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7 Intra-Industry Trade Among Exporters of Manufactured Goods[1]

Bela Balassa

7.1 INTRODUCTION

This paper examines the determinants of intra-industry specialisation[2] in manufactured goods in bilateral trade among countries whose manufactured exports exceeded $300 million and accounted for at least 18 per cent of their total merchandise exports, in 1979. This choice has been made because intra-industry trade occurs principally in manufactured goods that, in their large majority, are characterised by product differentiation.

Secton 7.2 presents alternative hypotheses put forward in the theoretical literature as regards the determinants of intra-industry trade. Section 7.3 describes the methodology of estimation utilised in explaining variations in the extent of intra-industry trade among pairs of countries, defined as the relative share of such trade in their total trade. Section 7.4 reports the results obtained for the entire group of countries as well as for trade among developed countries, among developing countries, and between developed and developing countries. Section 7.5 provides an evaluation of the results obtained for the various groups of countries and indicates their policy implications. In the Appendix, comparisons are made with results provided by Loertscher and Wolter (1980) for the developed countries.[3]

7.2 THEORETICAL HYPOTHESES EXPLAINING INTRA-INDUSTRY TRADE

In examining possible hypotheses to explain the extent of intra-industry trade between pairs of countries, consideration will be given to general country characteristics, including the level of economic development and differences thereof, the size of domestic markets and differences in market size, distance and the existence of common borders, as well as levels of protection. The investigation will further cover specific country characteristics, including participation in integration arrangements, common language, and former colonial ties, which pertain to certain countries only.

In analysing trade in differentiated products, Linder advanced the proposition that 'the more similar the demand structures of two countries, the more intensive, potentially, is the trade between these two countries' (1961, p. 94). He further argued that while 'a whole array of forces influences the demand structure of a country ... the level of average income is the most important single factor and that it has, in fact, a dominating influence on the structure of demand [so that] similarity of average income levels could be used as an index of similarity of demand structures' (p. 94). The converse of this proposition is that 'per capita income differences are a potential obstacle to trade... When per capita income differences reach a certain magnitude, trade can only take place in certain qualitatively homogeneous products' (Linder, p. 98).

Subsequently, Helpman provided proof of the proposition that, in the case when the home country has a lower (or equal) capital–labour ratio than the foreign country and factor prices are equalised, 'if we reallocate the world's labour and capital stock in a way which increases the foreign country's capital–labour ratio and reduces the home country's capital–labour ratio without disturbing commodity prices and factor rewards, then the share of intra-industry trade ... will decline' (1981, p. 325). Now, 'since the higher the capital–labour ratio the higher is income per capita (in a cross-section comparison), this raises the hypothesis that a country's share of bilateral intra-industry trade is negatively

correlated with the absolute difference in bilateral incomes per capita' (Helpman, p. 337).

Helpman also provided proof of the proposition that, in two countries that have the same capital–labour ratio, 'a redistribution of resources which preserves each country's initial capital–labour ratio increases the volume of trade if it reduces the inequality in country size, and it reduces the volume of trade if it increases the inequality in country size. The volume of trade is largest when both countries are of equal size' (p. 327). On the assumptions made, the entire increase in trade takes the form of intra-industry trade. Correspondingly, if capital–labour ratios differ among countries, the share of intra-industry trade will increase as the size of the two countries becomes more equal. Thus, one can hypothesise that the extent of intra-industry trade between any two countries will be negatively correlated with differences in their size.

The two propositions considered so far were combined by Dixit and Norman who showed that 'if the two countries are of similar size, and have no clear comparative advantage across industries, then we will see the predominant pattern of trade as one of intra-industry trade' (1980, p. 288). Comparative advantage is defined in terms of differences in factor endowments, for which per capita income differences may again be used as a proxy.

Linder further suggested that 'the higher the per capita income, the higher will be the degree of quality characterising the demand structure as a whole' when higher product quality is embodied in 'more complex, elaborated, refined or luxurious' products (1961, p. 99). As these products tend to be differentiated, the extent of intra-industry trade between any two countries is expected to be greater, the higher is their (average) per capita income.

Finally, Lancaster showed that owing to economies of scale, the equilibrium number of differentiated manufactured products will be the greater, the larger is the size of the market (1980, p. 158).[4] Correspondingly, it may be hypothesised that the extent of intra-industry trade between any two countries will be positively correlated with their (average) size.

