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Intra-Industry Trade by Types: What Can We Learn from Portuguese Data?

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Abstract: We provide evidence on intra-industry trade (IIT) in the Portuguese case from 1994 onwards by disentangling vertical from horizontal IIT with two different indexes—the Grubel–Lloyd and the so-called CEPII index—and analyse the determinants of both IIT types. Distinct explanatory factors are identified for each IIT type and we confirm the comparative advantage explanation in the vertical case. The regression results are robust to different estimation methods and to alternative IIT indexes. Nonetheless, sensitivity of the IIT levels to the arbitrary criterion of the CEPII measurement points out to the Grubel–Lloyd index as a preferable method. JEL no. F12, F14

Keywords: Intra-industry trade; product differentiation; unit values; comparative advantage; Portugal

1 Introduction

In the 1990s, research into intra-industry trade (IIT) received a significant stimulus with the development of a method, initially proposed by Abd-El-Rahman (1986), to empirically disentangle horizontal IIT (HIIT), associated with a differentiation in characteristics, from vertical IIT (VIIT), associated with a differentiation in quality. Since then, renewed interest has arisen in empirical research, not only in terms of evaluating the share of each IIT type in total trade, but also in order to discover whether the VIIT type of trade would be determined by the factor proportions explanation of comparative advantage instead of by the factors most frequently used, based on the standard monopolistic competition theory built to explain HIIT. This paper belongs to this line of research as it provides evidence about the nature of IIT in the case of Portugal, as well as the determinants of both the horizontal and vertical types of such trade.

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Measurement of IIT by types according to the method proposed by Abd-El-Rahman (1986) is usually incorporated into the traditional Grubel–Lloyd (G-L) index. However, an alternative method to the G-L one for disentangling inter- from intra-industry trade was also suggested by Abd-El-Rahman (1986) and later altered by Fontagné and Freudenberg (1997). We will name it the CEPII[1] index, due to the affiliation of these researchers to this institution. The fundamental difference between these two measurements of IIT is that the former is a trade-overlap method that draws the dividing line between inter- and intra-industry specialization within the product groups, while the latter is a trade-type method that draws the line between product groups. Studies on the subject have usually been confined to one or other of these indexes.[2] In this paper, we will use both indexes to evaluate the impact of the different measurements on the levels of IIT by types as well as on the regression results. Both the methodology used to divide HIIT from VIIT and the CEPII criterion used to divide inter- from intra-industry trade are based on two "thresholds" that are arbitrarily pre-defined. As such, we also test the sensitivity of our results to different cut-off levels.

The remaining part of the paper is organized as follows. In Section 2, we undertake a short review of the most relevant theoretical contributions that support our empirical modelling of IIT by types and present the methodology used to measure IIT. In Section 3, we focus on the Portuguese case from 1994 onwards, showing the evidence available about the various types of IIT. Section 4 analyses the determinant factors of vertical and horizontal IIT with a cross-country and a cross-industry model. We end with some concluding remarks.

1 Centre d'Études Prospectives et d'Informations Internationales.

2 An exception is Gullstrand (2002), but the purpose of his study is to analyse a HIIT-type model.

2 Theoretical Guidelines and Measurement

2.1 Theoretical Guidelines

The earlier and most widely used models for IIT concentrate on horizontal differentiation. Modelled for a context of monopolistic competition, they underline the major role of scale economies and horizontal differentiation.[3] Later on, Eaton and Kierzkowski (1984) introduced horizontal differentiation into a context of oligopoly; assuming the existence of two identical economies and, in each of them, two groups of consumers with a different "ideal variety", international trade leads to the existence of only one producer for each of the ideal varieties in each market, which gives rise to IIT.

The main reference for vertical differentiation is the model developed by Falvey (1981), complemented with the demand-side modelling of Falvey and Kierzkowski (1987). The supply side is elaborated in the context of comparative advantage theory, with product quality being linked to capital intensity in production. On the demand side, although all consumers have the same preferences, each individual demands only one variety of the differentiated product, which is determined by their income. Higher-income consumers acquire higher-quality varieties, while different income levels in each economy guarantee that there is a demand for every variety produced. Intra-industry trade arises because each variety of a differentiated good is produced in only one country but is consumed in all countries. In a two-country world, the country which is relatively labour-abundant will tend to export the labour-intensive (lower-quality) varieties demanded abroad by low-income consumers and to import the capital-intensive (higher-quality) varieties demanded in that country by higher-income consumers. Thus, IIT will be greater, the greater the factor endowments differences are in the two countries (which correspond to per-capita-income differences, in the context of the model). The model also suggests that IIT is positively correlated with the degree of income distribution dissimilarity between the trading countries.[4]

A less popular explanation of VIIT is provided by the Shaked and Sutton (1984) model, built for an oligopoly context. They assume that the quality

[3] Krugman (1979), followed among others by Dixit and Norman (1980) and Krugman (1980), adopted the predominant "love of variety" approach; alternatively, Lancaster (1980), followed by Helpman (1981), considered the "ideal variety" approach.
[4] See, for instance, Martín-Montaner and Ríos (2002).

of a product depends on R&D, which is reflected in the fixed costs, and, because of this, it is usually inferred that the model is better suited to high-technology sectors. On the demand side, as in the previous model, consumers who have a higher income will demand goods of a higher quality. With trade openness, average cost decreases, due to scale economies, and R&D profitability increases. With the firms that remain competitive located in different markets, VIIT will occur with a widespread increase in the quality of the traded varieties. If the average variable costs increase moderately with quality improvement, this model will lead to a "natural" oligopoly.

Three relevant theoretical implications for our empirical work should be highlighted from this literature. Firstly, IIT can be derived under different market structures. Both "large numbers" models and models designed for a high degree of market concentration are valid for explaining HIIT, even if there is theoretical support for the view that markets with a large number of firms are more likely to be conducive to HIIT.[5] The theoretical results of the impact of market structure are more equivocal in the presence of VIIT: if the neo-Heckscher–Ohlin–Samuelson (HOS) setting is valid, a structurally competitive market is the corresponding context, but the natural oligopoly model also supports this type of trade.

Secondly, the main theoretical references focus on variations across industries in bilateral trade. However, in empirical terms, one focuses either on IIT across countries, i.e. the IIT of one country with each (bilateral) partner, without disaggregating this at the sectoral level or, alternatively, on the IIT of one country with the "rest of the world", i.e. taking multilateral trade into consideration, disaggregated by sector. The implicit assumption in the former model is that the determinants of differences in IIT between countries are an aggregation of the industry characteristics considered in the theory.[6] For instance, it can be posited, as in Loertscher and Wolter (1980), that the larger the economy, the greater the opportunities for scale effects are, and hence the higher IIT should be. However, on the one hand, as Havrylyshyn and Civan (1983: 117–118) have clearly pointed out, aggregation may introduce countervailing effects; on the other hand, expected impact is even more difficult to grasp if there are cross-country differences in the effects of sectoral characteristics (so that bilateral imports and exports are affected asymmetrically), as is usually the case. As far as the latter model

[5] Lancaster (1980) argues that IIT will be at a maximum under conditions of "perfect" monopolistic competition.
[6] In regard to this particular subject, see Havrylyshyn and Civan (1983: 117–118).

is concerned, it implicitly assumes that the sectoral characteristics of the country analysed are an average of the sectoral characteristics of the partner countries.

