Intra-Industry Specialization
A Cross-Country Analysis
This paper tests various hypotheses as to the determinants of intra-industry trade in thirty-eight developed and developing countries exporting manufactured goods. The econometric estimates for the entire group of countries show that the extent of intra-industry trade increases with the level of economic development (GNP per head), the size of domestic markets (GNP), and the openness of national economies. The existence of trading partners with common borders and geographical proximity further contributes to intra-industry trade.

These hypotheses have also been confirmed for the developing country group. And while similarities in regard to trade orientation and the existence of border trade, as well as intercorrelation between the gross national product and per capita GNP, have reduced the statistical significance of the regression coefficients for these variables for the developed country group, this equation also has a high explanatory power.

1. Introduction

Since the introduction of the concept of intra-industry – as compared to inter-industry – trade [Balassa (1966)], a vast literature has developed on the subject. Efforts at the measurement of the extent of intra-industry specialization, i.e., its relative importance within a country's total trade, have been followed by research on the theory of intra-industry trade and its determinants.

The present paper investigates the determinants of intra-industry specialization in a cross-country framework by taking the country as the unit of observation. In so doing, it takes as the point of departure the work of Krugman (1979 and 1980), Lancaster (1980), and Helpman (1981) who established the theoretical rationale for the existence of intra-industry trade as distinct from inter-industry trade.

At the same time, the question has been raised, prominently by Finger (1975), if intra-industry trade is not a statistical artifact. But Finger

The expressions 'intra-industry trade' and 'intra-industry specialization' will be used interchangeably in the paper.
B. Balassa, Intra-industry specialization

subsequently qualified his position (1978) and later came to offer estimates of his own, although using the expression 'trade overlap' instead of intra-industry trade (1979). Furthermore, it has been shown that there is intra-industry trade even if a very fine trade classification is used [Gray (1979) and Abd-El-Rahman (1985)]. Finger's question is, however, answered not by disaggregation but by establishing meaningful industry categories. As noted below, this paper attempts to make use of such categories.

The objective of the paper is to explain intercountry differences in the extent of intra-industry trade in manufactured goods by reference to country characteristics affecting such trade. The investigation covers altogether 38 developed and developing countries that are major exporters of manufactured goods. Estimates are made for all the countries taken together, as well as for 18 developed and for 20 developing countries.

The subject matter chosen for the investigation is a neglected area as most contributions have examined the effects of commodity characteristics on intra-industry specialization. Exceptions are Loertscher and Wolter (1980), Bergstrand (1983), Havrylyshyn and Civan (1983), and Clair, Gaussens and Phan (1984). But these papers covered only developed country trade, the exception being the Havrylyshyn–Civan paper which included the trade of both developed and developing countries; comments on their estimation procedures, and comparisons with their results, will be offered below.

Section 2 of the paper examines a variety of possible hypotheses that may be put forward to explain the extent of intra-industry trade in a cross-country framework. Section 3 describes the methods and data used in the process of estimation. Section 4 reports the empirical results for all the countries under study and makes comparisons with the Havrylyshyn–Civan paper. Section 5 reports estimates for the developed and for the developing country groups. Section 6 provides a brief overview of the principal findings.

2. Hypotheses

In the following, a number of hypotheses will be reviewed, which may be introduced to explain intercountry differences in the extent of intra-industry trade. They pertain to the level of economic development, the size of domestic markets, transportation costs (distance), common borders with other countries, the level of trade restrictions, and participation in integration arrangements.

Staffan Burenstam Linder (1961) was the first to suggest that, at higher levels of economic development, international trade will increasingly involve the exchange of differentiated products, i.e., intra-industry specialization. Following Linder, one may formulate the hypothesis that the extent of intra-industry trade will be positively correlated with the level of economic development.
In turn, Lancaster (1980, p. 158) 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.\(^2\) Correspondingly, it may be hypothesized that the extent of intra-industry trade will be positively correlated with the size of the domestic market.

In models of intra-industry trade, such as that of Krugman (1980), transportation costs will reduce the volume of such trade. However, the literature does not provide a presumption as to whether intra-industry trade would be affected relatively more (or less) than inter-industry trade by transportation costs. Such a presumption may be established if information flows are taken into account.

