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MEASURES OF EXPORT-IMPORT

SIMILARITY, AND THE LINDER HYPOTHESIS

ONCE AGAIN

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MEASURES OF EXPORT-IMPORT SIMILARITY, AND THE LINDER HYPOTHESIS ONCE AGAIN

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Abstract

Two measures of export-import similarity are proposed, and found to contribute significantly to an explanation of the intensity of trade between a pair of countries. These measures are then applied to trade in manufactures only, to verify the Linder thesis of greater intensity of trade in manufactures at similar levels of per capita income of the trade partners. The findings do not support this hypothesis, as the intensity of trade in manufactures generally continues to increase with increasing per capita income. Although differing in some properties, both measures are useful statistical devices, and several other applications are suggested.

Measures of export-import similarity, and the Linder hypothesis once again.

In empirical studies on international trade issues, several measures for comparing the commodity composition of trade flows have been introduced. Two of the better-known measures are the Grubel-Lloyd (1975) index for estimating the extent of intra-industry trade, and the export similarity index proposed by Finger and Kreinin (1979) that is used to compare the patterns of exports of different countries to a third-country import market. Another measure has been introduced by one of the present authors (Linnemann, 1966), and used i.a. by Hufbauer (1970) in testing the hypothesis regarding trade in manufactured products formulated by Linder (1961). The purpose of the present paper is to compare the latter measure with the former two, which have a similar structure as was shown by Pomfret (1981), in a number of applications. Attention will be focused in particular on testing once again the Linder hypothesis. Hence, it is the comparison of the commodity composition of exports of country i with that of imports of country j that is at the core of the analysis - rather than a comparison of exports of i with exports of j (Finger and Kreinin) or exports of i with imports of i (Grubel and Lloyd).

I. Method and data

Let the subscripts i, j and k refer to exporting country, importing country, and commodity class, respectively. The trade flow of commodity k from country i to country j is X_{ijk}; furthermore $E_{ik} = \sum_{j=i} X_{ijk}$ and $M_{jk} = \sum_{i=j} X_{ijk}$.

The export vector of country i is composed of the n elements E_{ik} (k=1,...,n), and will be indicated by e_i; similarly, m_j is the import vector of country j with elements M_{jk} (k=1,...,n). The two vectors may now be compared by determining the angle between them in the n-dimensional commodity space.

Following Allen (1957, p. 381), the cosine of this angle is defined as

$$COS_{ij} = \frac{e_i \quad m_j}{|e_i| \cdot |m_j|}$$

or

$$COS_{ij} = \frac{\sum_k E_{ik} \cdot M_{jk}}{\sqrt{\sum_k E_{ik}^2 \cdot \sum_k M_{jk}^2}}$$

If the commodity composition of the exports of country i is identical to that of the imports of country j (i.e. if the two vectors differ only by a scalar: $e_i = \lambda\ m_j$), then $COS_{ij} = 1$ and the commodity patterns of the exporting and the importing country match perfectly. If, for all k, either E_{ik} or M_{jk} (or both) is zero, obviously no trade from i to j exists; the vectors e_i and m_j are orthogonal and $COS_{ij} = 0$. Some earlier applications of COS are discussed in Linnemann (1985).

An alternative measure of export-import similarity can readily be derived from the export similarity index of Finger and Kreinin (1979). In our symbols, it is defined as

$$EIS_{ij} = \sum_k \min\left(\frac{E_{ik}}{\sum_k E_{ik}} \ , \ \frac{M_{jk}}{\sum_k M_{jk}}\right)$$

The two terms on the RHS of the formula are again the elements of the export vector of i and the import vector of j, respectively, but now rescaled so that per vector the elements add up to unity. For each k the 'overlap' is determined by selecting the smaller of the two elements; summation over k gives the measure of overall similarity. The index EIS differs from Finger and Kreinin's S in two respects, as the latter (a) compares two export vectors, (b) covers trade with a particular importer only, whereas EIS (like COS) in the present context refers to all foreign trade. Conceptually, EIS is closely related not only to the Finger and Kreinin index but also to the Grubel and Lloyd intra-industry trade index in its amended form (Aquino,

1978). In fact, in the Aquino version[1] the latter index is identical with EIS_{ii}.