Thirdly, as far as the determinant factors of IIT are concerned, it has generally been accepted that, except in the case of the factor proportions model for VIIT, scale economies and product differentiation are necessary conditions for IIT. However, not even monopolistic competition models allow us to predict a continuous positive relationship with IIT. This will depend on the nature of the products, the size of the total market and the minimum efficient scale of production (Greenaway and Milner 1986: 122).[7] If the possibility of multi-product firms (firms which produce a number of varieties of a particular commodity) is considered, the presence of significant fixed overhead costs may not only create opportunities for profitable new varieties in the form of new firm entry but also for the entry of multi-product firms under the incentive of spreading fixed overhead costs across a number of varieties, and "as the domestic market power of incumbent firms increases and the scope and incentive for entry-deterring strategies (via pricing and product range decisions) increases, then the impact on 'foreign entry' and the extent of IIT becomes less predictable" (Greenaway and Milner 1986: 112).

These theoretical implications point to the ambiguity of some expected signs and justify the choice of a probabilistic (qualitative dependent variable) model (the Probit model) as a complement to the more standard specifications. The probabilistic model appears to be more adequate whenever we expect to discover a relationship between the phenomenon we are analysing—the volume (share) of intra-industry trade types—and its determinant factors, although the way in which the explanatory variables impact is not known a priori.

2.2 *Measurement of Vertical and Horizontal IIT*

In order to disentangle the different types of intra-industry trade, one uses the *product similarity criterion*, based on the ratio between the unit value of exports (UV(X)) and the unit value of imports (UV(M)). It is therefore a matter of calculating $a = UV(X)/UV(M)$, and the IIT type will be horizontal[8] if $a \in]1/(1+\alpha), 1+\alpha[$ and vertical if it does not belong to

[7] Ethier (1982: 390) reached a similar conclusion regarding trade in intermediate goods.

[8] The following range was also used by Fontagné and Freudenberg (1997).

that interval. In turn, the vertical IIT can be considered vertical superior if $a \in [1+\alpha, +\infty[$ or vertical inferior if $a \in [0, 1/(1+\alpha)]$. The parameter α is an arbitrarily fixed dispersion factor (usually equal to 0.15). If, for instance, $\alpha = 0.15$, in the case of HIIT, the assumption is that transport and freight costs alone are unlikely to account for a difference of any more than 15 per cent in the export and import unit values. Otherwise, quality differentiation will predominate and intra-industry trade will be of a vertical type. The value of 0.15 was considered too low in several similar studies—only the difference between CIF (for imports) and FOB (for exports) is estimated to be 5 to 10 per cent on average—which also led us to use the alternative value of 0.25 for α.

Instead of the range $]1/(1+\alpha), 1+\alpha[$, we could have opted for the widely disseminated alternative: $](1-\alpha), 1+\alpha[$. The reason for preferring the former is that, in the case of the latter, a product that is classified as vertical superior may be classified as horizontal (instead of vertical inferior) if the ratio of the unit values is inverted (as would occur, for instance, if UV(X) were equal to 1.16 and UV(M) were equal to 1).[9]

The basic assumption of the above-mentioned criterion is that prices (unit values) are considered as quality indicators of goods. The relationship between price and quality is supported by the idea that in a perfect information context a certain variety of a good can only be sold at a higher price if its quality is higher. However, even in a context of imperfect information, quality will be reflected in prices (Stiglitz 1987). In spite of criticism of the unit value proxy—in the short run consumers may buy a more expensive product for reasons other than quality—this approach has become widely accepted.[10]

The product similarity criterion has been applied to the traditional G-L index since Greenaway et al. (1994).[11] Alternatively, it can be applied to the CEPII index, which uses a different criterion for separating inter- from intra-

[9] The magnitude of the difference between the two alternative ranges will depend on the number of sectors (and respective trade volume) with $a \in [(1-\alpha), 1/(1+\alpha)[$. In the case of Portugal if, for instance, we consider the multilateral trade in the year 2000, and assume that $\alpha = 0.25$, the share of HIIT in total trade would be 21 per cent (instead of 19.3 per cent) using the G-L index and 31.1 per cent (instead of 27.7 per cent) using the CEPII10 index.

[10] Unit values of two bundles may also differ if the mix of products differs, so that one bundle may contain a higher proportion of high unit value items than the other. Increased disaggregation is the usual response to this drawback.

[11] See, for instance, Blanes and Martín (2000) and Mora (2002).

industry trade.[12] The criticism of the G-L formula is the fact that it is based on the concept of "trade overlap",[13] measuring, in this way, the proportion of the overlapping of exports and imports in total trade. As such, there is a dividing line within the majority flow (of either exports or imports) that can be explained by two different conceptual approaches: the part of the majority flow that exceeds the "overlap" is related to inter-industry trade and explained by comparative advantage theories, while the other part is based on IIT theories. The CEPII index rejects the above-mentioned dividing line within the product group and proposes alternatively that, in the event of there being a minimum pre-defined overlap between the two flows (usually 10 per cent), both will be considered, in their totality, as being part of the intra-industry trade type. Otherwise, we will have inter-industry trade. In any case, both exports and imports of a product group will always belong to the same trade type.

The 10 per cent criterion of the CEPII index for separating inter- from intra-industry trade is, however, questionable (why not a different level?) and the choice of the value for this threshold interferes not only with the division between inter- and intra-industry trade but also with the separation of the various IIT types.[14] As an alternative, we will use a higher value (20 per cent) for the minimum overlap, with the two measures being named CEPII10 and CEPII20, respectively. The product similarity criterion for the purpose of measuring the various IIT types will thus be applied not only to the G-L index but also to the CEPPII10 and CEPII20 indexes. As such, we will have a test of the sensitivity of our results not only to the use of the CEPII index as an alternative to the traditional G-L one, but also to the use of the cut-off (overlapping) criterion of the CEPII index.

3 Levels of Portugal's IIT: Multilateral and Bilateral

The empirical analysis of the IIT levels will be developed at the 6-digit level of the Combined Nomenclature (CN). Thus, we will consider all the products at the 6-digit level of the CN which, according to the Portuguese Classification of Economic Activities (CAE)[15], are classified as manufactur-

[12] For an application of the product similarity criterion to the CEPII index, see European Commission (1996) and Fontagné et al. (1998).

[13] In fact, the G-L index is the ratio of twice the minimum flow over total trade.

[14] See Nielsen and Lüthje (2002) for a discussion of this subject.

[15] At this level of disaggregation, CAE is equal to NACE.

ing industry sectors. In total, we consider 4,706 products. A major problem of the unit value approach is that the construction of import and export price data necessarily involves the so-called categorical aggregation problem: some categories contain goods that, though similar, are not varieties of the same good. Therefore, as pointed out by Durkin and Krygier (2000), different prices may partly reflect differences in the product mix in addition to differences in quality, and some horizontally differentiated trade will be misclassified as vertically differentiated. The 6-digit level is considered a rather refined product group for minimizing this bias, as proposed for instance by Gullstrand (2002) or Mora (2002).

