INTENSITY ANALYSIS OF WORLD TRADE FLOW

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I. *Introduction*

There has been an increasing interest in the interdependence among economies in the world. This is partly because advanced economies are forced to expose themselves internationally in the global movement of trade liberalization in the post-war era on one hand and the structural adjustments in global division of labour required to promote more efficient economic aid to countries in the 'South' on the other. Furthermore, it is also caused by the increased necessity for the harmonization of cyclical policies among major economies in the present crisis of world monetary system. An increasing number of studies in world trade flow, traditionally the most important aspect of interdependence among economies, have been published recently.[1]

This paper measures the interdependence among countries based on world trade matrix and analyzes factors affecting it. Traditional theory of international trade tells us that trade is determined by the difference in comparative advantage structures between countries. But many traditional theories were worked out in two-country models, and it has been pointed out by many writers that various other factors are important in determining trade in many country models, which will be given some empirical evidence in this paper.

Two methods have been developed to analyze the world trade flows; *gravity model* and *trade intensity index*. In gravity model, trade between two countries is mechanistically determined by gross national products of exporting and importing countries and economic distance between the two. The *GNP* of an exporting country represents the size of its supply capacity and that of an importing country its total demand. The volume of trade between the two countries tends to increase if the *GNP* of either country increases, and tends to decrease, if the economic distance between them (measured in terms of transport cost) increases. If this relationship holds between any pairs of countries, country i's export to country j is expressed as

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[1] In addition to the literatures referred to in this paper, see the following survey article of world trade models. Taplin, G. B. "Models of World Trade", *IMF Staff Papers*, Vol. 54, No. 3 (Nov. 1967). Interdependence among economies was one of the main theme in the conference on the linkage of econometric models of individual countries held in Tokyo September 1969 by Japan Economic Research Center.

$$X_{ij}=\alpha\cdot Y_i^{\beta}\cdot Y_j^{\gamma}\cdot D_{ij}^{-\delta} \qquad (1)$$

where Y_i, Y_j be the *GNP*'s of the two countries, D_{ij} be the measure of economic distance between them, and α, β, γ, δ be positive constants.[2]

Trade intensity analysis, on the contrary, concentrates the structure of departures of actual trade flows from trade flows estimated in gravity model. The index of intensity of country i's export trade with country j is defined by

$$I_{ij}\equiv\frac{X_{ij}}{X_{i.}}\Big/\frac{X_{.j}}{X_{..}} \qquad (2)$$

where $X_{i.}$ $(\equiv\sum_j X_{ij})$, $X_{.j}$ $(\equiv\sum_i X_{ij})$ and $X_{..}$ $(\equiv\sum_i\sum_j X_{ij})$, represents the total export of country i, total import of country j, and the total volume of world trade respectively.[3] It is easily proved that, in a simplified gravity model where bilateral trade is solely determined by the *GNP*'s of a pair of countries, I_{ij} is always equal to unity.[4] That is, I_{ij} equals unity when the value of trade is proportional to the *GNP*'s of the two countries, it exceeds unity when the trade becomes more intensive between the pair of countries, and it falls short of unity when trade becomes less intensive between countries i and j. High intensity of trade reflects such various factors as the strong complementarity in comparative advantage structures between

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[2] Tinbergen applied the equation (1) to the trade flows among 42 countries and obtained the following results.

$$\log X_{ij}=-0.6627+1.0240\log Y_i+0.9395\log Y_j$$
$$(.6802)\quad(.0270)\qquad(.0269)$$
$$-0.8919\log D_{ij}$$
$$(.0455)\qquad R^2=.8094$$

Tinbergen J., *Shaping the World Economy*, New York, 1962.

[3] Brown A. J., *Applied Economics, Aspects of the World Economy in War and Peace*, London, 1947. Kojima K., *Sekai Keizai to Nihon Boeki* (*World Economy and Japan's Foreign Trade*), Tokyo, 1962. Both Brown and Kojima defined intensity of trade as

$$I_{ij}^{*}\equiv\frac{X_{ij}}{X_{i.}}\Big/\frac{X_{.j}}{X_{..}-X_{.i}}$$

In theory, country j's import share in total world import minus country i's export may be more appropriate reference for the geographical distribution of country i's exports than j's import share in total world trade unadjusted $(X_{.j}/X_{..})$. However, this adjustment of denominator not only complicates the calculation procedure but also makes it impossible to derive the clear-cut relationships among various indexes.