We have considered here various hypotheses linking the level of development and country size (and inter-country differences thereof) to the extent of intra-industry trade. According to these hypotheses, the extent of intra-industry trade is expected to be positively correlated with average per capita incomes and the average size of the two countries and negatively correlated with inter-country differences in per capita incomes and in country size.[5] While the hypotheses have originally been formulated in a two-country model, in the present case they will be tested in the framework of a multi-country model.

The next question concerns the introduction of transportation costs. In models of intra-industry trade, such as that by Krugman (1980), transportation costs will reduce the volume of such trade. However, the literature does not provide us with a presumption that intra-industry trade will be affected relatively more (or less) than inter-industry trade. Such a presumption may be established if information flows are taken into account. There is less need to provide information on the characteristics of standardised (non-differentiated) products such as copper metal, steel ingots, and caustic soda, which have uniform specifications across the world; hence their trade is determined by relative costs, giving rise to inter-industry specialisation. However, there is need for information on the characteristics of differentiated products such as machinery, transport equipment, and consumer goods, which are subject to intra-industry trade. At the same time, it can be assumed that the availability of information decreases, and its costs increase, with distance. Correspondingly, it may be hypothesised that the extent of intra-industry trade between any two countries will be negatively correlated with the distance between them.

The existence of common borders will also contribute to information flows. Furthermore, as Grubel and Lloyd suggested, in countries sharing a common border, intra-industry trade may occur 'in products which are functionally homogeneous but differentiated by location' (1975, p. 5). Thus, it may be hypothesised that the extent of intra-industry trade will be higher between countries that share a common border than between countries which do not have

common borders. At the same time, the separate introduction of distance and border variables permits testing the hypothesis that common borders have economic significance for intra-industry trade beyond that of distance.

In a model incorporating specific capital and constant returns to scale, Falvey found that the volume of intra-industry trade will vary inversely with the level of tariffs and of trade restrictions in general (1981, p. 505). But, again, the question is whether tariffs will affect intra-industry trade relatively more than inter-industry trade. The present author suggested that such would be the case in the event of trade liberalisation in general and economic integration in particular. Thus, 'once manufacturing industries have been established, the elimination of protective measures on trade among developed countries does not appear to reverse the effects these measures had on industrial composition and the location of industry' (Balassa, 1977, p. 250). This will happen as adjustments to reductions in trade barriers occur largely through rationalising operations and changing the product composition of individual industries, with national product differentiation contributing to intra-industry trade.

The author further showed that trade liberalisation and economic integration in the European (1966, 1975) and the Latin American area (1974) was in fact accompanied by increases in the extent of intra-industry trade among the countries in question. In the present investigation, the hypotheses will be tested that the extent of intra-industry trade between any two countries is negatively correlated with the average level of their trade restrictions and positively correlated with participation in integration schemes.

Familiarity with each other's products may also contribute to intra-industry trade between particular countries. Common language breeds familiarity as does the existence of past colonial ties. It will be hypothesised that the existence of a common language and former colonial ties increases the extent of intra-industry trade between any two countries.

7.3 THE METHODOLOGY APPLIED

The investigation covers thirty-eight major exporters of manufactured goods.[6] Calculations have further been made for trade among eighteen developed countries, among twenty developing countries, and between developed and developing countries.

As defined for purposes of the study, developed countries cover the income range between $6,758 and $2,254 in 1973 at the exchange rate prevalent in that year. In decreasing order of their per capita GNP, the countries in question are Switzerland, United States, Sweden, Denmark, Germany, Australia, Canada, Norway, France, Belgium, Netherlands, Japan, Finland, Austria, United Kingdom, Israel, Italy, and Ireland. Using the same principle of ordering, with per capita GNP ranging from $2,031 to $96, the developing countries included in the study are Spain, Singapore, Greece, Argentina, Hong Kong, Portugal, Yugoslavia, Mexico, Brazil, Taiwan, Malaysia, Tunisia, Korea, Morocco, Turkey, Egypt, Thailand, Philippines, India, and Pakistan.

Manufactured goods have been defined by reference to the United States Standard Industrial Classification. Excluding natural resource products, altogether 167 industry categories have been established by merging four-digit categories in cases when the economic characteristics of the products in question were judged to be very similar. This has reduced the possibility of the heterogeneity of product categories that gives rise to spurious intra-industry trade.

