VERTICAL INTRA-INDUSTRY TRADE: PATTERNS AND DETERMINANTS IN THE ITALIAN CASE

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Using a cross-country analysis, this paper examines the determinants of the Italian intra-industry trade in vertically differentiated products. By considering the degree of specialization by quality within industries, we found that Italy's IIT in low-quality products is higher the lower the factor endowment difference and the higher the technological gap with the partner country. These findings confirm the peculiarity of the Italian specialization model which is strongly different from that of other main industrialized countries which are located mainly at the higher end of the price-quality spectrum.

Introduction

Today almost one forth of world trade has intra-industry nature, i.e. the simultaneous exports and imports of similar goods within the same industry. In the theory of international trade [Abd-el-Rahman, 1991; Greenaway et al. 1994], one issue that has received a large attention in the last years refers to the distinction between different types of intra-industry trade, depending on the type of product differentiation prevailing in each industry. In particular, total intra-industry trade (TIIT) has been disentangled into its two components of horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT). The first component represents trade among commodities that are similar in terms of quality, while the second one is referred to commodities of different quality.

Large empirical evidence underlines the growing role of vertical IIT in characterizing exchanges among countries. Fontagné and Freudenberg (2002) shows that in the period 1980-1994 the share of vertical IIT within the European Union's countries has increased noticeably from a share of less than 35 per cent in 1980-1985 to about 45 per cent in 1999.

Due to the predominance of VIIT in the Italy's bilateral trade - it accounts for more than 70 per cent of total IIT in 1990-1999 - in the present study we undertake a cross-country analysis of the determinant factors of the Italian intra-industry trade in vertically differentiated products. Section II resumes the main insights of the theoretical literature on IIT and the procedure for disentangling vertical and horizontal IIT. Section III presents the geographical and sectorial patterns of Italian intra-industry trade. Section IV presents the hypotheses and the methodology used. Section V reports regression results and, section VI draws some concluding remarks.

A brief survey of theoretical and empirical literature

In the literature intra-industry trade has been explained through different approaches. The first approach considers goods that are horizontally differentiated and are produced with increasing returns to scale. In monopolistically competitive markets, Krugman (1979), Lancaster (1980) and Helpman (1981) found that when the two partner countries have identical factor endowments, the volume of international trade (which is entirely intra-industry) is determined by differences in their relative country size. In particular, the volume of trade is greater, the greater the similarity in size among countries. Adding factor endowment differences in a two-sector model, where one sector produces an homogeneous good and the other a differentiated product, Helpman and Krugman (1985) found that the volume of international trade will be determined by both differences in relative country size and difference in factor endowments between the trading countries. In particular, this kind of model predicts that IIT will decline as countries' factor endowments diverge. An alternative approach considers models with vertically differentiated products. Falvey (1981) and Falvey and Kierzkowski (1987) suggest that since a higher-quality product requires higher capital-intensity in production, in an open economy the capital-rich country will export high-quality products whereas the labor-rich country will export low-quality products. These models predict that the share of intra-industry trade in the bilateral trade should be greater, the greater the difference in relative factor endowments between the two countries. A similar vertical IIT model was developed by Flam and Helpman (1987); the authors found that the North-South trade structure is determined by technological differences, income differences and income distribution differences between the North and the South. The source of quality differentiation is not the amount of capital used in producing the product, like in the Falvey and Kierzkowski (1987)

model, but the technology used. Labor input per unit output of the quality differentiated product differs between countries and the North has comparative advantage in high quality products. So, the North exports industrial products of high quality and imports industrial products of lower quality from the South. Given an overlap in income distribution, IIT emerges. The level of bilateral IIT between Italy and its main partner countries has been measured by the Grubel-Lloyd (GL) index:

$$IIT_{j_k} = 1 - \frac{\sum_i \left| X_{ij}^k - M_{ij}^k \right|}{\sum_i (X_{ij}^k + M_{ij}^k)} \qquad (1)$$

where X_{ij}^k and M_{ij}^k are Italian exports and imports of commodity *i* of industry *j* with country *k*. The GL index is equal to one if all trade is IIT and is equal to zero if all trade is inter-industry trade.