Comparing the two measures COS and EIS, the following properties deserve mentioning:

(1) Both measures have a value range from 0 to 1, a value of unity indicating perfect similarity.

(2) Only EIS requires a rescaling of the commodity vectors.

(3) EIS is a linear construct, whereas COS has non-linear properties; according to the COS measure, a strong correspondence in commodity class k scores relatively stronger, and a poor correspondence relatively poorer, than according to the EIS formula. Hence, the variance of COS will be larger than that of EIS.[2]

(4) The COS definition resembles that of the correlation coefficient. It can easily be shown that the larger the number of commodity classes distinguished, the closer COS approaches the correlation coefficient - except that it cannot take a negative value.

(5) Both measures are, in principle, sensitive to the level of disaggregation of the commodity classes; stronger disaggregation will as a rule result in lower values of both indices.

As to their economic interpretation, it should be noted that both measures give an indication of the trade potential, or the probability of trade, between the exporting and the importing country. Their computation is not directly based on actual trade flow observations like X_{ijk} or $\sum_k X_{ijk}$, and it is conceivable that all such flows would be zero even in case of non-zero COS_{ij} and EIS_{ij} values. Obviously, these comments do not pertain to the specific use of the measures for assessing the intensity of intra-industry trade, i.e. to the application of the formulae for $j = i$.

The two export-import similarity measures have been computed for a sample of

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1) The usefulness of the Aquino amendment is questionable; see Greenaway and Milner (1981, 1983).

2) It is not clear how Grubel and Lloyd (1975, p. 28) reach a different conclusion when comparing COS with their (original) measure.

47 countries using 1980 U.N. trade data. For 13 developed (OECD) countries and 34 developing countries, export and import vectors were calculated at the SITC Revision 2 three-digit level. For seven developing countries[3] this required a conversion of the original Revision 1 to the Revision 2 code, necessitating operations at the four- and five-digit level. The Revision 2 code has 239 three-digit positions; the six commodity groups with a code number higher than 900 were aggregated into one group, so that the all-trade vectors have 234 elements. In addition, vectors covering only manufactured exports and imports (defined as SITC 5-9) were calculated; these vectors have 152 elements.

The selection of developing countries in the sample was dictated by the (limited) availability of trade data on tape (which were, for other purposes, needed at the level of individual flows X_{ijk}). For this reason,

several important trading countries are not included in the sample; unfortunately, Latin America is represented by four countries only. The selection of the developed countries was the authors' free choice. The countries included in the sample are listed in Table 4.

The sets of COS and EIS measures generated in this way may be used to describe various trade-related phenomena or to analyse certain aspects of trade theories. In this paper the measures will be used in particular in an attempt to test once again the principal implication of the well-known Linder (1961) hypothesis, i.e. the implication that countries will trade - in manufactures - relatively more (other things being equal) with countries of similar per capita income levels than with countries of higher or lower per capita incomes. This would be due to the fact that, in Linder's words, "the more similar the demand structure of the two countries, the more intensive, potentially, is the trade between the two countries" (p. 94). And as the demand structure is largely determined by the per capita income level, the export-import similarity measure for trade in manufactures should take its highest values, for a given exporting or importing country, with regard to trading partners of similar per capita income.

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3) Brazil, Egypt, Kuwait, Somalia, Sudan, Tanzania and Venezuela.

This implication of the Linder thesis has been illustrated by Hufbauer (1970) with the help of a diagram, reproduced in Figure 1 for the case of a given importing country. Pooling the data for 24 countries, he applied regression analysis to estimate slope and intercept of the two line segments in Figure 1; if per capita income of country i is denoted by y_i, one pair of estimates (i.e. slope and intercept) was obtained for $y_i < y_j$, and another pair for $y_i > y_j$. With a minor modification only, this approach has been followed also in the present analysis.