The index of intra-industry trade for any pair of countries (IIT_{jk}) has been derived as in equation (1) where X^e_{jki} and M^e_{jki} refer to the adjusted exports and imports of commodity i in trade between countries j and k. The formula makes adjustment for imbalance in total trade between any pair of countries, when X_{jk} and M_{jk}, respectively, stand for the total exports and imports of country j in trade with country k.[7] The index takes values from 0 to 1 as the extent of intra-industry trade increases:

$$IIT_{jk} = 1 - \frac{\sum_i |X^e_{jki} - M^e_{jki}|}{\sum_i (X^e_{jki} + M^e_{jki})} = 1 - \frac{\sum_i \left| \frac{X_{jki}}{X_{jk}} - \frac{M_{jki}}{M_{jk}} \right|}{\sum_i \left(\frac{X_{jki}}{X_{jk}} + \frac{M_{jki}}{M_{jk}} \right)} \quad (1)$$

where:

$$X^e_{jki} = X_{jki} \frac{X_{jk} + M_{jk}}{2X_{jk}} \text{ and } M^e_{jki} = M_{jki} \frac{X_{jk} + M_{jk}}{2M_{jk}}$$

A linear or loglinear regression equation may give estimated values that lie outside the 0 to 1 range. A logistic function, defined in equation (2), does not have this shortcoming;[8] however, its logit transformation[9] cannot handle values of 0 or 1. Since a value of zero provides relevant information, representing the extreme case of inter-industry specialisation, equation (2) has been estimated by non-linear least squares in the present investigation.[10]

$$IIT_{jk} = \frac{1}{1 + \exp - \beta' z_{jk}} \quad (2)$$

where z_{jk} is the vector of the explanatory variables.

With income levels expressed in terms of per capita GNP (Y/P), country size has been represented by the gross national product (Y); averages of the two variables (AY/P and AY) have further been calculated for every pair of countries. At the same time, rather than taking absolute differences between per capita GNP and GNP to represent inter-country differences in income levels and country size, a relative inequality measure has been introduced that takes values between 0 and 1, with $INEQY/P$ denoting inequality in per capita GNP, and INEQY representing inequality in GNP. This measure, shown in equation (3) for INEQY, is superior to the use of absolute differences, which are affected by the absolute magnitudes of the values taken in the individual countries:

$$\text{INEQY} = 1 + [w \ln(w) + (1 - w)\ln(1 - w)]/\ln 2 \quad (3)$$

where

$$w = \frac{Y_k}{Y_j + Y_j},$$

Geographical distance (D) is measured in terms of miles between the centres of geographical gravity of a pair of countries. In turn, the existence of a common border between a pair of countries has been introduced in the form of a dummy variable.

Estimates of tariff levels are not available for a number of countries and the tariff equivalent of quantitative import restrictions is not known with any confidence for others. Correspondingly, an indicator of trade orientation has been used to represent the extent of trade restrictions. Trade orientation has been defined in terms of deviations of actual from hypothetical values of per capita exports. Hypothetical values have been derived from a regression equation that, in addition to the per capita income and population variables utilised in early work by Chenery (1960), includes variables representing the availability of mineral resources and propinquity to markets.[11]

Mineral resource availability has been represented by the ratio of mineral exports (X^m) to the gross national product, while propinquity has been defined as the weighted average of the inverse of distance between country j and partner country k, the weights being the gross national product of the partner countries $\Sigma_k(Y_k D_{jk})/\Sigma_k Y_k$. The results are reported in equation (4), with t-values shown in parentheses; all the regression coefficients are significant at the 1-per-cent level, using a one-tail test.[12]

$$\log \frac{X_j}{P_j} = \underset{(0.38)}{0.1864} + \underset{(15.02)}{0.9212} \log(Y_j/P_j) - \underset{(6.83)}{0.3541} \log P_j$$

$$+ \underset{(2.91)}{0.0251}\, X_j^m/Y_j + \underset{(2.06)}{0.0598} \sum \frac{Y_k/D_{jk}}{\Sigma_k Y}; \; \bar{R}^2 = 0.9404 \qquad (4)$$

While the lack of data on tariffs and non-tariff barriers does not permit one to test the results of the equation for the

individual countries, the pattern of the estimates indicates their practical usefulness. Thus, deviations from the regression line are larger for developing countries than for developed countries, reflecting the fact that variations in trade policies are greater in the former group than in the latter. Also, upward deviations are the largest in cases, such as Korea, Hong Kong, Singapore, and Taiwan, where outward-orientated policies have been applied, while downward deviations predominate in countries such as Argentina, Egypt, India and Mexico, characterised by inward-orientation.[13]