The weighted sum of I_{ij} for all import markets amounts to unity in either formulation,

$$\sum_{j(\neq i)}\left(\frac{X_{.j}}{X_{..}}\right)I_{ij}=1,\qquad\sum_{j(\neq i)}\frac{X_{.j}}{X_{..}-X_{.i}}I_{ij}^{*}=1.$$

The degree of overestimation resulting from the use of the formula (1) is proportional to the exporting country's share in total world trade $(X_{i.}/X_{..})$ and will not differ much among countries except between US and small exporters.

[4] The simplified gravity model is represented by

$$X_{ij}=\alpha Y_i^{\beta}Y_j^{\gamma}$$

Since

$$X_{i.}=\alpha Y_i^{\beta}\sum_j Y_j^{\gamma}$$

$$X_{.j}=\alpha Y_j^{\gamma}\sum_i Y_i^{\beta}$$

and

$$X_{..}=\alpha\Big(\sum_i Y_i^{\beta}\Big)\Big(\sum_j Y_j^{\gamma}\Big),$$

the intensity of trade is always equal to unity

$$I_{ij}=1.$$

the pair of countries, smaller geographical and psychic distances between them, and mutually favorable trade agreements between them, and low intensity the countrary situations. In this sense trade intensity analysis and simplified gravity model are complementary with each other, which may be compared to price and income analysis of world trade flows.[5]

Various factors mentioned above are reflected in the value of intensity of trade. If the effects on trade intensity of the degree of complementarity in comparative advantage structures are separated from the effects of other factors, it enables us to identify traditional trade-determining factors and their overtime changes. Dr. P. Drysdale has developed the intensity analysis by decomposing trade intensity into two main components; the "commodity bias" or the "degree of complementarity" which mainly reflects the complementarity in comparative advantage structures between exporting and importing countries, and the "degree of special country bias" which sums up the effects of other factors.[6]

One aim of this paper is to reformulate Drysdale's decomposition of trade intensity more rigorously and to associate the intensity analysis with the studies of comparative advantages. The following four sections are devoted to the theoretical or methodological arguments of trade intensity analysis, and an alternative decomposition of trade intensity is represented in Section 5.

Another aim is to produce an application of the theory to the matrix of world trade flow at three periods. Here the world-wide tendency of I_{ij} converging to unity is depicted, which is related to changes in the global division of labor caused by industrialization of primary good exporters on one hand and to the breakup of traditional trade ties and the formation of new ones on the other. This empirical testing is complementary to that of Drysdale's to the extent that the latter analysis gives detailed consideration of the two components of trade intensity between Japan and Australia at individual commodity level whereas the former gives the whole structure and its overtime change of the intensity of trade among various countries in the world. Section 6 explains statistical data and procedures and the last three sections describe the application. At the end is attached an appendix which clarifies some technical characteristics of trade indexes.

II. *Two Components of Intensity of Trade*

A country's patterns of exports to and imports from the world are principally determined by its structure of comparative advantage and disadvantage vis-à-vis the world. Assume a homogeneous commodity be traded in a world where both transport costs and artificial impediments to trade are negligible. Then the country i's export of commodity h to country j is expected to be the product of country j's total import of this commodity multiplied by the share of country i in the world trade of the same commodity, which is expressed as

$$\overline{X}_{ij}{}^{h}=X_{\cdot j}{}^{h}\left(\frac{X_{i\cdot}{}^{h}}{X_{\cdot\cdot}{}^{h}}\right) \tag{3}$$

[5] The concept of trade intensity is used for the prediction of world trade flow in Uribe, P. de Leeuw, C. G. and Theil, H. "The Information Approach to the Prediction of Interregional Trade Flows," *Rev. of Econ. Stud.*, Vol. 33 (1966).

[6] Drysdale P. D., *Japanese Australian Trade*, 1967 (Unpublished Doctoral Dissertation).

where $\bar{X}_{ij}^{h}$ is the expected value of country i's export of commodity h to country j, which is rewritten as

$$\bar{X}_{ij}^{h}=\frac{X_{i.}^{h}\cdot X_{.j}^{h}}{X_{..}^{h}} \tag{4}$$

The expected value of total exports from country i to country j is defined as the sum of expected values of all commodities.

$$\bar{X}_{ij}\equiv\sum_{h}\bar{X}_{ij}^{h} \tag{5}$$

The expected intensity of trade is obtained by replacing the expected value of trade for the actual one in the formula (2).