Following Abd-el-Rahman (1991) and Greenaway et al. (1994), we have decomposed total intra-industry trade (TIIT) into its two components of horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT). The first component represents trade among commodities that are similar in terms of quality, while the second one is referred to commodities of different quality.

Assuming that differences in prices reflect quality differences and that prices can be proxied by unit values (calculated per tonne), we have calculated unit values of exports and imports at the same level of statistical aggregation 5-digit SITC (*Standard International Trade Classification*) for the trade of Italy with 92 other countries over the period 1990-1999. Partner countries represent the 96% of total Italian exports in the manufacturing sector.

Trade products are considered to be horizontally differentiated if:

$$1 - a \le \frac{VUX_{ij}^k}{VUM_{ij}^k} \le 1 + a \qquad (2)$$

In equation (2), VUX_{ij}^k refers to unit value of exports, while VUM_{ij}^k refers to unit value of imports and the parameter α is a dispersion factor, arbitrarily fixed, which is assumed to be equal to 0.15.

Trade products are considered to be vertically differentiated when the relative unit values of exports and imports lie outside the range:

$$\frac{VUX_{ij}^k}{VUM_{ij}^k} > 1 + a \qquad (3)$$

or

$$\frac{VUX_{ij}^k}{VUM_{ij}^k} < 1 - a \qquad (4)$$

Moreover, VIIT is assumed to have two components, high quality (HQVIIT) and low quality (LQVIIT). A high share of LQVIIT means that a country is specializing into relatively low-price export goods in the vertically differentiated sectors. A high share of HQVIIT implies that VIIT takes the form of high-valued exports. Therefore if the relative unit value of a good is below (over) the limit of 0.85 (1.15), it is considered as a low (high) quality export. In sum, the G-L index contains the following components:

$$\text{IIT} = \text{HIIT} + \text{HQVIIT} + \text{LQVIIT} \qquad (5)$$

The geographical and sectorial patterns of Italy's intra-industry trade

Using the approach outlined in the previous section, let us present some measures of intra-industry trade in horizontally and vertically differentiated manufactured products between Italy and her major trading partners. Looking at **table 1** which shows the weighted averages of the IIT indices over the period 1990-1999, we can see that the share of IIT in Italy's trade has increased from 47.9 percent to 51.4 percent. It can be easily seen that vertical IIT dominates horizontal IIT: in the average of the period 1990-1999, vertical IIT accounts for 70.4 percent of total IIT. Moreover, Italy is basically specialized in the lower set of qualities: the share of vertical IIT of inferior quality represents the 62.6 percent of the total vertical IIT.

There is a wide variation of IIT shares across countries (**table 2)**. Similarly to the findings of other empirical studies, the share of IIT increases with the level of development (proxied by per capita income); in fact, Italy carries more IIT with countries at similar stage of development.

Table 1. Trend in the aggregate indices of IIT in Italy's trade, 1990-1999

	One way	**IIT**	**HIIT**	**VIIT**	**LQVIIT**	**HQVIIT**
Years						
1990	0.521	0.479	0.152	0.327	0.207	0.120
1991	0.515	0.485	0.160	0.325	0.203	0.122
1992	0.510	0.490	0.149	0.341	0.221	0.120
1993	0.539	0.461	0.119	0.342	0.226	0.116
1994	0.538	0.462	0.140	0.322	0.210	0.113
1995	0.532	0.468	0.140	0.328	0.204	0.125
1996	0.542	0.458	0.132	0.326	0.208	0.118
1997	0.525	0.475	0.135	0.340	0.216	0.124
1998	0.506	0.494	0.141	0.353	0.206	0.146
1999	0.486	0.514	0.152	0.362	0.210	0.151
Mean	**0.521**	**0.479**	**0.142**	**0.337**	**0.211**	**0.126**

Source: Own calculations based on OECD, International Trade by Commodities Statistics, CD-ROM

Analysing IIT in intra-EU exchanges from 1985 to 1996, Díaz Mora (2002) found that member countries with higher relative level of incomes (the North) export predominantly higher quality products; the opposite behavior is observed in Member States with lower relative level of incomes (the South). This is the case of Italy where the share of VIIT of low-quality exports is greater with countries of similar level of income (it accounts for 69.2 per cent of total VIIT), whereas the share of VIIT of high-quality exports is greater with countries of middle (77.8 per cent) or low income (71.4 per cent).