In the cross-industry analysis, the 6-digit product categories were aggregated to the 3-digit CAE.[16] The full sample covers 103 industries. The source for trade data is INE (Instituto Nacional de Estatística), *Estatísticas do Comércio Externo*.

Table 1 shows the main results concerning IIT for Portuguese trade with the rest of the world according to the application of the product similarity criterion of 15 per cent to the G-L and CEPII10 indexes.

Table 1: *Types of Trade: G-L and CEPII10 Indexes (per cent of total trade)*

	Vertical			Horizontal	IIT	Inter
	superior	inferior	total			
1994						
G-L	6.2	13.0	19.2	10.1	29.3	70.7
CEPII10	10.5	22.3	32.7	18.0	50.7	49.3
1996						
G-L	7.1	13.7	20.8	12.2	33.0	67.0
CEPII10	12.3	23.1	35.4	21.4	56.8	43.2
1998						
G-L	7.6	13.7	21.3	14.0	35.3	64.7
CEPII10	12.8	23.5	36.3	20.4	56.7	43.3
2000						
G-L	13.3	13.2	26.5	12.1	38.6	61.4
CEPII10	20.1	21.5	41.6	17.9	59.6	40.4

The first aspect to be noted is the clearly higher share of IIT when measured with the CEPII index, which may be explained by the low value

[16] The conversion between CN and CAE was provided by INE.

(10 per cent) used to identify this type of trade. However, the overall trend is similar with both measures. Throughout the 1990s, there was clearly an important increase in the relative share of IIT. VIIT shows itself to be the most relevant IIT type. In fact, measured by the CEPII index, it represents 41.6 per cent of total trade (69.8 per cent of total IIT) in 2000. The predominance of vertical IIT increases between 1994 and 2000, a result that is in line with some recent studies.[17] We tried to confirm the robustness of this conclusion by raising the value for the parameter α chosen to distinguish vertical from horizontal IIT ($\alpha = 0.15$) to one that was more favourable to horizontal IIT ($\alpha = 0.25$). Nevertheless, even so, when the CEPII10 index is used, VIIT clearly predominates in 2000. When the G-L index is considered, VIIT and HIIT have the same share of total trade.

To ascertain more clearly which of the two types of vertical IIT is dominant, we also investigated the quality of exports and imports. Table 2 shows the results of this analysis.

Table 2: *Types of Vertical IIT: G-L and CEPII10 Indexes (per cent shares in total VIIT)*

	Vertical superior IIT	Vertical inferior IIT
1994		
G-L	32.3	67.7
CEPII10	32.1	67.9
1996		
G-L	34.1	65.9
CEPII10	34.7	65.3
1998		
G-L	35.7	64.3
CEPII10	35.3	64.7
2000		
G-L	50.2	49.8
CEPII10	48.3	51.7

The results obtained with both methodologies are quite similar. The most relevant aspect is the progressive increase in vertical superior IIT. With the G-L index, vertical superior IIT even becomes the dominant type

17 See, for instance, European Commission (1996), Fontagné at al. (1998) and Mora (2002) for the European case, and Porto and Costa (1999) for Portugal.

of vertical IIT in 2000.[18] Disaggregating data by sector to the 2-digit level of the CAE nomenclature shows that, in the last year of our analysis, sectors with the highest values of IIT as measured by the G-L index were rubber and plastic products, metal products (except machinery and equipment) and motor vehicles, followed by furniture, other transport equipment and clothing, while vertical superior IIT predominates in the case of leather products, clothing, tobacco products and wood and cork products (except furniture). These results are also supported by the CEPII index even if the arrangement of sectors by IIT levels presents some differences, as is to be expected.

We also evaluated Portuguese IIT in bilateral terms, by considering the trade flows with Portugal's 53 main trading partners[19] in 2000. The results obtained with the G-L and the CEPII10 indexes are shown in the Appendix. Some features of these results are worth mentioning. Firstly, it appears that the geographically aggregated values of the previous tables overvalue IIT.[20] In fact, IIT is clearly lower when calculated at the bilateral level. This is an expected bias, as shown, for instance, if there is simultaneously an export and an import of the same product but with different trading partners. Secondly, the characteristics of bilateral trade differ depending on whether we are considering the EU partners or the other (non-EU) partners. In fact, with both indicators, IIT is, on average, higher in the former case. As far as the other partners are concerned, there is a global predominance of inter-industry trade. Thirdly, in all bilateral relationships with EU countries, vertical IIT is clearly predominant. Adopting $\alpha = 0.25$, this statement only ceases to be valid in the case of the United Kingdom when the G-L index is considered. Fourthly, in the case of Portugal's main trading partners (Spain, Germany and France)[21], vertical inferior IIT still predominates, mainly in the case of Spain (the most important of the three countries, representing 25.9 per cent of total Portuguese imports and 19.3 per cent of exports).

An empirically relevant evaluation relates to discovering whether the overlapping criterion of the CEPII index matters for our main results. We

18 We have concluded that this increase relates to products of major importance since the increase in vertical superior IIT is clearly higher in relation to the volume of trade than it is in relation to the number of products.

19 We included all countries whose trade flows (X and M) with Portugal exceeded PTE 2 billion, representing more than 95 per cent of total external trade.

20 A possible way to overcome this effect is to calculate the aggregated multilateral index as a weighted average of bilateral indexes.

21 The three countries together contribute to around 50 per cent of total exports and imports.

recalculated all the previous tables with a cut-off level of 20 per cent instead of 10 per cent (CEPII20 index) for the year 2000. Increasing this level means that we marginally increase the share of inter-industry specialization at product level. Table 3 allows for a comparison with the previous indexes for calculations at the multilateral level.

Table 3: *IIT Types: G-L, CEPII10 and CEPII20 Indexes (2000)*

	Vertical			Horizontal	IIT	Inter
	superior	inferior	total			
G-L	13.3	13.2	26.5	12.1	38.6	61.4
CEPII10	20.1	21.5	41.6	17.9	59.6	40.4
CEPII20	14.8	17.4	32.2	15.1	47.3	52.7

The results with CEPII20 are closer (than CEPII10) to those obtained with the G-L index (and IIT is obviously lower than with the 10 per cent level), showing that the distribution of the observations made in terms of the overlapping level must be skewed towards the 20 per cent cut-off level. Another notable result is the difference between IIT levels measured with the CEPII10 and CEPII20 indexes, as shown by the fact that IIT is 59.6 per cent when measured with the former and 47.3 per cent with the latter. A similar impact occurs at the bilateral level, the main examples of which are shown by the results with France, Belgium and Hungary. In the case of Spain, the main trading partner, IIT is 60.1 per cent with CEPII10, 49.4 per cent with CEPII20 and 34.6 per cent with the G-L index.

For the year 2000, we also calculated the correlation coefficients between these three alternative indexes, both in the case of multilateral trade (disaggregated by sectors to the 3-digit level of the CAE) and bilateral trade. We confirm that the results are, in both cases, more closely related in the case of the G-L and the CEPII20 indexes.