$$C_{ij}=\frac{\bar{X}_{ij}}{X_{i.}}\Big/\frac{X_{.j}}{X_{..}} \tag{6}$$

The divergence between the expected value of trade and the actual one defines the degree of special country bias.

$$\begin{aligned}B_{ij}&\equiv\frac{X_{ij}}{\bar{X}_{ij}}\\&=\frac{X_{ij}}{\sum_{h}\bar{X}_{ij}^{h}}=\frac{1}{\sum\left(\frac{X_{ij}^{h}}{X_{ij}}\right)\frac{1}{B_{ij}^{h}}}\end{aligned} \tag{7}$$

where B_{ij}^{h} is the degree of special country bias in each commodity trade ($B_{ij}^{h}=X_{ij}^{h}/\bar{X}_{ij}^{h}$) and B_{ij} turns out to be a weighted harmonic mean of B_{ij}^{h}.

The first line of equation (7) gives a decomposition of trade intensity into two components

$$I_{ij}=B_{ij}\cdot C_{ij}, \tag{8}$$

which is the basic formula for our analysis.

III. *Determinants of Complementarity*

What economic implications are attached to the expected intensity of trade and what factors determine its value? It is rewritten as follows.

$$\begin{aligned}C_{ij}&=\frac{\sum_{h}\bar{X}_{ij}^{h}}{X_{i.}}\Big/\frac{X_{.j}}{X_{..}}\\&=\sum_{h}\left(\frac{X_{i.}^{h}}{X_{i.}}\cdot\frac{X_{.j}^{h}}{X_{.j}}\cdot\frac{X_{..}}{X_{..}^{h}}\right)\\&=\sum_{h}\left(\frac{X_{..}^{h}}{X_{..}}\right)\left(\frac{X_{i.}^{h}}{X_{i.}}\Big/\frac{X_{..}^{h}}{X_{..}}\right)\left(\frac{X_{.j}^{h}}{X_{.j}}\Big/\frac{X_{..}^{h}}{X_{..}}\right)\\&=\sum_{h}\left(\frac{X_{i..}^{h}}{X_{..}}\right)S_{i}^{h}\cdot R_{j}^{h}\end{aligned} \tag{9}$$

where

$$S_{i}^{h}=\frac{X_{i.}^{h}}{X_{i.}}\Big/\frac{X_{..}^{h}}{X_{..}},\qquad R_{j}^{h}\equiv\frac{X_{.j}^{h}}{X_{.j}}\Big/\frac{X_{..}^{h}}{X_{..}} \tag{10}$$

S_i^h and R_j^h are the share of commodity h in i's total exports and j's total imports respectively both divided by commodity h's share in world total trade.[7] They measure the degrees of country i's export specialisation and country j's import specialisation in commodity h respectively. Since their weighted average over all commodities always take a constant value of unity,

$$\sum_h \left(\frac{X_{..}^h}{X_{..}}\right) S_i^h = \sum_h \left(\frac{X_{..}^h}{X_{..}}\right) R_j^h = 1 \tag{11}$$

each of them takes value around unity. S_i^h of over (under) unity implies that country i exports commodity h more (less) intensively than the world average, and the higher (lower) the value of S_i^h the stronger (weaker) is country i's export specialization in commodity h. Similarly, the higher (lower) the value of R_j^h, the stronger (weaker) is country j's import specialization in commodity h.

The vector of S_i^h over all commodities,

$(S_i^1, S_i^2, \cdots, S_i^n)$

shows the structure of export specialization of country i, which reflects country i's structure of comparative advantage. S_i^h of higher values indicate commodities with the production of which the country has strong comparative advantage, while those of lower values indicate those of weak comparative advantage. This also applies to the vector of indexes of import specialization. However the structure of import specialization is affected not only by the structure of comparative disadvantage but also by protective commercial policies much more than that of export specialization.

Table 1 gives the numerical example of a hypothetical case of two countries A and B exporting to country C. As is shown in Table 1 (b), both exporting countries, A and B, have the similar patterns of export specialization with the highest value in commodity IV and the lowest one in commodity I. Country C has the structure of import specialization which match the structures of export specialization of its trade partners.