Table 2. Geographical distribution IIT in the Italian manufacturing sector

(Average 1990-1999)

	One way	IIT	HIIT	VIIT	LQVIIT	HQVIIT
High income countries	0.650	0.350	0.081	0.269	0.186	0.083
Middle income countries	0.897	0.103	0.015	0.088	0.021	0.067
Low income countries	0.923	0.077	0.009	0.068	0.021	0.047
World	0.521	0.479	0.142	0.337	0.211	0.126

Source: Own calculations based on OECD, International Trade by Commodities Statistics, CD-ROM

This geographical pattern of IIT holds up, in general, disaggregating by manufacturing sectors. Using a sectorial classification *à la Pavitt*, **table 3** shows that the level of Italy's IIT varies greatly across industries. In comparison with other main European countries, Italy presents a quite different pattern of sectorial specialization.

Table 3. Sectorial distribution IIT in the Italian manufacturing sector

(Average 1990-1999)

	One way	IIT	HIIT	VIIT	LQVIIT	HQVIIT
Traditional sectors	0.607	0.393	0.079	0.314	0.113	0.201
Scale intensive sectors	0.500	0.500	0.221	0.279	0.181	0.098
Specialized sectors	0.496	0.504	0.154	0.350	0.271	0.079
High Tech sectors	0.330	0.670	0.065	0.604	0.554	0.051
Manufacturing sectors	0.525	0.475	0.142	0.337	0.206	0.134

Source: Own calculations based on OECD, International Trade by Commodities Statistics, CD-ROM

VIIT of higher quality is greater in traditional sectors (it accounts for 64 per cent of total VIIT), whereas VIIT of lower quality is greater in high-technology intensive (91.6 per cent) and specialized sectors (77.5 per cent).

The empirical model and the explanatory variables

In estimating the determinants of VIIT, most authors [Toh, 1982; Tharakan,1986] have used a linear (or log-linear) function by ordinary least squares such as:

Model 1: $VIIT = a + b'Z + u$ (6)

In equation (6) the dependent variable is the share of vertical intra-industry trade (VIIT) between Italy and country k, Z is a vector of explanatory variables and u represents the error term.

However, because the G-L index takes values from 0 to 1, the regression equation may have predicted values for the dependent variable that lie outside the feasible interval.

So, to restrict the predicted values between 0 and 1, a first group of researchers [Caves, 1981; Bergstrand, 1983; Loertscher and Wolter, 1980] have used a logit transformation of the G-L index. In this case the econometric model can be written as follows:

Model 2: $\ln\left(\frac{VIIT}{1-VIIT}\right) = b'Z + u$ (7)

Other scholars [Balassa, 1986; Balassa and Bauwens, 1987; Greenaway et al. 1999; Aturpane et al. 1999] have used a logistic function by non-linear least square estimation. In this case, the regression model takes the following form:

Model 3: $VIIT = \frac{1}{(1+\exp(-b'Z)} + u$ (8)

There is a large empirical literature which has been focused on testing various *country-specific* and *industry-specific* hypotheses concerning the determinants of vertical IIT. In this study, we draw our attention on testing *country-specific* characteristics of the Italy's bilateral vertical IIT with its main trading partners. The variables used and their statistical sources are defined in **table 4**.