A problem that may be masked by the aggregated values presented above is that small variations in both the overlapping level of the CEPII index and the dispersion factor for separating horizontal from vertical IIT may lead a product to easily change its position either from inter- to intra-industry trade or from vertical to horizontal trade, as shown by Nielsen and Lüthje (2002) for trade between Germany and France. Only the G-L index is immune to this problem as far as the criterion used to separate inter- from intra-industry trade is concerned, since its method of calculation does not

involve an arbitrary choice. A rough picture of this problem of instability in terms of IIT-type classification is provided by the correlation coefficients for each IIT index between each of the two years of the following sub-periods: 1994–1996, 1996–1998 and 1998–2000. Calculations were made for multilateral trade disaggregated by sector to the 3-digit level of the CAE and these are shown in Table 4.

Table 4: *Correlation Coefficients between Different Years*

	G-L			CEPII10			CEPII20		
	1994–1996	1996–1998	1998–2000	1994–1996	1996–1998	1998–2000	1994–1996	1996–1998	1998–2000
IIT	0.738	0.797	0.819	0.651	0.782	0.826	0.491	0.599	0.778
Vertical IIT	0.525	0.698	0.612	0.524	0.699	0.674	0.339	0.577	0.663
Horizontal IIT	0.727	0.864	0.747	0.508	0.654	0.536	0.601	0.844	0.720

The most notable aspect is that correlations for the IIT levels are higher with the G-L index (except for 1998–2000, where the correlation with CEPPI10 is very similar). This difference was greater when IIT registered a higher increase, which occurred in the first two sub-periods, particularly in 1994–1996; i.e. precisely when the case for the lack of stability mentioned above was most evident. Moreover, when VIIT and HIIT are disentangled, apparently the shift of a product between the two IIT categories of trade is less pronounced with the G-L index in the same two sub-periods, as shown by the higher correlations for HIIT and VIIT with this indicator.

4 The Model

Based on the theoretical references relating to IIT and the regularities shown in other ad hoc empirical studies, we formulate some hypotheses on the impact of the factors considered relevant for explaining the share of intra-industry trade in the total trade of the manufacturing industry in the year 2000, disentangled according to the two types—horizontal and vertical. The regressions for IIT are calculated with each of the indexes considered above, even though only the results for the G-L and the CEPII10 will be presented. The sources used to build the variables are presented in the Appendix.

We analyse the industry and country characteristics associated with IIT using two distinct models. Alternatively, we could have introduced both national and industry-specific variables simultaneously into the same equation, as in Balassa and Bauwens (1988) or Blanes and Martín (2000). However, we are sceptical about the advantage of doing this if the observation for the industry (product) is the same for every country involved in each bilateral transaction, which has been the case in all studies undertaken so far. In fact, due to data requirements, both home and foreign country conditions relating to product and industry characteristics have been proxied with just home-country conditions in the equivalent industry (product) transaction for every country involved in bilateral transactions. Of course, separate estimations do not overcome this shortcoming but at least we do not have to explicitly attribute a value at the industry level for each bilateral transaction.

In the *cross-country analysis* we considered 46 countries[22] and the following variables:

Average GNP of Portugal and the trading partner (*Dim*). With this variable, we seek to express the average size of the markets. We expect a positive sign for both vertical and horizontal IIT, viewing international trade as an extension of the internal market, somewhat along the lines of the Linder hypothesis. Arguments for a positive relationship can also be formulated on the supply side, such as: the larger an economy, the greater the opportunities for scale effects (Loertscher and Wolter 1980) and, owing to economies of scale, the greater the equilibrium number of differentiated products (Lancaster 1980).

Difference between per capita income of Portugal and the trading partner (YD). As it is frequently used in the literature, we take this variable as a proxy for the difference in factor endowments, in line with the model developed by Falvey and Kierzkowski (1987). Assuming that the relative capital abundance is reflected in relative per capita income, the model suggests that the intensity of VIIT will be positively correlated with the per capita income differences between the trading partners. In the horizontal IIT model, we expect a neutral or a negative impact.

The absolute difference of the GINI index of income distribution between Portugal and the trading partner (*GINI*). Still following the model of Falvey and Kierzkowski (1987), we hypothesize that the potential for trade in varieties of a different quality will increase as the pattern of income distribution in the two countries grows further apart.[23] The predicted sign is positive in the VIIT model and negative for HIIT.

Interaction between GINI and YD (*GINI* × *YD*). We also include the interaction between the GINI variable and the per-capita-income difference (YD), in line with the work of Veeramani (2002). Theoretical inferences in this respect are not unequivocal and we leave the expected sign to be determined empirically.

Cost of posting merchandise weighing up to 1 kg to several economic zones (*Dist*). This is a proxy introduced by Lee and Lee (1993). It seems to represent the concept of "economic distance" in a more reliable way than the proxies usually used to evaluate this effect, which are more concerned with geographical distance. In fact, transport costs do not usually increase in a linear way with distance. We expect a negative sign for the two types of IIT.

Absolute difference in per capita expenditure on education between Portugal and the trading partner (*ED*). We consider this variable to be an indicator of the differential in development. Several factors, such as per capita income, market size and industrial structure, allow us to expect that IIT will show a strong positive correlation with the degree of economic development and industrialization, even if this correlation may not be a continuous one. Thus, we hypothesize that IIT is less likely to occur in countries with accentuated differences in terms of development (as Table A1 clearly shows for the Portuguese case) and, therefore, we expect a negative impact of this variable on both of the two IIT types.

Country dummies/Integration space. We include a dummy which assumes the value one if the partner country belongs to the European Union (EU). The empirical evidence shows that the level of IIT tends to be higher in integration spaces (particularly in Europe). We believe that this variable will have a positive sign for both vertical and horizontal IIT. Furthermore, in the HIIT model, we included two other dummies, NORWAY and TUNISIA, as a control for exceptional HIIT levels in the case of these bilateral relations.

22 The fact that the required information does not exist for all the independent variables forced us to reduce the sample in this way.

23 See Tharakan and Kerstens (1995) and Veeramani (2002) for a similar proxy.

In short, we estimate the following model for the cross-country analysis in view of the above hypothesis:

$$\text{VIIT}_p = f\big(\overset{+}{\text{Dim}}, \overset{+}{\text{YD}}, \overset{+}{\text{GINI}}, \overset{?}{\text{GINI} \times \text{YD}}, \overset{-}{\text{Dist}}, \overset{-}{\text{ED}}, \overset{+}{\text{EU}}\big) \quad (1)$$

$$\text{HIIT}_p = f\big(\overset{+}{\text{Dim}}, \overset{-}{\text{YD}}, \overset{-}{\text{GINI}}, \overset{?}{\text{GINI} \times \text{YD}}, \overset{-}{\text{Dist}}, \overset{-}{\text{ED}}, \overset{+}{\text{EU}}, \overset{+}{\text{Norway}}, \overset{+}{\text{Tunisia}}\big), \quad (2)$$

where VIIT_p and HIIT_p are, respectively, the share of vertical IIT and horizontal IIT in the total volume of bilateral trade between Portugal and country p in total manufactured goods. The signs expected for the coefficients are shown above the variables.