There is no need to provide information on the characteristics of standardized (non-differentiated) products, such as copper metal, steel ingots and caustic soda, which have uniform specifications across the world; correspondingly, their trade is determined largely by relative costs, giving rise to inter-industry specialization. However, information is needed 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 hypothesized that the extent of intra-industry trade will be negatively correlated with the average distance of a country from its trading partners.

The existence of common borders will also contribute to information flows. Furthermore, as Grubel and Lloyd (1976, p. 5) suggested, in countries sharing a common border intra-industry trade may occur ‘in products which are functionally homogeneous but differentiated by location’. Thus, it may be hypothesized that the extent of intra-industry trade will be greater in a country which shares a common border with its trading partners. 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 over and above that of distance.

In a model incorporating specific capital and constant returns to scale, Falvey (1981, p. 505) found that the volume of intra-industry trade will vary inversely with the level of tariffs and trade restrictions in general. But, again, the question is if 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 liberalization 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

\(^2\)This result will not obtain if economies of scale are derived from a homogeneous production function.
not appear to reverse the effects these measures had on industrial composition and the location of industry' [Balassa (1977, p. 250)]. This will happen if adjustments to reductions in trade barriers occur largely through rationalizing operations and changing the product composition of individual industries, with national product differentiation contributing to intra-industry trade.

The author further suggested that trade liberalization (1977) and economic integration in Western Europe (1966, 1975) and in Latin America (1979) 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 is negatively correlated with the level of trade restrictions and positively correlated with participation in integration schemes.

3. Methods and data

The hypotheses put forward to explain the extent of intra-industry trade in particular countries have been tested in a cross-country framework utilizing trade data for the year 1971. This has involved explaining intercountry differences in the extent of intra-industry trade by simultaneously introducing the described hypotheses in the estimating equations.

The investigation has been limited to manufactured goods where product differentiation predominates, with the exclusion of natural resource products whose trade is much influenced by the availability of such resources in individual countries. The commodity classification scheme utilized has been established on the basis of the United States Standard Industrial Classification, with 4-digit SIC categories merged in cases when the economic characteristics of the products in question were judged to be very similar. The investigation covers 38 countries whose manufactured exports

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3 The investigation excludes foods and beverages (SIC 20), tobacco (SIC 21), non-ferrous metals (SIC 333), as well as several 4-digit categories covering textile waste, preserved wood, sawmill products, prefabricated wood, veneer and plywood, wood pulp, dyeing and tanning extracts, fertilizers, adhesives and gelatin, carbon black, petroleum refining and products, asbestos and asphalt products, cement and concrete, lime gypsum products, cut stone products and lapidary work. It also excludes ordnance (SIC 19), for which comparable trade data are not available. In turn, SITC categories in classes 5 to 8 were included in the Loertscher-Wolter study and these classes less iron and steel (68) in the Havrylyshyn-Civan study while Bergstrand and Clair, Gaussens and Phan covered only SITC classes 7 and 5 and SITC class 7 respectively.

4 Similarity in product characteristics has been defined in terms of high substitution elasticities in production and/or consumption. This contrasts with investigations by other authors, including Loertscher-Wolter and Havrylyshyn-Civan, who used for this purpose the 3-digit Standard International Trade Classification that cannot be regarded as an economically meaningful classification. In turn, Bergstraad made calculations for bilateral trade in a 2-digit SITC breakdown while Clair, Gaussens and Phan utilized a 5-digit SITC breakdown.
exceeded $300 million in the year 1979 and accounted for at least 18 percent of their total exports.\textsuperscript{5}

This benchmark has been chosen in order to avoid spurious correlations between the extent of intra-industry trade and the level of economic development through the inclusion of countries which hardly export any manufactured goods.\textsuperscript{6}