Table 4. Variables and Data Sources

Variables	*Sources*
Per Capita Income :	World Bank Development Indicators CD-ROM 2002
Total GDP:	World Bank Development Indicators CD-ROM 2002
Distance:	Jon Haveman's International Trade Data
Total Expenditure on R&D:	World Competitiveness Yearbook,
Foreign Direct Investment:	UIC - Ufficio Italiano Cambi

Per capita income differences (DIFYP). This variable is defined as the absolute value of the difference in per capita GDP (current US dollar) between Italy and country k. When two countries have different endowments of capital and labor, it is assumed that the higher quality variety of the differentiated good is produced using relatively capital-intensive techniques. As a result, the higher income, relatively capital-abundant country specializes in relatively high-quality manufactures, while the lower income, relatively labor-abundant country, specializes in low-quality manufactures. Therefore, we predict that the share of vertical IIT in the bilateral trade will be greater the greater the difference in the capital-labor endowment of the two countries and, accordingly, the greater the difference in per capita GDP.

Transportation costs (TC). We measure this variable as the geographical distance between Roma and the capital city of each of Italy's trading partners. Intra-industry trade both horizontal and vertical is generally regarded as being positively influenced by market proximity, largely as a consequence of transportation costs. Consequently, we expect that this variable will have a negative impact.

Differences in technology (DIFTEC). The variable DIFTEC is defined as the absolute difference of total R&D expenditure as a percentage of population between Italy and her trading partner. Since vertical IIT is determined by quality factors, we believe that the technology gap would be one of the most important factors influencing this type of intra-industry trade (Flam and Helpman,1987; Shaked and Sutton 1984). A larger difference in technological intensity would result in a larger difference in the price (quality) of the product. Therefore, vertical IIT will increase.

Differences in market size (DIFY) This variable represents difference in market size between the two countries and is measured by the absolute difference of total GNP (current US dollar) between Italy and her trading partner k. Differences in market size indicates differences in their ability to manufacture differentiated products; as countries become more similar in terms of their market size, the potential for overlapping demand for differentiated products is enhanced and, therefore, we expect a negative coefficient for DIFY.

Market size (SIZE). This variable represents the average size of the markets and is given by the average GDP of Italy and her trading partner k. A large domestic market makes easier the exploitation of economies of scale in the production of differentiated products and thereby large opportunities for trade in differentiated products. We expect that the share of vertical IIT will be positively correlated with the market size of partner countries.

Regional Integration agreement (EU15). Another *country-specific* factor that can influence the level of IIT is the belonging to the European Union; so we have used the dummy variable EU15 which takes value 1 if the two countries belong to the European Union and zero if not. The empirical evidence shows that the level of IIT is generally higher within regional integrated areas; so we expect a positive relationship between EU15 and the share of IIT.

Foreign direct investment (FDI). Another *country-specific* variable to be tested in this work is the Foreign Direct Investment flows between Italy and her trading partners. In the literature, there is no consensus about how FDI flows affect IIT. Variable FDI represents the total volume of foreign direct investment between Italy and her trading partner country. Some authors argue that both helps consumers to satisfy their differentiated demands and also helps scale economies to appear in production which in return increases IIT. On the contrary, others suggest that FDI flows cause the differentiated demand of consumers to be satisfied by domestic production instead of imports, so it will have a negative impact on IIT.

Estimation results

The empirical analysis refers to 46 partner countries over the period 1996-1999. Our results are set out in **table 5**. Columns (1)-(3) present estimates for total vertical IIT. Overall, the set of coefficients in both the models

