increasing with the capital intensity. It appears that we have a great similarity between Linders and Falveys explanations. Because of the fact that the income per capita, according to Linder, is determined by the capital stock, both Linder's and Falvey's explanation has a basis in the countries' factor endowments.

Furthermore Flam and Helpman (1987) show that an increased growth in the technological development determines that the capital-abundant countries introduces new high-quality varieties, whereas the labour-abundant countries omit to produce low-quality varieties. Those quality varieties, the capital-abundant countries in this connection omit to produce, are switched to the labour-abundant countries, whereby we have a technology transfer among the countries. In a similar analysis Davis (1995) finds that increasing returns to scale is not a necessary condition for intra-industry trade in vertically differentiated products, if we have differences in the technology among the countries. Finally, Murphy and Shleifer (1997) shows that a country, which is abundant with human capital, has comparative advantages in the production of high-quality products, and at the same time the country is rich enough to demand high-quality products, too.

Motta (1994) finds that the size of the country may have become important to the intra-industry trade in vertically differentiated products, too. We assume two countries, where increasing returns to scale determines that the large country has the lowest relative prices, the biggest income per capita and relatively are using the most resources in the industry production. By trading firms localised in the large country produce products of a higher quality than the rival firms in the small country. By small differences in the size of the country we have intra-industry trade in vertically differentiated products. Central to this conclusion is the countries' absolute endowment of human capital, because this endowment determines the production quality.

It appears that *the explanation of intra-industry trade in vertically differentiated products can be ascribed to a form of differences in the countries factor endowments*. That is that a country specialises in the production of those quality varieties, which are intensive as regards those resources, the country is abundant in. Hence, the trade can be ascribed to *comparative advantages in the production of these varieties*, and accordingly we use *the Heckscher-Ohlin model's way of thinking*.

That differences in the countries factor endowments explain the intra-industrial trade in vertically differentiated products, are supported by a number of empirical analyses. Among others Torstensson (1991, 96) finds that the positive relation between factor endowments and the quality of exports seems to be important in most industries. Moreover, it is not so much physical, but rather human capital that is positively related to quality.

However, it is problematic to characterise this trade as intra-industry trade. The intra-industry trade arises only when the trade between countries with differences in factor endowments includes the whole vertically differentiated product category. Inside the product category we have for a capital-abundant country inter-industry export of high-quality varieties to and inter-industry import of low-quality varieties from a labour-abundant country. Hence, we may also use the point of view that we have *inter-industry trade in quality varieties with different factor intensity ascribed to comparative advantages in the production of these varieties*. That is we have an inter-industry specialisation in the production of different product qualities as given by the Heckscher-Ohlin model. If the foreign trade can be ascribed to differences in the countries factor endowments, we use the same explanation in both inter-industry trade in homogeneous products and intra-industry trade in vertically differentiated products.

How far we have either intra- or inter-industry trade in vertically differentiated products depends upon how large a part of the product category the foreign trade is related to. If the foreign trade is related to that part of the vertically differentiated product category, which consists of trade in quality varieties between countries with *identical* factor endowments, the intra-industry trade gets much more substance. Thereby the inter-industry trade makes up a considerably larger part of the total foreign trade, than is the expression of e.g. table 1. This fact is consistent with section II, where a lower level of aggregation determined a smaller estimate of the share of intra-industry trade.

As an alternative to state that the inter-industry trade through the recent years is reduced and replaced by

an increase in intra-industry trade in different qualities of the same product, we can say that the intra-industry trade is *roughly unchanged*, whereas it is the *composition of the goods, which is changed*. The inter-industry trade is changed from only to take place in traditional products to include qualitatively different varieties, too. The decisive point is not how far we have small or large differences in the countries factor endowments, but only that we have a difference. In relation to this point of view the increase in and thereby the implications of the intra-industry trade is overvaluated by the first mentioned statement.

Accordingly, intra-industry trade in vertically differentiated products is ascribed to other factors than the factor endowments, which are important to the income per capita. Such a factor is the participation rate, because of the fact that this rate varies a lot over countries with similar factor endowments. The reason for this is that the cultural conditions for how large a part of a countrys population, who wants to work is very different. For instance the participation rate in Denmark is about 20 percentage point higher than in Spain, and for women alone it is double as high. Furthermore the income per capita depends of the working time and climatically conditions. Identical factor endowments and production technology among the countries determines that wages and capital cost and hence the whole cost structure is identical. Hence, which countries, who produce which varieties on the single quality levels, are accidentally.

Hence, with a view to analysing the character in the foreign trade it is necessary to definere the concept intra-industry trade sharply in relation to the concept inter-industry trade. *Intra-industry trade* only occurs between countries with identical factor endowments and is characterized by two-way trade in both qualitatively identical and qualitatively different varieties inside a product category.<sup>2</sup> By *inter-industry trade* we have one-way trade between countries with different factor endowments, and this in spite of wether the product category is homogeneous or vertically differentiated. For the vertically differentiated product category we have one-way trade in quality varieties inside the product category. The complex of problems is summarized in figure 11.