For any pair of countries, the sum of their trade-orientation index (ATO) has been introduced in the estimating equations to test the hypothesis that the extent of intra-industry trade is positively correlated with trade orientation. In turn, dummy variables have been included to represent participation in integration arrangements, such as the European Economic Community (EEC), the European Free Trade Association (EFTA), and the Latin American Free Trade Association (LAFTA). Dummy variables have also been used for common languages, such as English, Spanish, French, German, Portuguese, and Scandinavian. Finally, dummy variables have been introduced to denote the former colonial ties of United Kingdom (UKCOL) and France (FRCOL).

7.4 THE EMPIRICAL RESULTS

The empirical estimates for the entire group of thirty-eight countries are reported in Table 7.1. Equation (4) shows the results of estimation including the common characteristics of the countries cited in section 7.3, together with dummy variables for economic integration, common language, and colonial ties. In equation (5) those variables of equation (4) have been retained that were statistically significant at least at the 10-per-cent level. Finally, equation (6) includes common country characteristics only.

The results support the hypotheses put forward in section 7.2 as far as the common characteristics of the countries in

Table 7.1: *Estimates of intra-industry trade for countries exporting manufactured products—developed and developing countries combined (regression coefficients, with t-values in parenthesis)*

	Equation (4)	Equation (5)	Equation (6)
Constant	3.140 (11.21)	3.216 (11.78)	3.151 (11.36)
ℓn AY/P	0.662 (8.62)	0.670 (8.82)	0.698 (9.52)
INEQ Y/P	−1.115 (6.62)	−1.106 (6.60)	−1.214 (6.92)
ℓn AY	0.400 (11.84)	0.407 (12.40)	0.368 (11.46)
INEQY	−0.820 (7.31)	−0.847 (7.76)	−0.818 (7.23)
ATO	0.483 (10.54)	0.492 (10.93)	0.494 (10.98)
ℓn D	−0.525 (19.43)	−0.532 (20.24)	−0.531 (20.04)
BORDER	0.331 (3.69)	0.381 (4.89)	0.400 (4.94)
EEC	0.154 (1.28)	—	—
EFTA	0.368 (4.37)	0.371 (4.89)	—
LAFTA	2.047 (6.74)	2.050 (6.79)	—
ENGLISH	0.233 (2.26)	0.218 (2.12)	—
SPANISH	1.400 (5.14)	1.413 (5.21)	—
FRENCH	0.081 (0.25)	—	—
GERMAN	0.107 (0.56)	—	—
PORT.	0.024 (0.02)	—	—
SCAND.	0.068 (0.46)	—	—
FRCOL	−0.141 (0.21)	—	—
UKCOL	0.457 (2.00)	0.473 (2.07)	—
$\bar{R}^2$	0.8721	0.8772	0.8573
$\hat{\sigma}$	0.0707	0.0705	0.0741
N	684	684	684

Note: For the definition of the variables and explanation of methodology, see text.

question are concerned. Thus, the regression coefficients of the average per capita income, income inequality, average country size, inequality in country size, trade orientation, distance, and border variables all have the expected sign and are statistically significant at the 1-per-cent level in equations (4) to (6).

Among the economic integration variables, the EFTA and the LAFTA dummies have the expected sign and are statistically significant at the 1-per-cent level. In turn, the EEC dummy has the expected sign, but is not significant even at the 10-per-cent level. While this may seem surprising

in view of the emphasis given to intra-industry specialisation in the European Economic Community from the mid-sixties (Balassa, 1966) onwards, the results appear to indicate that general country characteristics, including the border variable, largely explain the extent of intra-industry trade among the EEC countries.

The English- and Spanish-language variables have the expected sign and are significant at the 1-per-cent level, whereas the other language dummies have very low t-values. The latter conclusion also applies to the French colonial ties variable which has a negative sign; in turn, the variable for English colonial ties has the expected positive sign and it is statistically significant at the 5-per-cent level.

The French-language and colonial-ties variables are highly intercorrelated as the former includes the latter plus Belgium and Switzerland.[14] At the same time, the results are not affected if only one or the other of the variables is included in the estimating equation. It would, then, appear that trade ties between France and its former colonies largely involves inter-industry specialisation.