The index of intra-industry trade for a particular country ($IIT_j$) has been derived as in (1), where $X_{ji}$ and $M_{ji}$, respectively, refer to the adjusted exports and imports of commodity $i$ by country $j$. The formula makes adjustment for the imbalance in total trade, when $X_j$ stands for total exports and $M_j$ for total imports.\textsuperscript{7} The index takes values from 0 and 1 as the extent of intra-industry trade increases.\textsuperscript{8}

\begin{equation}
IIT_j = 1 - \frac{1}{\sum_i (X_{ji} + M_{ji})} \sum_i \left| \frac{X_{ji} - M_{ji}}{X_{ji} + M_{ji}} \right|
\end{equation}

where

$$X_{ji} = \frac{X_j - M_j}{2X_j} \quad \text{and} \quad M_{ji} = \frac{M_j - X_j}{2M_j}$$

The level of development has been defined as GNP per head ($Y/P$). A dummy variable for developed and for developing countries has also been tried, but it has given poor statistical results. At any rate, the use of a continuous variable that recognizes the existence of gradation over the scale of economic development is preferable to a dummy variable that provides a binary classification.

Market size has been represented by the gross national product ($Y$). While the domestic consumption of manufactured goods would have been a more

\textsuperscript{5}Classification criteria pertaining to the year 1979 were used, so as to include countries that were actual or potential exporters of manufactured goods in 1971.

\textsuperscript{6}Loertscher-Wolter, Bergstrand, and Clair, Gaussens and Phan limited their investigation to the OECD countries while Havrylyshyn-Civan included a number of low income countries that export little manufactured goods. In the 62-country sample used by the two authors, the share of manufactured products in total exports did not reach 1 percent in Nigeria, the Central African Republic, Sudan, and Algeria while manufactured goods accounted for over 70 percent of total exports in most of the developed countries.

\textsuperscript{7}A consistent adjustment procedure was first proposed by Aquino (1978). However, while Aquino adjusted for the imbalance in trade in manufactured goods, in the present investigation adjustment has been made for the imbalance in total trade, so as to allow for inter-industry specialization between primary and manufactured goods [Balassa (1979)]. - The Aquino adjustment is used in the Loertscher-Wolter, Havrylyshyn-Civan and Clair-Gaussens-Phan studies while Bergstrand makes adjustment for imbalance in total trade on a bilateral basis.

\textsuperscript{8}I am indebted to Carl Christ for suggesting the transformation of eq. (1) shown here.
appropriate measure of the size of domestic market for these products, the necessary data are not available for several countries and are subject to considerable error for others. At the same time, from available information it appears that the consumption of manufactured goods and the gross national product are highly correlated.

Geographical distance has been introduced in the form of a variable for proximity. Following Glejser (1968) this has been defined as the weighted average of the inverse of distance \( D \) between country \( j \) and partner country \( k \), the weights being the gross national product \( Y \) of the partner countries \( \sum_k (Y_k/D_{jk})/\sum_k Y_k \).

In recent years, developed countries have made increased use of import restrictions that are the principal measures of protection in most developing countries. Estimates of the tariff equivalent of these measures are few and far between and, at any rate, their use is appropriate only under competitive conditions. This being the case, an indicator of trade orientation has been used to represent the level 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 utilized in early work by Chenery (1960), includes variables representing the availability of mineral resources and distance from foreign markets. The latter two variables have been included on the expectation that, ceteris paribus, the availability of mineral resources and proximity will raise per capita exports.

Mineral resource availability has been represented by the ratio of mineral exports \( X^m \) to the gross national product while proximity has been defined as stated above. The results are reported in eq. (2), with \( t \)-values shown in parentheses. All the regression coefficients are significant at the 1 percent level, using a one-tail test.

\[
\log \frac{X_j}{P_j} = -0.1864 + 0.9212 \log \left( \frac{Y_j}{P_j} \right) - 0.3541 \log P_j \\
+ 0.0251 \frac{X^m_j}{Y_j} + 0.0598 \sum_k \frac{Y_k/D_{jk}}{Y_k} \\
R^2 = 0.9404. \tag{2}
\]

In the long run, exports and imports tend to equality, hence it makes little difference as to whether exports or imports are used as the dependent variable.