In the *cross-industry analysis* we considered the 3-digit level of manufacturing industries for multilateral Portuguese external trade and the following variables concerning the characteristics of the industries:

Similarity of the unit values of the products (varieties) included in each industry's exports (Dif):

$$\text{Dif}_i = \sum_{j \in i} [v_j \times \min(\text{UV}_{jp}, \text{UV}_{jp'}) / \max(\text{UV}_{jp}, \text{UV}_{jp'})], \quad (3)$$

where UV is the unit value of Portuguese exports to different trading partners (represented by p and p') and v_j is the share of product (variety) j in total Portuguese exports of industry i to which product (variety) j belongs. This measure was proposed by Blanes and Martín (2000).[24] The greater the similarity in an industry between the unit values of the variety exported to different countries (i.e. the greater the horizontal differentiation in that industry), the higher its value. This measure ranges from 0 to 1 and it tends towards zero as the difference in unit values increases, i.e. the more vertically differentiated an industry is. The expected sign is therefore positive for HIIT and negative for VIIT.

Share of non-manual work in total work (SL). This is an indicator of the extent of skilled labour in the sector. The expected impact depends on the relative abundance and intensity of skilled labour in the Portuguese case and is a matter of empirical evidence.

Share of the number of workers in firms with more than 100 workers in the total number of workers of the sector (SE). This is a proxy that is normally used to evaluate the effect of scale economies. Concerning HIIT, the expected sign for this variable cannot be brought forward clearly as several empirical studies have proved, even if most studies postulate a positive sign. As far as VIIT is concerned, the neo-HOS model explanation assumes the perfect competitive context and the exclusion of scale economies, thus precluding a positive impact.

Share of the sales of the 4 largest firms in the total sales of the sector (C4). This is the variable traditionally used to express the level of concentration of the market. Depending on the market structure, both signs can be expected. However, some authors have hypothesized that the possibilities for concentration can be expected to decline with differentiation of the product, and intra-industry trade will be negatively associated with industrial concentration.[25] If the comparative advantage explanation for VIIT (as expected in the case of Portugal) or the monopolistic competition context for HIIT predominates, the expected sign will be negative.

Number of firms in the sector (NF). This is a variable considered, for example, by Greenaway et al. (1995) and it aims to complement the information of the previous variable. The ambiguity still remains concerning the sign. However, in accordance with the expected sign for C4, we endeavour to posit a positive sign.

Taking these considerations into account, the following models were estimated for the cross-industry analysis:

$$\text{VIIT}_i = f(\overset{-}{\text{Dif}}, \overset{?}{\text{SL}}, \overset{?}{\text{SE}}, \overset{-}{\text{C4}}, \overset{+}{\text{NF}}) \quad (4)$$

$$\text{HIIT}_i = f(\overset{+}{\text{Dif}}, \overset{?}{\text{SL}}, \overset{+}{\text{SE}}, \overset{-}{\text{C4}}, \overset{+}{\text{NF}}), \quad (5)$$

where VIIT_i and HIIT_i are the share of vertical IIT and horizontal IIT in the total volume of Portugal's multilateral trade in industry i, respectively. The signs expected for the coefficients are shown above the variables.

We will start with the standard OLS regressions. The correctness of this functional form is questionable considering the possibility that the predicted value for the dependent variable will fall outside the feasible interval [0,1]. However, this is more of a problem when the model is used for forecasting/prediction. If, as is the case here, the purpose is to explain IIT and "hypothesis testing", this problem becomes less critical, which has led many researchers to use the OLS estimation. Some authors prefer a logit

[24] A similar proxy was proposed by Fontagné et al. (1998).

[25] See, among others, Balassa and Bauwens (1988: 92).

transformation of IIT to restrict the predicted value to the limited range. We also estimated the model with a logistic function,[26] but the results do not differ qualitatively from the OLS case.[27] In any case, the choice of the OLS method has a simpler justification: "in the light of the data deficiencies and proxy problems encountered in such cross-sectional work it must be questionable whether such sophistication is merited" (Greenaway and Milner 1986: 131).

In the OLS estimations, we will alternatively consider the CEPII10 index and the G-L index with two values for the parameter α (0.15 and 0.25).

In line with the difficulties anticipated in hypothesizing an unambiguous and continuous relationship with IIT in the case of some variables, we will complement this evaluation by using the Probit model. In this case, we will investigate what factors explain the probability that the share of the IIT type considered is above a certain threshold (which was allowed to vary according to the data). In both cases, the robust estimation method was used to deal with the typical problems of heteroscedasticity.

With regard to the determinant factors, our main purpose is to test whether comparative advantage arising from differences in factor endowments between countries may explain VIIT (but not HIIT) and whether the proxy for horizontal differentiation (Dif) accounts for HIIT (but not for VIIT). Accordingly, the results for the variables YD in the cross-country case and Dif in the cross-industry one are crucial.

4.1 *Cross-Country Analysis*

Starting the cross-country study with the analysis of the determinant factors of vertical IIT, let us consider Table 5.

The overall picture for the OLS estimations shows the harmony between the results of all the regressions, giving them a high degree of robustness. All variables[28] have the expected sign. Synthetically, VIIT increases with the difference (in absolute terms) between factor endowments (YD is significant

[26] Due to the fact that several observations for IIT have a zero value, the logistic function has to be estimated either by non-linear least squares or, alternatively (as in Lee and Lee 1993), by a linear transformation where the zero values of the IIT index are replaced by a very small number (such as 0.0000001). The latter was used in this study.
[27] A similar conclusion was obtained by Balassa and Bauwens (1988), who also tested alternative functional forms.
[28] We were forced to exclude a proxy for the difference in market size, most commonly used in this kind of study, due to evident problems of multicollinearity.

Table 5: *Vertical IIT: Cross-Country Analysis*

	OLS regressions				Probit regressions	
	(1) VIIT (CEPII10) $\alpha = 0.15$	(2) VIIT (CEPII10) $\alpha = 0.25$	(3) VIIT (G-L) $\alpha = 0.15$	(4) VIIT (G-L) $\alpha = 0.25$	(5) VIIT (CEPII10 > 5%)	(6) VIIT (G-L > 5%)
Constant	14.00	10.66	5.96	3.81	−1.44	−3.88
	(1.35)	(1.17)	(1.04)	(0.77)	(−0.80)	(−1.88)*
Dim	0.005	0.004	0.004	0.004	0.0006	0.0003
	(3.63)***	(3.88)***	(6.83)***	(6.90)***	(0.71)	(0.60)
YD	0.0008	0.0008	0.0005	0.0005	0.0003	0.0004
	(3.06)***	(3.26)***	(3.25)***	(3.50)***	(2.16)**	(2.42)**
GINI	0.64	0.65	0.44	0.44	0.24	0.37
	(1.54)	(1.71)*	(1.67)	(1.83)*	(1.96)**	(2.75)***
GINI × YD	−0.00008	−0.00008	−0.00006	−0.00006	−0.00003	−0.00004
	(−1.63)	(−1.71)*	(−1.83)*	(−1.96)*	(−2.01)**	(−2.32)**
Dist	−0.003	−0.003	−0.001	−0.001	−0.0002	−0.0001
	(−1.65)	(−1.51)	(−1.42)	(−1.22)	(−0.43)	(−0.27)
ED	−0.07	−0.06	−0.03	−0.02	−0.003	−0.01
	(−1.60)	(−1.36)	(−1.19)	(−0.86)	(−0.29)	(−1.05)
EU	11.40	10.05	6.34	5.52	1.11	1.89
	(3.84)***	(3.66)***	(4.16)***	(3.96)***	(1.78)*	(2.59)***
N	46	46	46	46	46	46
F	8.21***	7.43***	10.89***	10.75***		
R^2	0.60	0.58	0.67	0.66		
Adj. R^2	0.53	0.50	0.61	0.60		
LR					14.33**	27.01***
Correct predictions (%)					71.74	80.43