Table 7.2 provides the results obtained for intra-industry trade among developed countries. Equation (7) includes all the relevant variables; it omits the dummies for LAFTA, Spanish and Portuguese languages, and colonial ties. Equation (8) also excludes variables whose level of statistical significance did not reach 10 per cent, while equation (9) incorporates only the common country characteristics.

With the exception of intercountry differences in income levels, the results support the hypotheses confirmed by the estimates for the entire group of countries. However, apart from the EEC dummy, the statistical significance of the coefficients is lower than in the previous case, and two variables (AY/P and BORDER) are significant at only the 5-per-cent level and one variable (English) at the 10-per-cent level.

The lack of statistical significance of the variable representing inter-country differences in per capita incomes may be explained by the fact that, with income differences being much smaller among developed countries than in the entire group of countries, the demand structure of the countries

Table 7.2: *Estimates of intra-industry trade for countries exporting manufactured products—trade among developed countries (regression coefficients, with t-values in parenthesis)*

	Equation (7)	Equation (8)	Equation (9)
Constant	2.299 (2.82)	2.243 (2.87)	2.497 (3.10)
ℓn AY/P	0.596 (2.32)	0.660 (2.69)	0.680 (2.66)
INEQ Y/P	−0.775 (0.77)	—	−0.548 (0.53)
ℓn AY	0.298 (3.99)	0.299 (4.07)	0.277 (3.82)
INEQY	−0.579 (2.84)	−0.608 (3.05)	−0.677 (3.34)
ATO	0.792 (3.20)	0.765 (3.26)	0.738 (2.98)
ℓn D	−0.445 (8.95)	−0.452 (9.28)	−0.478 (9.64)
BORDER	0.265 (2.11)	0.343 (3.14)	0.401 (3.59)
EEC	0.252 (1.65)	0.210 (1.46)	—
EFTA	0.353 (3.13)	0.404 (3.99)	—
ENGLISH	0.271 (1.74)	0.244 (1.59)	—
FRENCH	0.037 (0.09)	—	—
GERMAN	0.226 (0.95)	—	—
SCAND.	0.218 (1.13)	—	—
$\bar{R}^2$	0.9467	0.9458	0.9390
$\hat{\sigma}$	0.0846	0.0841	0.0886
N	153	153	153

Note: See Table 7.1.

concerned is also more similar. Correspondingly, one may not expect large variations to occur in the extent of intra-industry trade as a function of income differences.

In turn, the lower level of significance of the English-language variable may be attributed to the fact that several of the English-speaking countries are in the developing country sample. Finally, the EEC dummy is (barely) significant at the 10-per-cent level in equation (7), indicating the relevance of this variable once developing countries are omitted from the calculations.

The level of significance of the EEC dummy variable (slightly) falls below the benchmark in equation (8) that excludes the variables which were not significant at the 10-per-cent level as in equation (7). The same fate befalls the English-language variable, but again by a small margin.

By contrast, the EFTA dummy remains statistically significant at the 1-per-cent level. Also, the level of significance of the average per capita income and the border variables improves to 1 per cent as the variables that were not significant at the 10-per-cent level are eliminated from the estimating equation. These results are not affected if only the variables representing the common country characteristics are retained as in equation (9).

The EEC, EFTA, the German- and Scandanavian-language, and the colonial-ties variables have been omitted from equation (10), estimated for intra-industry trade among developing countries and reported in Table 7.3. The per capita income inequality variable is again not statistically significant, reflecting considerations similar to those adduced for the developed country group. Apart from this variable, the results again support the hypotheses confirmed

Table 7.3: *Estimates of intra-industry trade for countries exporting manufactured products—trade among developing countries (regression coefficients, with t-values in parenthesis)*

	Equation (10)	Equation (11)	Equation (12)
Constant	5.121 (3.92)	4.782 (3.76)	6.738 (5.80)
ℓn AY/P	1.117 (4.02)	1.291 (5.11)	1.349 (4.53)
INEQ Y/P	−0.564 (0.98)	—	−0.283 (0.50)
ℓn AY	0.872 (3.57)	0.807 (3.43)	1.356 (7.56)
INEQY	−1.592 (2.14)	−1.522 (2.11)	−3.344 (5.73)
ATO	0.875 (7.88)	0.869 (8.26)	1.031 (8.65)
ℓn D	−0.609 (5.79)	−0.611 (6.03)	−0.531 (5.04)
BORDER	0.880 (2.48)	0.821 (2.38)	1.118 (3.84)
LAFTA	2.187 (5.56)	2.274 (5.80)	—
ENGLISH	0.776 (3.33)	0.641 (3.18)	—
SPANISH	1.556 (3.90)	1.610 (4.02)	—
FRENCH	0.404 (0.05)	—	—
PORT.	0.620 (0.55)	—	—
$\bar{R}^2$	0.7402	0.7385	0.6671
$\hat{\sigma}$	0.0501	0.0498	0.0558
N	175	175	175