The described procedure was first utilized in Balassa (1985); a distance variable has been added in the present paper. While population appears on both sides of the equation, as in Chenery's original formulation, and mineral exports are part of total exports, this should not affect the appropriateness of using deviations from hypothetical values as an indicator of trade orientation. Also, with the trade orientation variable being defined as a residual, the inclusion of some of the same variables in eq. (2) and in the equations of table 1 does not affect the values of the estimated regression coefficients derived from the latter. This has been confirmed in the early trials made with alternative estimating equations.
In turn, the border trade variable has been given a value of 1 for countries that have a common border with at least one trading partner covered by the investigation. Dummy variables have also been introduced for membership in the European Common Market and the Latin American Free Trade Association, as well as for Singapore that has considerable entrepot trade.

4. Empirical results

The index of intra-industry trade defined under (1) takes values between 0 and 1. There is no guarantee, however, that the predicted values of the regression equation will fall within this range when linear (3) or log-linear functions are used while such an outcome is ensured if a logistic function is chosen as in (4). The logistic function is thus more appropriate in the present case, but use has also been made of ordinary least squares, in part to test the sensitivity of the results to the choice of the estimation procedure and in part for comparability with other studies.

Estimation by ordinary least squares and by non-linear least squares utilizing a logistic function have given similar results in terms of the statistical significance of the variables and the explanatory power of the regression equations. The best statistical results are reported in table 1.

The regression coefficients of income per head, the gross national product, the trade orientation variable, the proximity variable, and the Singapore dummy are all statistically significant at the 1 percent level in every equation while the border dummy is significant at least at the 5 percent level. However, the dummy variables for economic integration are not significant at even the 10 percent level in any of the equations, when combined with the above variables, and they have been dropped from the estimating equations.

The coefficient of determination is 0.90 using ordinary least-squares and 0.98 utilizing non-linear least-squares. While differences in the estimation procedures do not allow a comparison of the adjusted $R^2$s, the residual standard deviations, estimated as the sum of squares of the residuals divided by the number of observations, are directly comparable. They are 0.067 and 0.066, practically identical in the two cases.

\[ IIT_j = \gamma'x_j, \]  
\[ IIT_j = \frac{1}{1 + \exp(-\beta'x_j)}, \]

11 This has also been the case in using the logit procedure with ordinary least-squares and with non-linear least squares.

12 A further discussion of alternative estimation procedures is contained in a Technical Appendix written by Luc Bauwens, which is available on request.
Table 1
Estimates of intra-industry trade for countries exporting manufactured products (regression coefficients with t-values in parentheses).a

<table>
<thead>
<tr>
<th></th>
<th>Ordinary least squares</th>
<th>Non-linear least squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.176 (5.26)</td>
<td>-1.604 (8.45)</td>
</tr>
<tr>
<td>Proximity</td>
<td>0.141 (5.72)</td>
<td>0.611 (4.60)</td>
</tr>
<tr>
<td>Border dummy</td>
<td>0.098 (2.90)</td>
<td>0.469 (2.07)</td>
</tr>
<tr>
<td>Per capita GNP</td>
<td>0.061 (4.10)</td>
<td>0.377 (4.34)</td>
</tr>
<tr>
<td>GNP</td>
<td>0.054 (4.84)</td>
<td>0.204 (3.80)</td>
</tr>
<tr>
<td>Trade orientation</td>
<td>0.128 (4.52)</td>
<td>0.612 (4.28)</td>
</tr>
<tr>
<td>Singapore dummy</td>
<td>0.333 (3.95)</td>
<td>1.413 (3.94)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.8977</td>
<td>0.9784</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.0670</td>
<td>0.0659</td>
</tr>
<tr>
<td>$N$</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

*aFor definition of variables and explanation of methodology, see text. The proximity, per capita GNP, and GNP variables have been scaled in terms of 10,000 miles, 1,000 dollars, and 100,000 dollars, respectively, and have been expressed in natural logarithms.

The plots obtained with the two alternative estimation procedures are also very similar and show uniformly small deviations from the regression line. As in the case of OLS estimation, upward deviations are relatively more pronounced for India, Mexico, Austria and France while downward deviations are larger for Greece, Switzerland, and Germany. The deviations may be attributed to random errors rather than to economic causes; given their smallness, a formal analysis of the residuals has not been attempted.