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2. Intra-industry trade in homogeneous products may occur by identical factor endowments, and is explained by market segmentation (Brander, 1981 and Brander and Krugman, 1983) and cross-border trade in tunge products (Grubel and Lloyd, 1975).

Figure 11. The trading partners factor endowments and the types of trade

Product category	Factor endowments	Type of trade
Horizontally differentiated	Identical	<i>Intra</i> -industry trade in qualitatively identical varieties
Vertically differentiated	Identical	<i>Intra</i> -industry trade in qualitatively different varieties
	Different	<i>Intra</i> -industry trade in the <i>whole</i> product category
		<i>Inter</i> -industry trade in quality varieties <i>inside the</i> product category
Homogeneous	Different	<i>Inter</i> -industry trade

Hence, we have two methodically problems connected with an analysis of the character in the foreign trade in differentiated products:

1. How do we have to delimitate horizontally and vertically differentiated products from each other? It appeared from the previous section that all differentiated product categories can be characterized as vertically differentiated, and hence make up a considerable part of the total foreign trade in differentiated products.
2. Should the foreign trade in vertically differentiated products be characterized as intra- or inter-industry trade? If this trade is ascribed to differences in the countries factor endowments, the trade can be characterized as inter-industry trade. Except that we do not have homogeneous products and perfect competition, but instead differentiated products and imperfect competition, we use the Heckscher-Ohlin model's way of thinking. The way of thinking has only become more nuanced.

Because of the fact that the main part of the differentiated product categories can be seen as vertically differentiated, and that the part of the foreign trade in vertically differentiated products ascribed to differences in the countries factor endowments can be characterized as inter-industry trade, the intra-industry trade makes up a far smaller share of the total foreign trade, than is the expression of e.g. table 1. Hence we do not have much room left for the intra-industry trade theory!

## V. CONCLUSION

With a view to understanding the character in the foreign trade it is necessary to make a sharp delimitation between the concepts intra-industry trade and inter-industry trade. Accordingly, the purpose of this article was to analyse the problems connected with the delimitation between these types of trade.

Together with the discussion about problems connected with a statistical delimitation between intra- and inter-industry trade we saw that a lower level of aggregation determines a smaller estimate of the share of intra-industry trade. The share of intra-industry trade is smaller by a bilateral estimation than by a multilateral estimation, too. Correspondingly by a regional estimation in relation to an estimation on the country level. The share of intra-industry trade becomes smaller, too, if it is related to that time period, the production season makes up. Finally, we concluded that there is no reason to adjust Grubel and Lloyds index for a trade imbalance.

The most pressing methodical problem was how narrowly a part of a product category, the two types of foreign trade has to be related to. If we relate the foreign trade to that part of a product category that includes foreign trade in quality varieties between countries with identical factor endowments, the intra-industry trade gets much more substance. Thereby the inter-industry trade makes up a far larger share of the total foreign trade, than is normally assumed. Hence, through the last 30 to 40 years two things has happened that make the problem far more nuanced, than in the traditional Heckscher-Ohlin model, but nevertheless do not shake the model's explanation force and hence the model's continued legitimacy:

1. The composition of the goods has changed from only to take place in a homogeneous capital intensive product and a homogeneous labour intensive product to include a large number of differentiated product categories. But we still have inter-industry trade in capital- and labour intensive products, respectively. Now a days the foreign trade takes place in qualitatively different varieties inside the single product categories, too.
2. The trade takes place partly between the industrialised countries and the developing countries and partly inside the industrialised country groups, where some of the countries are on a higher economic level of development than others. Even though there are small differences in the countries factor endowments, we have inter-industry trade in qualitatively different varieties between "more capital-abundant countries" and "less capital-abundant countries".

The discussed problems connected with the delimitation between the concepts intra- and inter-industry trade are summed up in figure 12.

*Figure 12.* Problems connected with the delimitation between intra- and inter-industry trade

<b>Delimitation by</b>	<b>Problem</b>	<b>Solution</b>
<i>Statistically categorisation</i>		
The level of aggregation	IIT becomes smaller at a lower level of aggregation	On the same level analyse IIT over time or across countries
The production season	On a yearly basis intra-industry trade and on a season basis inter-industry trade	Relate IIT to the duration of the production season
Countries	A multilateral estimation may disguise important circumstances on a country level	Analyse IIT bilaterally between countries
Regions	An country estimation may disguise important circumstances on a regional level	Analyse IIT bilaterally between the countries regions
<i>Estimation of IIT</i>	Trade imbalance	Estimate IIT using the unadjusted Grubel and Lloyd index
<i>Product differentiation</i>	The character in the foreign trade that is ascribed to differences in the countries factor endowments	Analyse IIT between countries with identical factor endowments

Note: "IIT" denotes Intra-Industry Trade.

The stated solutions determines that the intra-industry trade makes up a smaller part of the total foreign trade, than is normally assumed. As we at the same time found out that the Heckscher-Ohlin model still is the essential incentive in the explanation of the foreign trade, we do not have much room left for the intra-industry trade theory. The problem has only become more nuanced to include differentiated products and imperfect competition, too.



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