Note: See Table 7.1

for the entire group of thirty-eight countries, although the inequality in country size and the border variables are significant at only the 5-per-cent level.

The LAFTA and the Spanish- and English-language dummies are statistically significant at the 1-per-cent level, representing an improvement in the case of the latter variable over the previous results. In turn, if these variables are omitted as in equation (12), the level of significance of the inequality in country size and the border variables improves to 1 per cent.

Finally, all the variables representing the common characteristics of the countries are statistically significant at the 1-per-cent level in equation (13), which provides estimates for intra-industry trade between pairs of developed and developing countries (Table 7.4). Among the dummy variables for economic integration, common language, and colonial ties, the EFTA dummy pertaining to trade between the developed member countries and Portugal is significant

Table 7.4: *Estimates of intra-industry trade for countries exporting manufactured products—trade between developed and developing countries (regression coefficients, with t-values in parenthesis)*

	Equation (13)	Equation (14)	Equation (15)
Constant	2.749 (5.59)	2.693 (5.61)	2.591 (5.45)
ℓn AY/P	0.741 (3.63)	0.765 (3.81)	0.768 (3.86)
INEQ Y/P	−1.373 (5.48)	−1.322 (5.33)	−1.383 (5.58)
ℓn AY	0.408 (6.34)	0.403 (6.28)	0.378 (6.03)
INEQY	−0.635 (2.79)	−0.622 (2.77)	−0.561 (2.50)
ATO	0.333 (4.38)	0.348 (4.70)	0.358 (4.91)
ℓn D	−0.483 (9.38)	−0.482 (9.54)	−0.476 (9.65)
BORDER	0.789 (4.08)	0.785 (4.06)	0.787 (4.06)
EFTA	0.354 (1.71)	0.343 (1.66)	—
ENGLISH	0.165 (0.81)	—	—
FRENCH	0.982 (2.17)	—	—
FRCOL	−0.010 (1.37)	—	—
UKCOL	0.541 (1.50)	0.675 (2.08)	—
$\bar{R}^2$	0.6993	0.6966	0.6920
$\hat{\sigma}$	0.0713	0.0713	0.0717
N	356	356	356

at the 10-per-cent level while the French-language and the British colonial-ties variables reach this level of significance under some specifications but not under others.[15]

It is apparent that, apart from the income inequality variable that loses its statistical significance in cases where the inter-country variation of incomes is more limited, the variables representing the common characteristics of the countries concerned are highly significant statistically, regardless of the choice of the country sample or the specifications of the estimating equations. Several of the variables pertaining to economic integration, common language, and colonial ties are also statistically significant, but, with the exception of the developing country group, they add little to the explanatory power of the equations. Also, the coefficient of determination remains practically unaffected if variables whose level of significance does not reach 10 per cent are omitted from the regression equations.

The coefficient of determination is highest (0.95) in the equation explaining intra-industry trade among developed countries. This result is of particular interest in view of the fact that, as first suggested by Linder, the extent of intra-industry specialisation is much greater in trade among developed countries than in trade among developing countries or between developed and developing countries.[16] At the same time, it is noteworthy that the explanatory power of the regression equation is high, with coefficients of determination of 0.74 and 0.70, in the latter two cases also; it is 0.87 in the equation pertaining to the entire group of countries.[17]

7.5 EVALUATION OF THE RESULTS

Various hypotheses put forward in the theoretical literature as regards the determinants of intra-industry specialisation have been tested in this paper for trade among countries exporting manufactured goods. This has been done in regard to trade among all the countries meeting certain criteria, as well as for trade among developed countries, among de-

veloping countries, and between developed and developing countries.

The results show that the extent of intra-industry trade between any two countries increases with their average income level, represented by per capita GNP, and with their average size, represented by GNP, and it decreases with differences in their income level and in their size. However, differences in income levels are not significantly related to the extent of intra-industry specialisation in trade among developed and among developing countries, where income differences are much smaller than between developed and developing countries.