Table 2 compares the results obtained in the Havrylyshyn–Civan study by ordinary least-squares with estimates derived using the same specification in the present study, involving the introduction of an export concentration variable and EEC and NIC dummies. The regression equations explain three-fourths of the variance of the index of intra-industry trade in both cases and, with one exception, the statistical significance of the regression coefficients is also similar in the two studies.

The per capita income variable and the dummy variables for the European Common Market and for the newly-industrializing countries are statistically significant at the 1 percent level whereas the market size variable is not significantly different from zero. However, while the variable for export concentration is significant at the 1 percent level in the Havrylyshyn–Civan study, it is not significantly different from zero in the present study.13

13Comparisons have not been made with the results obtained by Havrylyshyn–Civan in introducing dummy variables for the Latin American Free Trade Association and the Central American Free Trade Area, which were not significant at the 5 percent level in these authors' equations.
Fig. 1. Observed and predicted values of intra-industry specialization: Developed and developing countries.
Table 2
Alternative estimates of intra-industry tradea (regression coefficients; ordinary least-squares).

<table>
<thead>
<tr>
<th></th>
<th>Present study</th>
<th>Havrylyshyn-Civanb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.1702 (2.86)</td>
<td>0.0222 (0.38)</td>
</tr>
<tr>
<td>Proximity</td>
<td>0.0761 (2.37)</td>
<td>0.0710 (7.04)</td>
</tr>
<tr>
<td>Border dummy</td>
<td>0.1268 (3.02)</td>
<td>0.0084 (0.91)</td>
</tr>
<tr>
<td>Per capita GNPb</td>
<td>0.0015 (0.08)</td>
<td>0.0010 (0.94)</td>
</tr>
<tr>
<td>GNPb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade orientation</td>
<td>-0.2343 (2.74)</td>
<td>-0.6517 (1.44)</td>
</tr>
<tr>
<td>Export concentration</td>
<td>-0.1268 (3.78)</td>
<td>-0.1259 (2.31)</td>
</tr>
<tr>
<td>EEC dummy</td>
<td>0.2683 (5.29)</td>
<td>0.2247 (3.78)</td>
</tr>
<tr>
<td>NIC dummy</td>
<td>0.1668 (4.95)</td>
<td>0.0936 (1.98)</td>
</tr>
<tr>
<td>Singapore dummy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.7663</td>
<td>0.7397</td>
</tr>
<tr>
<td>N</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

*For definition of variables, see text and table 1.

bGross domestic product in the Havrylyshyn-Civan study.

*For comparability with the present study the coefficient values have been divided by 100, with the exception of the per capita income variable where the same scaling was used in the two cases.

aExpressed in logarithmic terms.
The high significance of the export concentration variable\(^4\) in the Havrylyshyn–Civan study can be explained by the fact that these authors included in the sample countries whose exports are dominated by a few primary export commodities. In fact, the export concentration variable and the per capita income variable, both representing the level of economic development in the country sample, dominate the results, with a coefficient of determination of 0.62 for the two variables alone. This is hardly surprising since the Havrylyshyn–Civan study includes countries that have widely different economic structures, with a high extent of export concentration and a low share of manufactured exports being associated with a low level of intra-industry specialization. Also, the choice made among low-income countries involves a considerable degree of arbitrariness, and the selection of a different set of countries might have given rise to different results. By contrast, the present study covers all countries that fulfil the criteria stated earlier.

In turn, the poor performance of the market size variable (GDP in the Havrylyshyn–Civan investigation and GNP in the present study) is explained by its introduction in an untransformed form. As shown in table 2, this variable is highly significant statistically if expressed in logarithmic terms, which compresses the extreme observations and reduces the variability of GNP that is quite large compared to the variability of the index of intra-industry trade.

At the same time, the level of statistical significance of the EEC and the NIC dummies declines if the proximity, border trade, and the Singapore dummy variables are introduced in the estimating equations of the present study.\(^5\) And, these dummy variables are not significant statistically at even the 10 percent level if the market size variable is expressed in logarithmic terms.