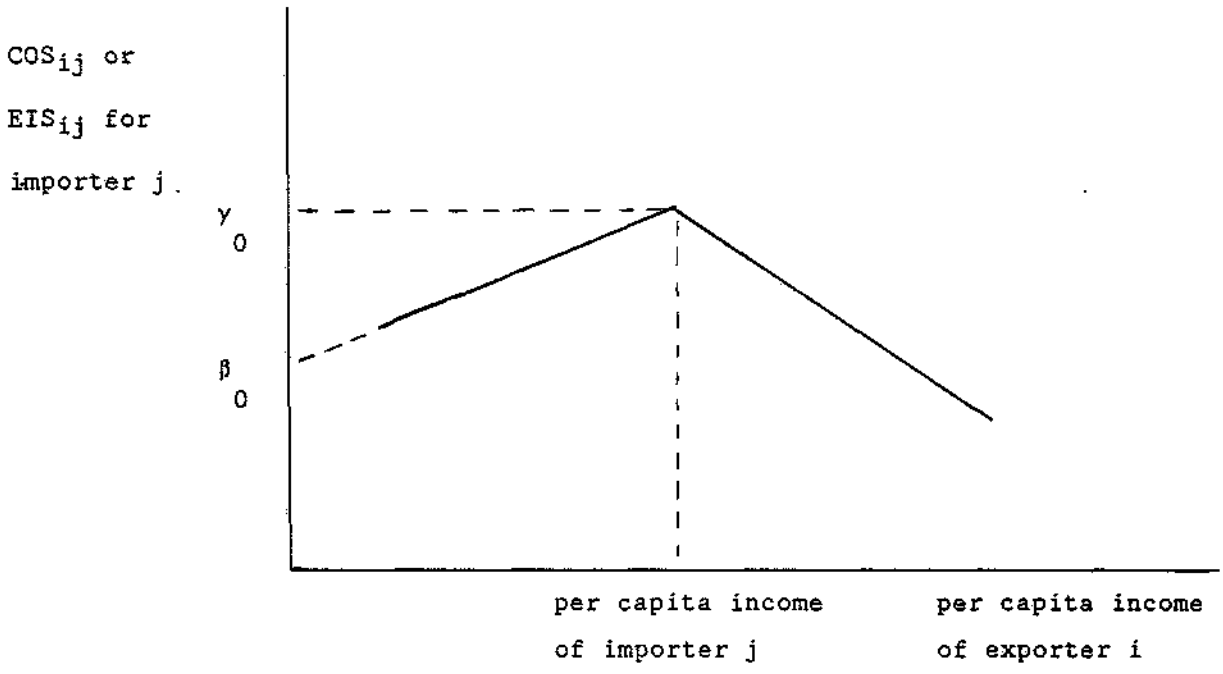

Fig. 1. Schematic representation of the Linder hypothesis.

II. Results

Thus far, empirical tests of the Linder hypothesis have been rather inconclusive. It may be true that "many countries do indeed trade disproportionately large amounts with countries of similar per capita income", as Deardorff (1984, p. 505) summarises several of these studies. However, he continues, "the large trade between them may be accounted for solely by transportation costs, and, if so, provides no evidence in support of Linder". Therefore, most of the more recent tests have tried to avoid or eliminate the effect of the distance variable; Hufbauer, mentioned above, was one of the first to do so. With the help of the well-known gravity equation (see e.g. Linnemann, 1966), we will show first of all that, in addition to the distance variable, the export-import similarity index contributes significantly to an explanation of the intensity of trade between a pair of countries.

The import flows of the 34 developing countries in our sample, as they originate from the (34-1) developing and the 13 developed countries, yield a set of 34 x 46 = 1564 bilateral trade flows X_{ij}, with $X_{ij} = \sum_k X_{ijk}$. Summation over the commodity classes k in SITC 5-9 only results in a set of bilateral flows of trade in manufactures. The non-zero observations in both sets were log-linearly regressed with OLS on the standard gravity-model variables: Y_i and N_i (GNP and population size of the exporting country), Y_j and N_j (ditto, of the importing country), D_{ij} (geographical distance between i and j), plus - alternatively - COS_{ij} and EIS_{ij}. The results are given in Table 1.