Although countries A and B have the similar patterns of export specialization, the departure of the indexes of export specialization from unity is half as large for each commodity in country B as in country A. That is, A has more concentrated structures of export specialization than B, or B has more diversified one than A. The degree of concentration or diversification is affected by such important aspects of comparative advantage as size of a country, skewed resource endowments, and so on. They are measured in terms of standard deviations of specialization indexes from their mean, unity.

$$\sigma(S_i) = \sqrt{\sum_h \left(\frac{X_{..}^h}{X_{..}}\right)(S_i^h - 1)^2}$$
$$\sigma(R_j) = \sqrt{\sum_h \left(\frac{X_{..}^h}{X_{..}}\right)(R_j^h - 1)^2} \tag{12}$$

As is shown in the right-end column of Table 1 (b), the standard deviation of country B is half of that of country A.

[7] A country's structure of export specialization is principally determined by its structure of comparative advantage. In theory a country's comparative advantage is represented by comparative cost before trade is opened, but in empirical studies variables of export performance are frequently used to reveal its comparative advantage, since in international trade statistics price data are less reliable than value data. See Balassa B., 'Trade Liberalization and "Revealed" Comparative Advantage', *The Manchester School of Economic and Social Studies*, Vol. 33, No. 2, May 1965, pp. 91-123.

TABLE 1. AN EXAMPLE OF THE CALCULATION OF THE DEGREE OF COMPLEMENTARITY

(a) Commodity Compositions of Country A's and B's Exports, Country C's Imports, and World Trade.

Country \ Commodity	I	II	III	IV	Total
A's Exports	4	10	36	50	100
B's Exports	24	35	66	75	200
C's Imports	10	15	35	40	100
World Trade	200	250	300	250	1000

(b) Relative Share Indexes and Their Standard Deviations.

Country \ Commodity	I	II	III	IV	$\sigma(S_i)$, $\sigma(R_C)$	$\mathrm{cov}(S_i, R_C)$
A's Exports	0.20	0.40	1.20	2.00	0.6298	0.2692
B's Exports	0.60	0.70	1.10	1.50	0.3464	0.1346
C's Imports	0.50	0.60	1.17	1.60	0.4343	—

(c) Degrees of Complementarity.

$$C_{AC}=\mathrm{cov}(S_A, R_C)+1=1.2692,\quad C_{BC}=\mathrm{cov}(S_B, R_C)+1=1.1346$$

$$r_{AC}=\frac{\mathrm{cov}(S_A, R_C)}{\sigma(S_A)\times\sigma(R_C)}=\frac{0.2692}{0.6928\times 0.4343}=0.8946,\quad r_{BC}=\frac{0.1346}{0.3464\times 0.4343}=0.8946$$

Covariance of the indexes of country i's export specialization and those of country j's import specialization is defined as

$$\begin{aligned}\mathrm{cov}(S_i, R_j)&\equiv\sum_h\left(\frac{X_{..}^h}{X_{..}}\right)(S_i^h-1)(R_j^h-1)\\&=\sum_h\left(\frac{X_{..}^h}{X_{..}}\right)S_i^h\cdot R_j^h-1\\&=C_{ij}-1\end{aligned}$$

or

$$C_{ij}=\mathrm{cov}(S_i, R_j)+1 \tag{13}$$

This gives a clear economic meaning to the expected intensity of trade, C_{ij}. If country i's structure of export specialization matches country j's structure of import specialization closely, that is if indexes of i's export and j's import specialization are positively correlated ($\mathrm{cov}(S_i, R_i)>0$), C_{ij} takes a value over unity, while they match poorly, or they are negatively correlated ($\mathrm{cov}(S_i, R_j)<0$), C_{ij} takes a value under unity. If they are independent ($\mathrm{cov}(S_i, R_j)=0$), C_{ij} equals unity. In this sense, the hypothetical intensity of trade measures *the degree of complementality* in the specialization structures between trade partners.

The degree of complementarity is not only affected by the degree of match of the specialization structures of exports and imports, but also by the degree of concentration or diversification in them. A country with highly concentrated structure of export specialization tends to have high complementarity in its export trade than another country with the similar but more diversified structure of export specialization. Thus if we calculate the correlation coefficient between the specialization structure of exports and imports, we obtain the measure of the degree of match of the two structures neutral from the degree of concentration or

diversification.

$$r_{ij}=\frac{\mathrm{cov}(S_i, R_j)}{\sigma(S_i)\cdot\sigma(R_j)} \tag{14}$$

In the hypothetical case of Table 1, the degree of complementarity of A's export trade with C is twice as high as that of B's export trade with C, whereas they have the same correlation coefficient, which implies that the difference in C_{AC} and B_{BC} is solely attributed to the difference in the degree of diversification in the structure of export specialization between A and B.[8,9]