It appears, then, that the use of EEC and NIC dummies involves a misspecification as they pick up the statistical impact of other variables. This conclusion is of particular interest as far as the Common Market is concerned as it indicates that membership in the EEC adds little to the effects of proximity and border trade on intra-industry specialization, when the market size variable is expressed in logarithmic terms. Also, the reduced statistical significance of the NIC dummy in the event of the inclusion of the Singapore dummy may indicate that the former picks up in part the impact of the latter.

Finally, the model specification of the present study has successfully

\(^4\)This variable has been derived by calculating for each country the so-called Herfindahl index.

\(^5\)The exclusion of the trade orientation variable does not change this result as this variable is uncorrelated with the other explanatory variables, it having been obtained from the residuals of eq. (2).
included a policy variable in its effects on intra-industry specialization that is absent from the Havrylyshyn–Civan study. The results obtained with this variable indicate that increased openness, reflecting liberal trade policies, leads to greater intra-industry trade. At the same time, the specifications used in the present study have permitted explaining a high proportion of the variance of the extent of intra-industry trade even though the countries under consideration represented a more homogeneous group than in the Havrylyshyn–Civan investigation.

5. Estimates for the developed and developing country groups

It has been noted that, in contrast to the Havrylyshyn–Civan investigation, this study has been limited to countries exporting manufactured products, thereby reducing the heterogeneity of the observations. It has further been noted that the inclusion of a dummy variable for developed and for developing countries has given poor statistical results. At the same time, interest attaches to making separate estimates for developed and for developing country subgroups.

The separation of developed and developing economies has been effected by taking their 1973 per capita incomes as the benchmark. Countries with per capita incomes of $2,250 or higher have been classified as developed and countries with per capita incomes of $2,030 or lower as developing, with no country being between these two benchmarks.

The separation of the countries under study into two groups does not affect the explanatory power of the regression equation as represented by the coefficient of determination, under the non-linear least squares procedure. For the developing country sample, this is also the case under ordinary least squares estimation while the explanatory power of the regression equation is lower for the developed country sample under the non-linear least squares procedure. However, the residual standard deviation is uniformly lower for the developing country sample and, to a much lesser extent, the developed country sample than for all countries taken together (tables 1 and 3).

16The results are not directly comparable to those obtained by other writers who also analyzed the determinants of intra-industry trade among developed countries. Loertscher and Wolter used bilateral trade flows rather than each country's overall trade as observations. While this permitted testing for inter-country differences in per capita incomes and in market size, the coefficient of determination was only 0.15 and the results are marred by reason of the fact that, in using weighted least squares, the authors failed to weight the dependent variable. Weighted least squares estimation was correctly used by Bergstrand, but his investigation covered only SITC class 7 and the coefficient of determination of the regression equation is not reported. In turn, Clair, Gaussens and Phan employed ordinary least squares in an equation pertaining to the intra-industry trade of the developed countries in SITC classes 5 and 7, with the coefficient of determination ranging between 0.66 and 0.74 in the reported estimates.

17The standard deviation of the trade orientation variable, estimated from eq. (2), is 0.19 for the developed country group and 0.62 for the developing country group.
Table 3
Estimation of intra-industry trade for developed and for developing countries exporting manufactured products.a

<table>
<thead>
<tr>
<th>Developed countries</th>
<th>Developing countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ordinary least squares</td>
</tr>
<tr>
<td>Constant</td>
<td>0.1276 (1.08)</td>
</tr>
<tr>
<td>Proximity</td>
<td>0.1527 (2.41)</td>
</tr>
<tr>
<td>Border dummy</td>
<td>0.0268 (0.27)</td>
</tr>
<tr>
<td>Per capita GNP</td>
<td>0.1219 (1.55)</td>
</tr>
<tr>
<td>GNP</td>
<td>0.0209 (0.80)</td>
</tr>
<tr>
<td>Trade orientation</td>
<td>0.2342 (1.25)</td>
</tr>
<tr>
<td>Singapore dummy</td>
<td>--- ---</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.8122</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.0643</td>
</tr>
<tr>
<td>N</td>
<td>18</td>
</tr>
</tbody>
</table>

aSee footnote (a) of table 1.

the same time, as noted above, it is the latter statistic rather than the coefficient of determination that permits comparisons of the goodness of fit under the different estimation procedures.