The findings show both trade similarity measures to be significant, even though their contribution to the overall explanation of the magnitude of bilateral trade flows is a modest one - with EIS_{ij} performing better than COS_{ij}. Comparing the results of regressions including a similarity measure with those of regressions without the measure, it is found that the parameter estimates regarding the exporting country's trade potential (Y_i and N_i) are primarily affected by the inclusion of the similarity

Table 1

Estimation results of a gravity-model analysis of bilateral trade flows; 1980 data

$$\ln X_{ij} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln N_i + \alpha_3 \ln Y_j + \alpha_4 \ln N_j + \alpha_5 \ln D_{ij} + \alpha_6 \ln COS_{ij} + \alpha_7 \ln EIS_{ij}$$

α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	$\bar{R}^2$
A. Total trade (1210 non-zero flows)								
2.43 (2.5)	1.47 (32.5)	-0.39 (6.6)	1.04 (18.1)	-0.19 (3.4)	-1.64 (16.8)			0.61
3.67 (3.8)	1.32 (26.5)	-0.31 (5.3)	1.05 (18.6)	-0.20 (3.6)	-1.60 (16.7)	0.37 (6.8)		0.63
5.87 (5.8)	1.18 (22.1)	-0.28 (4.9)	1.04 (18.9)	-0.19 (3.6)	-1.63 (17.3)		0.85 (9.4)	0.64
B. Trade in manufactures (1089 non-zero flows)								
0.65 (0.6)	1.64 (32.5)	-0.48 (7.4)	0.91 (14.7)	-0.17 (2.9)	-1.52 (14.4)			0.61
2.37 (2.3)	1.31 (18.8)	-0.26 (3.7)	0.88 (14.4)	-0.12 (2.1)	-1.46 (14.1)	0.67 (6.7)		0.62
3.83 (3.6)	1.13 (14.7)	-0.15 (2.1)	0.88 (14.7)	-0.10 (1.7)	-1.47 (14.4)		1.36 (8.7)	0.63

Note : Variables are defined in the text. Figures in brackets are t-statistics.

Sources : UN trade data tapes for 1980. GNP and population data are from World Bank Atlas 1983, Washington: The World Bank. Sea distances have been calculated from U.S. Defense Mapping Agency (1985), Distances between ports; Publication No. 151. Estimated hinterland distances have been added when greater than 100 nautical miles.

measure as an additional explanatory variable. In particular, this inclusion lowers the α_1 estimates (note that Y and N show considerable intercorrelation, and that estimated parameter values relating to N 'follow' those relating to Y). We may expect, therefore, that both similarity measures are positively correlated with the GNP of the exporting country.

Now that the significance of the trade similarity measures in explaining the intensity of trade has been established, we turn to the Hufbauer test of the Linder hypothesis. Using again y for GNP per capita, the two line segments of Figure 1 are:

$$COS_{ij} = \beta_0 + \beta_1 \frac{y_i}{y_j} \quad \text{for } y_i < y_j,$$

and

$$COS_{ij} = \gamma_0 + \gamma_1 \frac{y_i}{y_j} \quad \text{for } y_i > y_j,$$

with $\beta_1 > 0$, $\gamma_1 < 0$, and $\beta_0 < \gamma_0$. The same data set as before has been used to obtain OLS estimates of the parameter values. For this purpose, importing country data have been pooled for (A) all 47 countries, (B) the 13 developed countries, and (C) the 34 developing countries. In the latter two cases, observations are limited to those involving developed countries only, respectively developing countries only, in order to verify separately the relevance of the Linder hypothesis for trade between developed countries (case B) and for trade between developing countries (case C). Table 2 summarises the results.

In most regressions the correlation is very low or virtually absent. As to the signs of the parameter estimates, only for the subsample of the developed countries the Linder hypothesis finds some support; note, however, that the two negative γ_1 estimates are not significant at the 95 % probability level. For the samples A and C, the hypothesis has to be rejected. Regressions have been run also for the latter two samples excluding five OPEC countries with oil accounting for 90 percent or more of their export value, as for several reasons these countries might not fit in the 'normal' pattern. However, the results obtained did not differ substantially from those reported in Table 2.