It further appears that the extent of intra-industry trade is positively correlated with the trade orientation of the countries concerned and with the existence of a common border, and it is negatively correlated with distance between them. Taken together, these common characteristics of countries explain much of the variation in the extent of intra-industry specialisation, with the coefficient of determination ranging from 0.95 in trade among developed countries to 0.67 for trade among developing countries.

Introducing variables for economic integration, common language, and colonial ties increases the explanatory power of the regression equation relatively little, the exception being the equation for trade among developing countries. At the same time, several of these variables are highly significant statistically. Thus, it is apparent that participation in the European Free Trade Association and in the Latin American Free Trade Association increases the extent of intra-industry trade. The regression coefficient for EEC membership is also positive, but its level of statistical significance rarely reaches 10 per cent. Finally, English and Spanish as common languages and English colonial ties appear to contribute to intra-industry specialisation.

While the statistical significance of the estimates for the various country groups is generally high, the regression coefficients of several of the variables vary among the groups. The statistical significance of these differences has been tested in regard to the three subgroups by utilising the results obtained in equations (9), (12), and (15) that contain

common country-characteristics, so as to ensure comparability in the results.

As shown in equations (16), (17), and (18), the differences in the regression coefficients are not statistically significant in regard to the average per capita GNP, income inequality, and distance variables at the 10-per-cent level, and in regard to the border variables at the 5-per-cent level, in any of the three comparisons (Table 7.5). Nor are there statistically significant differences at the 5-per-cent level in regard to any of the variables if the estimates for intra-industry trade between developed and developing countries and among developed countries are compared. However, differences in the regression coefficients of the average country size and the size inequality variables are significant at the 1-per-cent level in the other two comparisons. The same conclusion

Table 7.5: *Differences between regression coefficients estimated in the three sub-groups*[a] *(with t-values in parenthesis)*

	Trade among developing countries and trade among developed countries	Trade between developed and developing countries, and trade among developed countries	Trade between developed and developing countries, and trade among developing countries
	Equation (16)	Equation (17)	Equation (18)
Constant	4.241 (2.58)	0.094 (0.12)	−4.148 (2.62)
ℓn AY/P	0.669 (1.53)	0.088 (0.31)	−0.581 (1.34)
INEQ Y/P	0.264 (0.24)	−0.836 (0.95)	−1.100 (1.42)
ℓn AY	1.079 (4.50)	0.101 (1.17)	−0.978 (4.07)
INEQY	−2.667 (3.45)	0.116 (0.42)	2.783 (3.53)
ATO	0.293 (1.15)	−0.380 (1.77)	−0.673 (3.94)
D	−0.052 (0.37)	0.002 (0.03)	0.055 (0.38)
BORDER	0.717 (1.85)	0.386 (1.79)	−0.331 (0.78)
joint test[b]	31.38	11.07	35.05

Notes:

(a) The differences are derived from pairwise comparisons between equations (9), (12), and (15).

(b) The statistic for the joint test of equality is distributed as a chi-square random variable, with eight degrees of freedom.

applies to the trade orientation variable, when the estimates for the trade between developed and developing countries and among developing countries are compared.

In addition to testing the statistical significance of differences between the individual regression coefficients, combined tests for these coefficients have also been carried out. As it is apparent from the results of Table 7.5, the hypothesis that the regression coefficients, taken jointly, are equal is rejected in the comparisons of the equation pertaining to intra-industry trade among developing countries with the other two equations; it is accepted in the comparison of the estimates for trade among developed countries and between developed and developing countries.

Almost twenty years ago the author analysed the benefit of intra-industry trade through the increased exchange of consumer goods and specialisation in narrow ranges of machinery and intermediate products. These benefits include greater satisfaction of consumer needs as well as the exploitation of economies of scale through the lengthening of production runs (Balassa, 1966). It is apparent that developing countries can increasingly obtain the benefits of intra-industry trade as they reach higher levels of economic development. At the same time, the findings of the paper point to the conclusion that these benefits can be augmented through the liberalisation of trade that contributes to intra-industry trade.

The paper thus provides an additional argument for trade liberalisation. This argument has relevance to developed as well as to developing countries. At the same time, the paper provides some support for regional integration efforts that also contribute to intra-industry trade, although the results for the European Economic Community are not very strong.