Regression analyses of indexes of export specialization on variables or their proxies of the alleged determinants of comparative advantage such as capital-labor ratio, skilled-unskilled labor ratio, R and D variables, scale economy variables attached to the production of individual commodities,

$$S_i{}^h=f\left(\left(\frac{K}{L}\right)^h, \left(\frac{L_s}{L_u}\right)^h, \lambda^h R \,\&\, D^h\right) \tag{15}$$

can verify the theories of comparative advantage.[10]

Overtime changes of structures of export specialization can be explained by changes in such determinants of comparative advantage as mentioned above by means of regression analysis. An alternative is to regress a variable which characterizes the overtime change in the structure of export specialization on such broad factors as the rate of total investment ($\dot{I}$), the rate of increase in education ($\dot{e}$), and the rate of wage increase ($\dot{w}$) all of which cause changes in comparative advantage. For example, the ratio of average specialization indexes of two commodity groups one of which represents simple labor intensive commodities and the other high technology intensitive commodities may be used for that purposes.

$$\dot{\lambda}=\frac{\dot{S}_i{}^l}{S_i{}^t}=f(\dot{I}, \dot{w}, \dot{e}, \cdots) \tag{16}$$

Although structures of import specialization are also affected by other factors than comparative advantage, they generally show contrary but less concentrated structures than those of export specialization.

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[8] The effects of r_{ij} and those of $\sigma(S_i)$ and $\sigma(R_j)$ are distinguished by Drysdale in his explanation for a decline of 30 to 40% in total commodity bias in Japan's export trade with Australia in the post-war period.

"At first sight it appears strange that total commodity bias fell since the structure of Japanese exports grew rather more like the structure of Australian imports between 1953 and 1963. An overriding consideration was that the composition of both trade flows came to resemble the compositions of world trade more closely than before. Hence there was less reason to expect Japan to export relatively more to Australia than to other countries because of their uniquely similar trade structures." Drysdale P., op. cit. p. 164.

The first statement refers to the increase in r_{JA} (although the contrary evidence is shown in Table 5 and the second to the decline in $\sigma(S_J)$ and $\sigma(R_A)$.

[9] Linneman introduces to his gravity model analysis ot world trade flow a similar concept to our r_{ij}. However he has not given its clear economic implication.

See Linneman, H., *An Econometric Study oj International Trade Flow*, Amsterdam, 1966.

[10] A similar attempt was made in Gruber W. H. and Vernon R. *The Technology Factor in a World Trade Matrix*, mimeographed 1969. However, they used as the dependent variable country i's share in world trade of commodity h ($X_i{}^h/X_{\cdot\cdot}{}^h$) instead of our relative share index, $S_i{}^h$.

IV. *Determinants of Special Country Bias*

The intensity of trade between a pair of countries is also affected by other factors than those which determine the commodity composition of each country's global trade. They are put aside from the hypothetical model of homogeneous commodity trade. They include transport cost, discriminatory tariffs and other import restrictions, product differentiation within commodity classes, and other international economic relations than trade such as capital movements and economic cooperations.

They are supposed to affect all commodities in a bilateral trade to the same extent, so that the degree of complementarity between a pair of countries is solely determined by the global structures of export and import specialization and is neutral from other factors. This is not necessarily the case in reality. Transport cost tends to depress imports of bulk commodities from the distance more than those of other commodities, so that the global commodity composition of the exporter does not reflect precisely its structure of export specialization relevant to the importer. Similarly, preferential tariff arrangements may discriminate against non-member sources of supply in imports of manufactures more than in those of raw materials. Product differentiation is more important in finished manufactures than in semi-finished ones. Therefore, the degree of special country bias is not necessarily the same for all commodities but vary around the overall special country bias in each bilateral trade, which is a weighted harmonic mean of special country bias of individual commodities.

The size and structure of divergence vary in each bilateral trade, and we can, for the first approximation, regard them as random disturbance around the overall bias and independent from the overall degrees of complementarity and special country bias. Thus we can separate two groups of factors affecting the intensity of bilateral trade. One is the structure of comparative advantage of exporters and importers modified somewhat by their commercial policies, which determines the degree of complementarity between two countries. The rest of the factors constitutes the second group which mainly determines the degree of special country bias in bilateral trade.

Traditional theories have been forcussing on the first group of factors as the determinants of the pattern of international trade and occasional mention have been made for factors of the second group. This is partly because most traditional theories of international trade have been worked out in two country model in which no special country bias can be introduced until recently discriminatory effects of customs union or free trade area is explored in three country model. It is interesting to see, from the viewpoints both of theory and policy in international economics, how much the second group of factors affect trade patterns.