Table 2

Estimation results of an 'explanation' of trade similarity measures

(trade in manufactures only)

	for $y_i < y_j$: $COS_{ij} = \beta_0 + \beta_1 \frac{y_i}{y_j}$			for $y_i > y_j$: $COS_{ij} = \gamma_0 + \gamma_1 \frac{y_i}{y_j}$		
	β_0	β_1	$\bar{R}^2$	γ_0	γ_1	$\bar{R}^2$
A. All countries	0.163 (19.6)	0.177 (8.9)	0.067	0.313 (39.5)	0.002 (6.6)	0.038
B. Developed countries	0.385 (9.0)	0.315 (5.3)	0.257	0.687 (25.5)	-0.012 (1.0)	0.000
C. Developing countries	0.138 (14.2)	0.030 (1.4)	0.002	0.170 (22.4)	0.004 (8.8)	0.120

	for $y_i < y_j$: $EIS_{ij} = \beta_0 + \beta_1 \frac{y_i}{y_j}$			for $y_i > y_j$: $EIS_{ij} = \gamma_0 + \gamma_1 \frac{y_i}{y_j}$		
	β_0	β_1	$\bar{R}^2$	γ_0	γ_1	$\bar{R}^2$
A. All countries	0.179 (25.7)	0.175(10.5)	0.092	0.345 (51.6)	0.002 (6.8)	0.040
B. Developed countries	0.458 (15.9)	0.183 (4.6)	0.204	0.635 (36.5)	-0.005 (0.7)	0.000
C. Developing countries	0.167 (21.3)	0.029 (1.7)	0.003	0.215 (34.0)	0.002 (7.0)	0.080

Note: Variables are defined in the text. Figures in brackets are t-statistics.

For the boundary case of $y_i = y_j$ the two estimated line segments should predict about the same value of the trade similarity measure. The actual results can be obtained immediately from Table 2:

for $y_i = y_j$	COS_{ij}		EIS_{ij}	
	$y_i \leq y_j$	$y_i \geq y_j$	$y_i \leq y_j$	$y_i \geq y_j$
C. Developing countries	0.168	0.174	0.196	0.217
A. All countries	0.340	0.315	0.354	0.347
B. Developed countries	0.700	0.675	0.641	0.630

In spite of the poor fit of the regression equations the boundary values with $y_i = y_j$ are, for each pair of predicted values, fairly close to one another. Two comments are in order: (a) as observed before, the COS values show a greater variance than the EIS values; (b) the value of both measures increases with the level of development as reflected in the (average) income per capita.

In his 1970 paper, Hufbauer, too, arrived at the conclusion (b) when analysing his set of COS values. His specification of the regression equations was less restrictive than ours:

$$COS_{ij} = \delta_0 + \delta_1 y_i + \delta_2 y_j \quad \text{for } y_i < y_j$$

and

$$COS_{ij} = \epsilon_0 + \epsilon_1 y_i + \epsilon_2 y_j \quad \text{for } y_i > y_j.$$

Using this specification for both COS and EIS, we obtained the results reported in Table 3.

Again, the estimation results do not lend support for the Linder hypothesis, which would require the parameters δ_2 and ϵ_1 to be negative (the t value would have to be at least 2.0 for significance at the 95 % probability level). The finding that the constant ϵ_0 is always larger that δ_0 (just as in Table 2 $\gamma_0 > \beta_0$) is in conformity with the Linder assumption, but ϵ_0 and γ_0 are not the maximum values of the trade similarity measures - as they should have been. The values of COS and EIS continue to increase with increasing per capita income of any of the two trade partners. On the whole, the influence of the per capita income of the exporting country is stronger than that of the importing country. This is no surprise: the changes in the

vector of manufactured exports in the course of development (as approximated by the level of per capita income) are much more pronounced than the changes in the import vector. The correlation between the trade similarity measures and the GNP of the exporting country, as it showed up in the gravity-model results of Table 1, is due to the same phenomenon.