Notwithstanding the high explanatory power of the regression equations as countries exporting manufactured products have been divided into developed and developing country groups, increased intercorrelation among the explanatory variables and smaller variations in the values they take, have reduced the statistical significance of the individual regression coefficients. This is the case, in particular, in the developed country group where the gross national product and GNP per capita are highly correlated and show much less variation than in the entire sample or in the developing country group. Thus, the market size variable is not significant in the estimates for the developed country group, and the statistical significance of the per capita income variable barely approaches 10 percent.

In turn, the proximity variable is statistically significant at the 5 percent level in the developed country equations while the border variable is not significant, presumably because, apart from Australia and Japan, all developed countries have trading partners with common borders. Finally, the trade orientation variable is not significant at the 10 percent level. This result may be attributed to similarities among the developed countries as far as their trade orientation is concerned. With differences between actual and hypothetical values of per capita exports derived from eq. (2) being relatively small, one cannot expect the trade orientation variable to be highly significant.
By contrast, there are considerable variations among developing countries as far as their trade orientation is concerned, and this variable is statistically significant at the 1 percent level under the alternative estimation procedures. This is also the case for the proximity and the domestic market size variables and the Singapore dummy, while the per capita income variable is not significant at even the 10 percent level. Finally, the border dummy is statistically significant at the 5 percent level in the equation estimated by ordinary least-squares and at the 10 percent level in the other two equations.

The observed values of the index of intra-industry trade are close to their estimated values for both the developed and the developing country groups. This is the case, in particular, for the developing country group, with larger than average deviations shown for Portugal and Mexico in the upward and for Spain in the downward direction.

The differences are somewhat greater in the developed country group, where Australia and France show relatively large deviations in the upward, and Germany and Switzerland in the downward, direction. The deviations appear to largely correspond to those observed in making estimates for all the countries under consideration and do not appear to have a particular economic rationale; rather they can be attributed to random variations.

6. Overview

This paper has set out to explain intercountry differences in the extent of intra-industry trade in manufactured goods by reference to hypotheses derived from contributions to the theory of intra-industry trade. Apart from the effects of economic integration on intra-industry specialization, all the hypotheses put forward have been confirmed by the results and the explanatory power of the regression equation is high, irrespective of the estimating procedure used.

First of all, the extent of intra-industry specialization increases with the level of economic development and the size of domestic markets. The existence of trading partners with common borders and geographical proximity also contribute to intra-industry trade and its role as an entrepot increases the extent of such trade in Singapore. Finally, intra-industry specialization is positively associated with the openness of national economies.

In turn, while according to the Havrylyshyn and Civan study participation in integration arrangements contributes to the explanation of intra-industry specialization, this does not appear to be the case if more appropriate specifications are introduced. Thus, defining the market size variable in logarithmic terms, the newly industrializing country dummy loses its statistical significance if the Singapore dummy is included in the regression equation and the same fate befalls the Common Market dummy if allowance
is made for border trade and geographical proximity that appear to be the dominant variables.

Estimates have further been made by separating the countries under study into developed and developing country groups. The explanatory power of the regression equations and the statistical significance of the coefficients in the developing country equations are again high. And while similarities in regard to trade orientation and the existence of border trade, as well as inter-correlation between the gross national product and per capita GNP, reduce the statistical significance of the regression coefficients of these variables from the developed country group, the equations have a relatively high explanatory power.

In providing evidence on the determinants of intra-industry trade the findings of this paper support and complement the relevant theoretical literature. At the same time, as noted by the author nearly two decades ago, the existence of intra-industry trade has important policy implications [Balassa (1966)]. This is because the cost of adjustment associated with reductions in trade barriers will be much less in cases when this involves increased intra-industry specialization than in cases when resources are reallocated among industries.

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