It is important to note that a weighted harmonic mean of special country biases of a country with its all trade partners is always unity.

$$\frac{1}{\sum_j \left(\frac{X_{ij}}{X_{i.}}\right)\frac{1}{B_{ij}}} = \frac{1}{\sum \frac{\bar{X}_{ij}}{X_{i.}}} = 1 \tag{17}$$

That is, if a country's overall special country biases are larger than one with some countries, they must be smaller than one with other countries. Therefore, the structures of overall special country biases in bilateral trades between all possible pairs of countries in the world

throw light on the study of major determinants of special country bias.

The degree of special country bias in country i's export trade with country j is regressed on various factors which characterize ecocomic relationships between the two countries. Economic distance is measured in terms of average transportation cost between the two countries (D_{ij}); the effects of preferencial trade arrangements such as common market, free trade area, and Common Wealth Preferences is introduced in dummy variable form (P_{ij}) whose value is either one if such preferencial arrangement exists between two countries or zero if not.

If a product of country i is preferred by country j to the products of other countries in the same commodity class, the hypothetical volume of country i's export of this commodity to country j ($\overline{X}_{ij}^{h}$) understates the true one based on country i's structure of comparative advantage relevant to country j's market, so that the special country bias for this commodity will be overestimated. The closer is the living standard of the two countries, the more their products tend to be preferred each other in many commodity classes. Thus the difference in per-capita incomes between the two (ΔY_{ij}) is introduced as a proxy variable to represent the effect on overall special country bias of proximity or familiarity through product differentiation.

Drysdale suggested that the increased investments in Australia by U.S. since mid-1950's and by Japan in recent years tend to increase imports of capital goods and related commodities from these countries, resulting in higher special country bias in the export trade of these countries with Australia. This is more likely to be the case for distribution of economic aids by advanced countries among LDC's since tied loans are the most used form of giving aids. A variable quantifying the intensity of economic relationships other than trade is introduced to represent these factors, for example

$$A_{ij}=\frac{K_{ij}}{K_{i.}}\Big/\frac{K_{.j}}{K_{..}} \tag{18}$$

where K_{ij} is the flow of capital or aids from country i to country j.

Above arguments are summed up in functional form as

$$\Delta Y_{ij}\ B_{ij}=f(D_{ij}, P_{ij}, \Delta Y_{ij}, A_{ij}, \cdots) \tag{19}$$

D_{ij} and ΔY_{ij} tend to affects B_{ij} in negative direction, whereas P_{ij} and A_{ij} in positive direction.

Overtime changes of special country bias also reflect changes in some of these underlying factors and overtime analysis of B_{ij} contribute to the study of the determinants of special country biases, since some of them are more easily quantified in their changes than their absolute levels.

It is interesting to note that symmetrical movements are expected between B_{ij} and B_{ji}, special country biases in bilateral trade of both directions, since most determinants of special country bias tend to affect bilateral trades in both directions in similar ways, which is likely to be the case for economic distances, proximity in living standard or familiarity, and reciprocity in trade arrangements.

V. *Alternative Formulation of Complementarity*

Another formula of the degree of complementarity is derived from an alternative assumption of world trade flow. Assume, in stead of a homogeneous commodity, that the product of each exporter in a commodity category is differentiated from each other's product, so that

a country's import of the commodity is composed of various exporters' products and each exporter's share in it is determined by the preference pattern of the importer.[11]

Thus an exporter's performance in different import makets should be considered to reflect its comparative advantage relevant to each market, whereas its export to the world as a whole is merely the average of its performance in different markets. The structure of country i's specialization in a particular market is expressed in index form by

$$S_{ij}^{h}=\frac{X_{ij}^{h}}{X_{ij}}\Big/\frac{X_{..}^{h}}{X_{..}} \tag{20}$$

while the country's export specialization to the world as a whole (S_i^h) is merely an average of individual S_{ij}^h weighted by the geographical composition of the country's export.[12]

$$S_i^h=\sum_j\left(\frac{X_{ij}}{X_{i.}}\right)S_{ij}^h \tag{21}$$

Degree of complementarity is defined in this alternative model by the sum of products of S_{ij}^h and R_j^h weighted by the share in world trade of each commodity, which equals the covariance of S_{ij}^h and R_j^h added by one.

$$\begin{aligned}C_{ij}^{*}&\equiv\sum_h\left(\frac{X_{..}^{h}}{X_{..}}\right)S_{ij}^{h}\cdot R_j^h\\&=\mathrm{cov}(S_{ij}^h, R_j^h)+1\end{aligned} \tag{22}$$

If the structure of i's export specialization in j's market matches that of j's import specialization, the potential volume of i's export to j tends to be larger than those of its competitors, so that the potential intensity of i's export trade with j in the world with neither transport cost nor artifical trade impediments (C_{ij}^*) will be over unity. In the reverse case C_{ij}^* will be under unity.