*, **, *** statistically significant at the 10, 5 and 1 per cent level, respectively.
Note: In parentheses are the t-statistics (White heteroscedasticity corrected).

at the 1 per cent level). This result confirms those obtained by Blanes and Martín (2000) for Spain and Veeramani (2002) for India. The variable GINI is not so robust but, when a less favourable criterion to VIIT is adopted ($\alpha = 0.25$), it has a positive sign, showing that the intensity of VIIT increases with the difference in the distribution of income between Portugal and each one of the trading partners. The variable GINI × YD shows a negative sign and is significant in all equations but one, showing that VIIT decreases if the increasing dissimilarity in the income distribution of the partner countries is associated with an increase in the per capita income gap, as also found by Veeramani (2002).

It is possible that bilateral inequality in per capita income (YD) also measures differences in preferences, as suggested by the Linder hypothesis. To confirm the (neo-HOS) comparative advantage effect of YD,[29] we replaced this variable by more direct proxies for factor endowment differences, namely in physical capital per capita (K), technological capital per capita (T) and human capital (H), as in Blanes and Martín (2000) or Martín-Montaner and Ríos (2002), for instance. These variables were built as follows: absolute difference in the stock of physical capital per capita for K; absolute difference in the average R&D expenditure per capita (in the period 1997–1999) for T; absolute difference in the number of years of schooling for H. In the case of H, calculations were made for the year 1990, in order to take into account the fact that the impact of education on production is not immediate. The sources for these variables are described in the Appendix. Due to missing data, the number of countries of our sample was reduced to 36, 26 and 20 in the case of K, T and H, respectively. The notable result is that, with the three proxies, we observe the expected positive and significant sign in the VIIT model, whereas the sign is negative and non-significant in the HIIT model. The other coefficients remain very similar.

The explanation put forward by Falvey and Kierkowski (1987) thus seems confirmed in the Portuguese case: the greater the differences in endowments, the higher the share of vertical intra-industry trade. This conclusion is broadly supported by the positive influence of differences in factor endowments as measured either by YD or by K, T and H, and corroborated by the positive correlation of dissimilarity in income distribution with the potential for this trade type.

The expected negative relationship with distance/transport costs (Dist) is supported by our results, as is the negative impact of the difference in the development level of countries (ED). Finally, the evidence also showed that VIIT is higher between countries belonging to the same integration space, a common result in this literature, mainly in relation to the European space.

Let us now consider the Probit regressions (assuming a minimum value of 5 per cent as the criterion for the existence of VIIT). Overall, we observed a great similarity between the results obtained now and the ones from equations (1) to (4). From (5) and (6), we conclude that the probability of VIIT assuming a higher share than 5 per cent of the total volume of bilateral

[29] For a recent study that uses differences in per capita income as an indicator of differences in factor endowments, see Durkin and Krygier (2000).

trade increases with the difference in factor endowments and the fact that the partner is a member of the EU.

Table 6 presents the results relating to horizontal IIT.

Table 6: *Horizontal IIT: Cross-Country Analysis*

	OLS regressions			
	(1) HIIT (CEPII10) $\alpha = 0.15$	(2) HIIT (CEPII10) $\alpha = 0.25$	(3) HIIT (G-L) $\alpha = 0.15$	(4) HIIT (G-L) $\alpha = 0.25$
Constant	11.86	14.92	6.89	8.94
	(1.53)	(1.61)	(1.55)	(1.72)*
Dim	0.002	0.002	0.001	0.001
	(0.76)	(0.86)	(0.82)	(0.91)
YD	0.0001	0.0001	0.00007	0.0001
	(0.60)	(0.76)	(0.72)	(0.90)
GINI	0.05	0.07	0.06	0.08
	(0.24)	(0.29)	(0.46)	(0.50)
GINI × YD	−0.00001	−0.00002	−0.00001	−0.00002
	(−0.64)	(−0.75)	(−0.93)	(−0.96)
Dist	−0.002	−0.003	−0.001	−0.002
	(−1.65)	(−1.70)*	(−1.65)	(−1.80)*
ED	−0.04	−0.06	−0.02	−0.03
	(−1.28)	(−1.46)	(−1.20)	(−1.50)
EU	3.82	5.37	2.23	3.16
	(2.09)**	(2.48)**	(1.79)*	(2.28)**
Norway	37.96	39.83	34.18	35.46
	(12.71)***	(9.93)***	(18.43)***	(14.39)***
Tunisia	32.08	31.32	30.49	30.06
	(26.25)***	(21.69)***	(41.09)***	(36.29)***
N	46	46	46	46
F	14.84***	11.14***	30.34***	23.70***
R^2	0.79	0.74	0.88	0.86
Adj. R^2	0.73	0.67	0.85	0.82

*, **, *** statistically significant at the 10, 5 and 1 per cent level, respectively.
Note: In parentheses are the t-statistics (White heteroscedasticity corrected).

With any dependent variable, it is important to note the picture of neutrality depicted by the proxy for the difference in factor endowments (YD) as well as for GINI, in contrast with what was noted in the case of VIIT. Furthermore, the dummy variable related to joint participation in the EU displays a positive influence, as do the dummies for the partners with an exceptional HIIT level (Norway and Tunisia), just as was presumed. The variable Dist has the negative sign that we expected but only when the dispersion factor α is 0.25.

Considering the supremacy of VIIT presented in Section 3, the results for global IIT are expected to be close to those for the vertical type. In fact, we noted that they are clearly similar as far as the sign and the relevant explanatory variables are concerned. Furthermore, the explanatory power of the model is also quite similar. This conclusion is valid if we use either the CEPII10 or the G-L index as the dependent variable.

4.2 *Cross-Industry Analysis*

Other studies on this subject have shown that the explanatory power of the regressions for the industry characteristics is lower than in the previous case. The results for the Portuguese case confirm this tendency. Relevant variables that are omitted, the weak correspondence between the proxies chosen and the concepts to be evaluated (the scale economies and product differentiation variables being just an example), the difficulties in making the conversion from trade to the sectoral nomenclature and the consideration of the characteristics of the industries of a given country (in this case, Portugal) as being representative for every other country are some evident problems which certainly contribute towards the poor results usually obtained. The results for the industry variables related to vertical IIT are presented in Table 7.

With both dependent variables, the horizontal product differentiation proxy (Dif) is highly significant with the expected negative sign. It is important to emphasize that product differentiation was used in many studies as a determinant factor of total IIT with an expected positive sign, due to the prevailing idea that IIT should be associated with the horizontal type of the monopolistic competition models. If, as shown in several recent studies, the main component of IIT is vertical, the fact that this sign appears to be negative ceases to be "surprising." As far as the market structure is concerned, the results indicate that vertical IIT is perhaps higher in those sectors with a large number of firms, pointing to the comparative advantage explanation of vertical IIT.