There is still another implication of Linder's views that lends itself to empirical verification. In his words: "Potential exports and imports are - when they are manufactures - the same products. An actual import product today is a potential export product today and may be an actual export product tomorrow" (Linder, 1961, p. 138). As Hufbauer (1970, p. 198) concluded from this and similar statements, Linder would seem to imply that "(i)n the extreme case, the export and import menus for a given country should be highly similar". Thus, one might expect at least a tendency towards similarity between a country's export vector of manufactures and its import vector of manufactures - irrespective, in principle, of its level of development. Whether or not this is so for our set of countries can be verified easily by computing the values of COS_{ii} and EIS_{ii}. These values are given in Table 4, with the countries ranked according to GNP per capita.

The values of the two similarity measures vary greatly between the countries, as can be seen from this table. The assumed tendency towards similarity in the export and import menus of manufactures, for all countries, is not borne out by the actual trade data. If the results reported in Table 4 show a general tendency at all, it is that of an increasing correspondence between export and import structure (of manufactures) with increasing income per capita[4] or - better perhaps - with increasing levels of manufacturing output per capita.

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4) If the distinction between developing and developed countries would be dropped, Portugal would appear in the list of Table 4 between Brazil and Cyprus, Saudi Arabia between the U.S. and Germany, and Kuwait after Sweden.

Table 3

Estimation results of an 'explanation' of trade similarity measures in the Hufbauer specification
(trade in manufactures only)

	for $y_i < y_j$: $COS_{ij} = \delta_0 + \delta_1 y_i + \delta_2 y_j$				for $y_i > y_j$: $COS_{ij} = \epsilon_0 + \epsilon_1 y_i + \epsilon_2 y_j$			
	δ_0	δ_1	δ_2	$\bar{R}^2$	ϵ_0	ϵ_1	ϵ_2	$\bar{R}^2$
A. All countries	0.131 (18.8)	0.044 (22.7)	0.002 (2.8)	0.394	0.170 (21.4)	0.021 (21.2)	0.019 (8.4)	0.431
B. Developed countries	0.306 (3.3)	0.009 (0.9)	0.026 (5.0)	0.318	0.490 (5.2)	0.004 (0.7)	0.013 (1.4)	0.028
C. Developing countries	0.126 (16.8)	0.035 (5.2)	-0.0001 (0.1)	0.048	0.139 (16.5)	0.014 (12.0)	0.009 (1.2)	0.238
	for $y_i < y_j$: $EIS_{ij} = \delta_0 + \delta_1 y_i + \delta_2 y_j$				for $y_i > y_j$: $EIS_{ij} = \epsilon_0 + \epsilon_1 y_i + \epsilon_2 y_j$			
	δ_0	δ_1	δ_2	$\bar{R}^2$	ϵ_0	ϵ_1	ϵ_2	$\bar{R}^2$
A. All countries	0.157 (27.7)	0.040 (25.2)	0.002 (2.6)	0.441	0.228 (33.2)	0.018 (21.1)	0.013 (6.6)	0.407
B. Developed countries	0.404 (6.4)	0.015 (4.2)	0.006 (1.0)	0.255	0.492 (8.1)	0.011 (1.9)	0.001 (0.4)	0.041
C. Developing countries	0.151 (25.5)	0.034 (6.2)	0.001 (0.8)	0.078	0.186 (26.5)	0.010 (9.9)	0.017 (2.7)	0.120

Note: Variables are defined in the text. Figures in brackets are t-statistics.

A few more comments on the Table 4 results are in order. A comparison of COS_{ii} and EIS_{ii} values shows that (a) the two series are strongly correlated, (b) the variance of the COS series is greater than that of the EIS series, and (c) occasionally a COS value may differ considerably from the corresponding EIS value. The latter phenomenon may occur when one or two commodity classes have an unusually large share in the total; in the case of the Philippines this is due to the fact that this country reports a very considerable part of its trade in manufactures in the SITC Section 9 (Goods not classified).[5]

As mentioned above, EIS_{ii} is the Grubel and Lloyd intra-industry trade index as amended by Aquino; obviously COS_{ii} is likewise a measure for intra-industry trade. The highest values in Table 4 pertain to EC member countries, with the U.K. and France on top. The EIS_{ii} value for the U.K. of 0.769 is in line with the 1977 values of the (unamended) Grubel-Lloyd index at the three-digit level reported by Greenaway and Milner (1983) for the SITC divisions 5 to 8 and ranging from 0.69 to 0.80. Remarkable is the relatively low value for Japan. We will refrain from further discussion of the results, as our principal aim is a verification of the Linder thesis.