Degree of special country bias is defined by the gap between the actual and expected

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[11] Commodity classifications detailed enough to satisfy the homogeneity assumption are not available in reality, so that the model of differentiated products will be more practical in this sense. For the use of this assumption in the studies of international economics, see Johnson, H. J. "The International Competitive Position of the United States and the Balance of Payments Prospects for 1968." *Rev. of Econ. and Stat.* Vol. 46, N. 1, (Feb. 1964), p. 23-25.

Each exporter is as competitive as in each importer's market in the model of homogeneous products, while in the model of differentiated products, an exporter is more competitive in some markets than it is in others. These are two alternative sets of assumptions on world trade flow and are distinguished from each other also in Oom, V. D., "Models of Comparative Export Performance" *Yale Econ. Essays*, Vol. 7, No. 1. (Sep. 1967).

[12] S_{ij}^h may be defined alternatively as i's export performance of commodity h in j's market divided not by the share of commodity h in world trade, but by that in J's import trade.

$$S_{ij}^{h}\equiv\frac{X_{ij}^{h}}{X_{ij}}\Big/\frac{X_{.j}^{h}}{X_{.j}} \tag{i}$$

However, C_{ij} with S_{ij}^h in equation (i) in the place of S_{ij}^h in equation (22) turns out to take the constant value of unity for all cases,

$$\begin{aligned}C_{ij}&=\sum_h\left(\frac{X_{..}^{h}}{X_{..}}\right)S_{ij}^{h}\cdot R_j^h\\&=\sum_h\left(\frac{X_{..}^{h}}{X_{..}}\right)\left(\frac{X_{ij}^{h}}{X_{ij}}\Big/\frac{X_{ij}^{h}}{X_{.j}}\right)\left(\frac{X_{.j}^{h}}{X_{.j}}\Big/\frac{X_{..}^{h}}{X_{..}}\right)\\&=\sum_h\left(\frac{X_{ij}^{h}}{X_{ij}}\right)=1.\end{aligned}$$

values of trade intensity.

$$B_{ij}^* \equiv \frac{I_{ij}}{C_{ij}^*} \tag{23}$$

Thus we have obtained an alternative formula for the decomposition of I_{ij}.

Values of S_{ij}^h are independent from such factors as distance and artificial trade impediments provided that these factors affect the trade of all commodities uniformly, and, therefore, C_{ij}^* will be independent of these factors. And the difference between C_{ij} and C_{ij}^* comes out from alternative definition of commodity category.

In order to distinguish between the two models, consider the following cases. Suppose i's productivity in the production of commodity h improves so that i's export specialization in commodity h is strengthened. Country i's export to country j which has strong import specialization in the same commodity tends to increase and so does the intensity of i's export trade with j. Since both S_i^h and S_{ij}^h increase in this case, the increase in I_{ij} will be explained by higher complementarity in either model.

On the other hand, in stead of over-all increase in productivity of commodity h, a change from low quality products to high quality one in the production of commodity h occurs. Export specialization in high-quality h commodity will increase, whereas that in low-quality one will decline, so that i's export specialization in h-commodity as a whole remains constant. Country i's export to country j with strong preference for high-quality h commodity tends to increase, leading to higher intensity of i's export to j, whereas i's export to country k with strong preference for low-quality h commodity tends to decrease, resulting in lower intensity of i's export trade with k.

This change is reflected in the export specialization in individual markets (increase in S_{ij}^h and decrease in S_{ik}^h), but not in export specialization to the world as a whole (constant S_i^h). Thus the degree of complementarity of i's export trade with j will, ceteris paribus, increase, and that with k will decline in the alternative model, while both of them remain constant in the initial model, so that the changes in I_{ij} and I_{ik} are explained by changes in C_{ij} and C_{ik} in the former model, but in the latter they have to be explained, with constant C_{ij} and C_{ik}, by changes in B_{ij} and B_{ik}, that is, changes in special country biases.