APPENDIX TO CHAPTER 7: COMPARISONS WITH ESTIMATES BY LOERTSCHER AND WOLTER *LUC BAUWENS*[18]

The only comparable estimates of the determinants of intra-industry specialisation in bilateral trade are those by

Loertscher and Wolter, who made calculations for OECD countries other than Australia and New Zealand.[19] Table 7.6 reports the Loertscher–Wolter results, together with estimates for the same group of countries derived by using the data of this study.

In order to ensure comparability, the variables used in the present study have been redefined to correspond to those of Loertscher and Wolter. This has involved using absolute differences of per capita GNP (DY/P) and GNP (DY) in the place of the inequality measures, omitting the trade orientation variable, and combining the dummy variables for economic integration (EI) and common languages (CL). However, a cultural group (CG) dummy variable has not been included because of its intercorrelation with the language variable.

In interpreting the estimates it should be noted that the index of intra-industry trade used by Loertscher and Wolter (P_{jk}) is scaled to vary between 0 and 100. Furthermore, in applying logit analysis with weighted least squares, Loertscher and Wolter weighted the independent but not the dependent variable by $[P_{jk}(100 - P_{jk})]^{\frac{1}{2}}$ (1980, p. 288). This is incorrect, and in the estimates reported in equation (20) the dependent variable has also been appropriately weighted. At the same time, as noted below, the coefficient values and their level of significance are affected to a considerable extent if the incorrect weighting procedure is used.

Table 7.6 further reports the results obtained by nonlinear least squares estimation of the logistic function used elsewhere in this investigation. The results show that the average size variable, the size differential variable, as well as the distance variable are statistically significant at the 1-per-cent level in all the equations. The per capita income differential variable is also significant at the 1-per-cent level in the present study. In turn, the average per capita income variable is not significant in the Loertscher–Wolter study while it is significant at the 1-per-cent level in the estimates of this study. Among the remaining variables, the economic integration dummy is statistically significant at the 5-per-cent level in the estimates derived by weighted least squares in both studies, whereas the common language dummy is

Table 7.6: *Estimates of intra-industry trade among OECD countries (regression coefficients, with t-values in parenthesis)*

	Loertscher-Wolter[a] weighted least squares	*This study* weighted least squares	nonlinear least squares
	Equation (19)	Equation (20)	Equation (21)
Constant	−78.300 (n.a.)	1.855 (3.75)	2.419 (5.03)
ℓn AY/P	−0.210 (0.25)	0.877 (6.06)	0.954 (6.60)
ℓn DY/P	−0.436 (8.92)	−0.075 (1.89)	−0.063 (1.66)
ℓn AY	0.619 (7.85)	0.580 (6.47)	0.617 (7.25)
ℓn DY	−0.251 (2.67)	−0.246 (4.34)	−0.243 (4.73)
ℓn D	−0.408 (5.59)	−0.438 (9.28)	−0.527 (11.05)
Border	0.094 (0.03)	0.259 (1.93)	0.195 (1.61)
EI	0.535 (2.12)	0.385 (2.36)	0.418 (2.77)
CL	0.166 (0.09)	0.286 (2.13)	0.342 (2.80)
CG	0.363 (0.99)	n.a.	n.a.
$\bar{R}^2$	0.147	0.798	0.927
$\hat{\sigma}$	n.a.	0.089[b]	0.088
N	187	190	190

Notes:
(a) All the regression coefficients should be multiplied by 10^{-2}. This is explained by the scaling of the index of intra-industry trade and the lack of weighting of the dependent variable.
(b) Standard deviation of the differences between the observed values of IIT_{jk} and the estimated values computed by using the estimates of equation (20).

significant at the 1-per-cent level in the non-linear least squares, and at the 5-per-cent level in the weighted least squares estimates of this study and not at all in the Loertscher–Wolter study. Applying the incorrect weighting procedure used by Loertscher and Wolter to the data of the present study, the average per capita income, average size and distance variables are significant at the 1-per-cent level, the differential size variable barely attains the 10-per-cent level of significance while the other variables are far from reaching this level. Furthermore, the absolute values of the coefficients are affected to a considerable extent, although

all retain the expected sign. Finally, the standard error of the implied residuals is 0.146, while the adjusted coefficient of determination drops to 0.462. The latter value is nonetheless much higher than in the Loertscher–Wolter results (0.147).