With regard to Probit regressions, we evaluated the factors which explain the probability of VIIT occurring when, in terms of the total sectoral volume of trade, it is higher than 45 per cent. The expected negative impact of the variable Dif is supported and the evidence is, in general, in line with the

Table 7: *Vertical IIT: Cross-Industry Analysis*

	OLS regressions				Probit regressions	
	(1) VIIT (CEPII10) $\alpha = 0.15$	(2) VIIT (CEPII10) $\alpha = 0.25$	(3) VIIT (G-L) $\alpha = 0.15$	(4) VIIT (G-L) $\alpha = 0.25$	(5) VIIT (CEPII10 > 45%)	(6) VIIT (G-L > 45%)
Constant	45.18	24.50	22.77	15.65	−0.40	−1.41
	(3.83)***	(2.14)**	(3.71)***	(2.52)*	(−0.58)	(−1.06)
Dif	−71.90	−65.96	−37.64	−36.13	−3.50	−11.43
	(−4.09)***	(−4.05)***	(−3.85)***	(−3.66)***	(−2.51)**	(−1.64)
SL	7.11	21.83	3.19	6.92	0.30	0.63
	(0.40)	(1.32)	(0.33)	(0.74)	(0.31)	(0.35)
SE	−0.01	0.09	0.10	0.10	0.0003	0.008
	(−0.08)	(0.74)	(1.57)	(1.67)*	(0.06)	(0.81)
NF	0.003	0.004	0.002	0.002	0.0003	0.0002
	(2.21)**	(2.28)**	(1.70)*	(1.59)	(1.88)*	(1.73)*
C4	0.02	−0.03	−0.03	−0.03	0.006	−0.006
	(0.17)	(−0.23)	(−0.46)	(−0.48)	(0.88)	(−0.59)
N	92	92	92	92	92	92
F	3.83***	3.82***	4.21***	3.72**		
R^2	0.18	0.18	0.20	0.18		
Adj. R^2	0.14	0.13	0.15	0.13		
LR					15.24***	13.14**
Correct predictions (%)					64.13	90.22

*, **, *** statistically significant at the 10, 5 and 1 per cent level, respectively.
Note: In parentheses are the t-statistics (White heteroscedasticity corrected).

OLS estimates. The results for horizontal IIT in a cross-industry analysis are, as usual, not very conclusive. They are presented in Table 8.

As far as Table 8 is concerned, what is remarkable is the fact that the proxy for the differentiation of the product (Dif) has a different result from the VIIT model, where it was negative and significant, proving the advantage of distinguishing the two IIT types.

We also considered total IIT as the dependent variable and the results are once more consonant, in terms of the determinant industry-specific factors, their respective signs and the explanatory power of the model, with the analysis developed for vertical IIT.

When we considered the CEPII20 index as the dependent variable, the picture we obtained earlier with the other IIT measurements remained much the same.

Table 8: *Horizontal IIT: Cross-Industry Analysis*

	OLS regressions				Probit regressions	
	(1) HIIT (CEPII10) $\alpha = 0.15$	(2) HIIT (CEPII10) $\alpha = 0.25$	(3) HIIT (G-L) $\alpha = 0.15$	(4) HIIT (G-L) $\alpha = 0.25$	(5) HIIT (CEPII10 > 20%)	(6) HIIT (G-L > 15%)
Constant	19.75	19.74	9.94	17.08	−0.78	−1.10
	(2.04)**	(2.03)**	(1.78)*	(2.46)**	(−1.15)	(−1.51)
Dif	18.51	18.50	9.21	7.71	1.17	1.48
	(1.36)	(1.36)	(0.97)	(0.73)	(1.00)	(1.15)
SL	−30.64	−30.67	−15.72	−19.48	−1.64	−1.98
	(−2.10)**	(−2.10)**	(−1.81)*	(−2.05)**	(−1.55)	(−1.66)*
SE	0.12	0.12	0.10	0.09	0.006	0.006
	(1.44)	(1.45)	(1.73)*	(1.32)	(0.97)	(0.79)
NF	0.001	0.001	0.0006	0.007	0.0002	0.0002
	(1.18)	(1.19)	(1.21)	(0.70)	(2.07)**	(1.83)*
C4	0.06	0.06	0.03	0.03	0.01	0.01
	(0.93)	(0.93)	(0.60)	(0.53)	(1.56)	(1.51)
N	92	92	92	92	92	92
F	3.14**	3.15**	2.58**	1.86		
R^2	0.15	0.15	0.13	0.10		
Adj. R^2	0.11	0.11	0.08	0.05		
LR					9.96*	9.27*
Correct predictions (%)					75.00	84.78

*, **, *** statistically significant at the 10, 5 and 1 per cent level, respectively.
Note: In parentheses are the t-statistics (White heteroscedasticity corrected).

5 Concluding Remarks

We investigated the nature of Portuguese intra-industry trade (IIT) by types and concluded that, independently of the index used, IIT represented an increasing proportion of the external trade of the Portuguese manufacturing industry in the second half of the 1990s, with a predominance of the vertical type. We also observed an increase in vertical superior IIT, even if bilateral analysis shows that, in the case of Portugal's main trading partners, vertical inferior IIT still predominates.

The fact that the increase in IIT is mainly due to vertical differentiation points to specialization throughout the quality spectrum, but also to the possibility that the Portuguese trade pattern did not register any significant alteration in the trade determinants, traditionally associated with the factor proportions model. In fact, from the econometric analysis of the determinant factors of IIT, we not only identified distinct explanatory factors for each IIT type, but also saw that the comparative advantage explanation holds for the vertical case.

The robustness of the main results was confirmed (i) through alternative measures for the continuous dependent variable; (ii) by considering alternative values to separate horizontal from vertical IIT, (iii) by re-estimating all equations with a probabilistic model. The reason for using the Probit model was related to the theoretical shortcomings in stipulating the way in which some of the explanatory variables impact. The fact that the results obtained do not contradict those of the functional forms previously used in this kind of study lends more credibility to the empirical evaluation.

This study allowed us to confront the traditional G-L measure for IIT with the measurement proposed in the context of the CEPII. In the case of the latter index, the main criticism is the "subjectivity" of the criterion used for disentangling inter- from intra-industry trade. We have shown that IIT levels may in fact be very sensitive to the empirical overlapping criterion of the CEPII index. The G-L method appears, thus, to be a preferable method.

Appendix

Sources for the proxies of Section 4: Dim, YD and ED: United Nations; GINI: United Nations and Deininger and Squire (1996); Dist: CTT, Correios de Portugal; K: Benhabib and Spiegel (1994) for physical capital (we used data from 1985, the most recent year reported) and United Nations for population; T: OECD for technological capital and United Nations for population; H: Bassani et al. (2001: 13); Dif: trade data used in this paper; SL and SE: Ministry of Employment, *Quadros de Pessoal*; C4, NF: INE, *Estatísticas das empresas – agricultura e indústria*.