Table 5. Determinants of total vertical intra-industry trade

	Dependent Variable: VIIT			*Dependent Variable: HQVIIT*			*Dependent variables: LQVIIT*		
	(1)	***(2)***	***(3)***	***(4)***	***(5)***	***(6)***	***(7)***	***(8)***	***(9)***
Independent Variables									
CONSTANT	0.177	-1.633	-1.464	0.108	-2.430	-2.138	0.069	-2.581	-2.372
	(13,659)a	*(-10,471)a*	*(-17,275)a*	*(11,978)a*	*(-12,845)a*	*(-16,158)a*	*(7,603)a*	*(-14,993)a*	*(-25,241)a*
DIFYP	-2.748	-20.725	-15.888	0.716	22.24	34.345	-3.464	-70.335	-31.598
	(-3,239)a	*(-2,029)b*	*(-2,278)b*	*-1217*	*(1,795)c*	*(3,434)a*	*(-5.802)a*	*(-6.238)a*	*(-3.805)a*
EU15	0.114	0.697	0.487	0.043	0.481	0.407	0.071	0.826	0.428
	(6,594)a	*(3,344)a*	*(5,478)a*	*(3,609)a*	*(1,904)c*	*(3,924)a*	*(5,812)a*	*(3,590)a*	*(4,140)a*
TC	-0.011	-0.120	-0.131	-0.007	-0.128	-0.134	-0.004	-0.087	-0.157
	(-9,800)a	*(-9,086)a*	*(-8,876)a*	*(-8,618)a*	*(-8,043)a*	*(-8,150)a*	*(-5,426)a*	*(-6,019)a*	*(-6,378)a*
FDI	0.045	0.280	0.194	0.001	0.079	0.026	0.044	0.436	0.270
	(4,178)a	*(2,182)b*	*(3,785)a*	*(0,067)*	*(0,508)*	*(0,308)*	*(5,870)a*	*(3,078)a*	*(5,572)a*
SIZE	0.033	0.359	0.259	0.014	0.323	0.318	0.019	0.306	0.300
	(4,302)a	*(3,842)a*	*(5,908)a*	*(2,629)a*	*(2,858)a*	*(3,354)a*	*(3,521)a*	*(2,966)a*	*(6,291)a*
DIFTEC	0.079	0.405	0.613	-0.094	-1.335	-2.331	0.173	2.164	1.659
	(2,411)b	*(1,029)*	*(3,218)a*	*(-4,147)a*	*(-2,797)a*	*(-5,379)a*	*(7,512)a*	*(4,980)a*	*(8,525)a*
Adjusted R-squared	0.713	0.576	0.729	0.464	0.376	0.519	0.739	0.620	0.748
Numb. obs.	138	138	138	138	138	138	138	138	138

Note: t-values are in parentheses

a,b,c denote significance at the 1, 5, and 10 percent levels (one-tailed) respectively

showed good statistic significance in terms of adjusted R squared. Individually, all the estimated coefficients have a high statistic significance (except DIFTEC in model 2) and have the expected signs with the exception of DIFYP (which has a negative sign). As expected, the share of vertical IIT with Italy will grow with EU membership, market size, foreign direct investment and economic distance. The negative relationship between vertical IIT and per-capita income difference does not seem to support a factor proportions explanation of vertical IIT. This result is similar with the findings of other studies undertaken in the context of trade among developed countries [Greenaway et al., 1999] as well as between developed and developing countries [Clark and Stanley, 1999].

Estimates for vertical IIT of the superior type are reported in columns (4)-(6). The coefficient for FDI is positive but no longer statistically significant. Larger market size, fewer transportation costs and EU membership are found to be conducive for enhancing the intensity of vertical IIT. The coefficients for DIFYP are positive and statistically significant in the model of nonlinear least squares but insignificant in the linear model. This indicates that differences in factor endowments enhance IIT only when Italy exports high quality varieties.

Finally, columns (7)-(9) show estimates for vertical IIT of the inferior type. All of the coefficients are significant at the 1 per cent level and have the same signs of the total VIIT. It should be noted that vertical IIT of low quality products is higher the lower the factor endowment difference and the higher the technological gap with partner country.

Summary and Conclusions

In this study we have tested some hypotheses regarding country-specific characteristics of vertical Italy's IIT. In order to check robustness of the results, we used three alternative estimation methods: i) a linear model by ordinary least squares, ii) a logit transformation by ordinary least squares and iii) a logistic function by non-linear least squares. In accordance with main theoretical predictions, we found that the share of VIIT was: a) negatively correlated with economic distances between Italy and its trading partners, and positively correlated with market size, FDI, and membership to the EU. However, we found that considering the degree of specialization by quality within industries, Italy's IIT in low-quality products is higher the lower the factor endowment difference and the higher the technological gap with the partner country. These findings confirm the peculiarity of the Italian specialization model which is strongly different from that of other main industrialized countries which are located mainly at the higher end of the price-quality spectrum.

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