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5) Similarly, when COS is computed for total trade the OPEC countries show high COS values due to an extreme concentration of their exports in the SITC group 333 Crude petroleum.

Table 4

Similarity between a country's export structure and import structure (trade in manufactures only), at SITC three-digit level, 1980

	COS_{ii}	EIS_{ii}		COS_{ii}	EIS_{ii}
Developing countries					
Bangladesh	0.021	0.067	Morocco	0.137	0.133
Ethiopia	0.033	0.041	Congo	0.023	0.087
India	0.323	0.286	Mauritius	0.109	0.183
Somalia	0.185	0.240	Colombia	0.228	0.296
Tanzania	0.052	0.134	Tunisia	0.209	0.196
Sri Lanka	0.015	0.085	Korea Rep.	0.448	0.385
Niger	0.547	0.341	Malaysia	0.518	0.369
Centr. Afr. Rep.	0.001	0.005	Algeria	0.051	0.093
Togo	0.219	0.292	Brazil	0.346	0.419
Sudan	0.050	0.041	Cyprus	0.219	0.285
Kenya	0.226	0.309	Gabon	0	0
Indonesia	0.030	0.122	Venezuela	0.136	0.274
Liberia	0.334	0.389	Hong Kong	0.484	0.420
Egypt	0.048	0.094	Singapore	0.752	0.664
Thailand	0.332	0.254	Saudi Arabia	0.597	0.471
Philippines	0.841	0.322	Kuwait	0.771	0.669
Cameroon	0.143	0.214			
Developed countries					
Portugal	0.348	0.381	Netherlands	0.798	0.737
Ireland	0.684	0.659	France	0.884	0.785
Italy	0.636	0.604	Belgium-Luxembourg	0.807	0.714
United Kingdom	0.892	0.769	United Stated	0.588	0.592
Japan	0.328	0.408	Germany, Fed.Rep.	0.798	0.705
Australia	0.352	0.434	Sweden	0.668	0.675
Canada	0.741	0.592			

Note: Within each group, countries have been ranked according to their GNP per capita.

III. Conclusions

The two measures of the degree of export-import similarity between an exporting and an importing country, COS and EIS, would seem to be useful indicators, which may play a part in empirical analyses of international trade flows. In an analysis that aggregates over commodities, a measure of export-import similarity may function as an (additional) explanatory variable reflecting trade characteristics at a more disaggregated level. For a gravity-model analysis of international trade flows, its significance has been shown.

In principle, the commodity composition of external trade may be influenced by the commodity trade orientation of a country's trade partners - in particular that of its most proximate partners. Yet our empirical findings suggest that the two variables distance and export-import similarity are not closely associated (see Table 1). Hence, the latter variable can be used to check the relevance of the Linder hypothesis while eliminating the distorting influence of the distance variable that is necessarily present in original trade flow data.

The findings reported above do not support the Linder thesis of a relatively stronger trade in manufactures between countries of similar levels of per capita income; instead, the intensity of trade would generally seem to increase continually with increasing income per capita of the trading partners.

Other uses of the measures of export-import similarity that can be thought of are, e.g., (a) an analysis of bilateral trade unbalances resulting from $COS(EIS)_{ij} \neq COS(EIS)_{ji}$ (in the present study $COS_{US,Japan} = 0.139$ and $COS_{Japan,\ US} = 0.281$), (b) an assessment of the effect of the (weighed) sum of $COS(EIS)_{ij}$ on a country's foreign trade/GNP ratios, and (c) identification of a country's main competitors (in terms of the goods supplied) on a particular import market - see Finger and Kreinin (1979) and Pomfret (1981).

As to the differences between the measures COS and EIS, it is difficult to come to a hard and fast conclusion regarding their relative merits and

demerits. Both measures 'perform' well in the above applications, with slightly better results for EIS in the simple gravity model. Their usefulness as a statistical device may be limited to a static or comparative-static context only. Nevertheless they may function at times as convenient tools of analysis, as the above exercises have tried to demonstrate.

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