Table A1: *Intra-Industry Trade Types by Country (2000)*[a]

	Vertical						Horizontal		IIT		Inter	
	superior		inferior		total							
	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L
EUROPEAN UNION												
Germany	12.0	7.8	14.5	8.9	26.5	16.7	18.3	12.8	44.8	29.5	55.2	70.5
Austria	11.6	4.8	4.6	3.5	16.2	8.3	2.3	1.5	18.5	9.8	81.5	90.2
Belgium	23.4	8.3	8.8	6.5	32.2	14.8	1.0	0.9	33.2	15.7	66.8	84.3
Denmark	3.4	2.8	6.6	3.9	10.0	6.7	1.4	0.7	11.4	7.4	88.6	92.6
Spain	14.4	7.8	22.6	13.5	37.0	21.3	23.1	13.3	60.1	34.6	39.9	65.4
Finland	1.6	0.8	2.8	1.2	4.4	2.0	0.9	0.5	5.3	2.5	94.7	97.5
France	16.4	9.5	17.9	10.5	34.3	20.0	8.2	4.0	42.5	24.0	57.5	76.0
Greece	1.4	1.1	0.9	0.8	2.3	1.9	0.6	0.4	2.9	2.3	97.1	97.7
Ireland	1.4	0.9	5.0	2.9	6.4	3.8	0.3	0.2	6.7	4.0	93.3	96.0
Italy	17.1	8.9	11.1	6.9	28.2	15.8	6.2	3.3	34.4	19.1	65.6	80.9
Luxembourg	2.9	2.0	0.9	0.5	3.8	2.5	2.6	1.8	6.4	4.3	93.6	95.7
Netherlands	7.8	5.3	5.6	4.2	13.4	9.5	5.1	2.6	18.5	12.1	81.5	87.9
United Kingdom	12.3	6.9	11.2	6.3	23.5	13.2	10.3	8.1	33.8	21.3	66.2	78.7
Sweden	6.4	3.0	6.7	4.6	13.3	7.6	1.0	0.7	14.3	8.3	85.7	91.7
OPEC												
Saudi Arabia	0.5	0.1	0.1	0.1	0.6	0.2	2.2	1.8	2.8	2.0	97.2	98.0
Algeria	0	0	0	0	0	0	0	0	0	0	100	100
Nigeria	0	0.1	0	0.4	0	0.5	0	0	0	0.5	100	99.5
U.A. Emirates	5.2	3.1	0.5	0.2	5.7	3.3	0.1	0.1	5.8	3.4	94.2	96.6
Venezuela	0.7	0.4	0.3	0.2	1.0	0.6	0.3	0.3	1.3	0.9	98.7	99.1
OTHER COUNTRIES												
EUROPE												
Bulgaria	0.8	0.6	0.3	0.2	1.1	0.8	0.7	0.6	1.8	1.4	98.2	98.6
Hungary	15.4	5.6	1.8	1.2	17.2	6.8	0	0.2	17.2	7.0	82.8	93.0
Iceland	0.1	0	0.3	0.2	0.4	0.2	0	0	0.4	0.2	99.6	99.8
Norway	0.3	0.3	4.2	1.5	4.5	1.8	33.5	31.6	38.0	33.4	62.0	66.6
Poland	4.4	2.0	1.1	0.8	5.5	2.8	0.2	0.2	5.7	3.0	94.3	97.0
Czech Republic	3.9	2.4	4.8	2.7	8.7	5.1	10.1	3.6	18.8	8.7	81.2	91.3
Romania	0	0	0.1	0.2	0.1	0.2	0.7	0.6	0.8	0.8	99.2	99.2
Russia	0.1	0	0	0.1	0.1	0.1	0	0.1	0.1	0.2	99.9	99.8
Switzerland	3.6	2.2	8.9	6.1	12.5	8.3	1.9	1.8	14.4	10.1	85.6	89.9
Turkey	1.7	0.9	3.4	1.5	5.1	2.4	9.3	7.3	14.4	9.7	85.6	90.3
AFRICA												
Angola	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.3	0.3	99.7	99.7
Botswana	0.3	0.2	0	0.1	0.3	0.3	0	0	0.3	0.3	99.7	99.7
Mozambique	0.3	0.2	0.8	0.5	1.1	0.7	0.1	0.1	1.2	0.8	98.8	99.2
South Africa	5.1	4.0	1.9	1.2	7.0	5.2	0.6	0.5	7.6	5.7	92.4	94.3
Egypt	0	0	0.3	0.2	0.3	0.2	0	0	0.3	0.2	99.7	99.8
Morocco	1.1	0.9	2.9	2.0	4.0	2.9	0.5	0.2	4.5	3.1	95.5	96.9
Tunisia	1.2	0.9	7.3	3.3	8.5	4.2	34.3	32.0	42.8	36.2	57.2	63.8

Table A1: *Continued*

	Vertical						Horizontal		IIT		Inter	
	superior		inferior		total							
	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L	CEPII10	G-L
AMERICA												
Argentina	0.3	0.2	0.2	0.2	0.5	0.4	0.2	0.2	0.7	0.6	99.3	99.4
Brazil	3.8	2.2	5.6	3.4	9.4	5.6	0.4	0.4	9.8	6.0	90.2	94.0
Canada	4.3	2.0	3.0	2.0	7.3	4.0	0.5	0.6	7.8	4.6	92.2	95.4
Chile	0.1	0.1	0.1	0	0.2	0.1	0	1.8	0.2	1.9	99.8	98.1
USA	3.2	3.2	18.0	15.3	21.2	18.5	1.3	1.4	22.5	19.9	77.5	80.1
Mexico	3.8	2.1	8.1	4.2	11.9	6.3	0.2	0.5	12.1	6.8	87.9	93.2
ASIA												
China	4.0	2.7	1.2	0.8	5.2	3.5	0.2	0.1	5.4	3.6	94.6	96.4
South Korea	0.8	0.6	1.2	2.9	2.0	3.5	0.8	0.5	2.8	4.0	97.2	96.0
Hong Kong	6.4	4.1	2.9	1.9	9.3	6.0	1.5	0.8	10.8	6.8	89.2	93.2
India	8.4	3.9	5.2	3.3	13.6	7.2	0.1	0	13.7	7.2	86.3	92.8
Israel	0.7	1.3	4.4	1.9	5.1	3.2	1.4	1.7	6.5	4.9	93.5	95.1
Japan	0.3	0.5	1.9	1.2	2.2	1.7	0.1	0.1	2.3	1.8	97.7	98.2
Singapore	0.9	2.4	5.8	4.1	6.7	6.5	0	0	6.7	6.5	93.3	93.5
Taiwan	4.0	2.3	1.5	1.1	5.5	3.4	0.7	0.5	6.2	3.9	93.8	96.1
Thailand	0.7	0.4	0.2	0.2	0.9	0.6	0.6	0.3	1.5	0.9	98.5	99.1
OCEANIA												
Australia	3.5	3.4	1.2	0.8	4.7	4.2	0.1	1.7	4.8	5.9	95.2	94.1
New Zealand	0.7	0.6	0.5	0.5	1.2	1.1	0	1.1	1.2	2.2	98.8	97.8

[a] Shares in the total bilateral volume of trade.

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