Thus in the initial model, there always exists the tendency of underestimation of C_{ij} which are eliminated partly at least in the alternative model. However, only the initial model is applied in the empirical study of this paper since additional data are required for the computation of the alternative model.

VI. *Statistical Problems and Procedures*

Calculations are based on trade statistics taken from U.N.'s *Monthly Bulletin of Statistics* (Special table E published in March issue every year). It provides world trade matrix of sixteen regions for years 1955–67 in U.S. dollars and commodity composition of global exports and imports of each region according to six commodity categories. Matrix of trade flows among fifteen regions (USA, Canada, Latin America, EEC, UK, EFTA excluding UK, Other Western Europe, Eastern Europe including USSR, South African Republic, Other Africa, Japan, West Asia—Asian part of Mid East, Other Asia, Mainland China and other Asian Communist countries, Australia and New Zealand) are constructed for three-year averages at

three periods 1955-57, 1960-62, and 1965-67. The commodity composition of global exports and imports of each region for the same three year-averages at three periods are calculated under six commodity classes (Standard International Trade Classification Section 0 and 1, 2 and 4, 3, 5, 7, 6 and 8).[13] The data has both merits and demerits, the effects of which should be taken into accounts in the interpretation of the results of calculations.

(1) Country groups are taken as units instead of individual countries except five countries, US, CAN, UK, S AFR, and J each of which makes a unit by itself. This tends to mitigate irregular trade figures inherent to small, primary exporting countries. Furthermore, this makes it possible to cover the whole world trade and to conclude about the over-all structures of I_{ij}, C_{ij}, and B_{ij}. However, country grouping tends to make even structures of export and import specialization and to under-estimate both γ_{ij} and σ resulting in under-estimates of C_{ij} (to be exact their departure from unity) and thus in under- or over-estimate of B_{ij}.[14]

(2) All indexes of S_i^h, R_j^h, C_{ij}, I_{ij}, B_{ij} are ratios of ratios and tends to be neutral from cyclical or irregular movements of absolute trade figures. And three-year averages with five year durations between each period are appropriate to eliminate short term fluctuations and to look to the secular changes of trade relationships.

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[13] The statistics before 1961 are shown under different regional classification and are adjusted to that of after 1961. The sixteenth region, the rest of the world which consists of Carribian and Pacific islands, is excluded. Figures in world trade matrix include SITC Section 9 (miscellaneous transactions and commodities n. e. s.) which is excluded from data of commodity composition. These omissions prevent the data from being fully exhaustive of world trade, but both of them are listed as residuals and suffer considerably from statistical errors and the inclusion of them doesn't seem to add much to our analysis.

[14] If a country construct a unit by itself, zero should be attached to the expected value of trade within the unit.

$$\bar{X}_{ii}\equiv 0.$$

Thus the sum of expected value of trade over all world trade defined by the formula (4) tends to understate the world total

$$\begin{aligned}\sum_i \sum_{j(i\neq j)} \bar{X}_{ij}^h &= \sum_i \sum_{j(\neq i)} \frac{X_{i\cdot}^h X_{\cdot j}^h}{X_{\cdot\cdot}^h} = \sum_i \left(\frac{X_{i\cdot}^h}{X_{\cdot\cdot}^h}\right) \Sigma X_{\cdot j}^h \\ &= \sum_i \left(\frac{X_{i\cdot}^h}{X_{\cdot\cdot}^h}\right) \Sigma X_{\cdot j}^h \\ &= \sum_i \frac{X_{i\cdot}^h}{X_{\cdot\cdot}^h}(X_{i\cdot}^h - X_{\cdot j}^h) \\ &= \sum_i X_{i\cdot}^h \left(1-\frac{X_{\cdot i}^h}{X_{\cdot\cdot}^h}\right) \\ &= X_{\cdot\cdot}^h - \sum_i \frac{X_{i\cdot}^h \cdot X_{\cdot j}^h}{X_{\cdot\cdot}^h} \\ &= X_{\cdot\cdot}^h \left[1-\sum_i \left(\frac{X_{i\cdot}^h}{X_{\cdot\cdot}^h}\right)\left(\frac{X_{\cdot j}^h}{X_{\cdot\cdot}^h}\right)\right].\end{aligned}$$

This understatement will be adjusted by defining the expected value of trade divided by the factor in parenthesis.

$$(\bar{X}_{ij}^h)^* = \bar{X}_{ij}^h \cdot \frac{1}{\left[1-\sum_i \left(\frac{X_{i\cdot}^h}{X_{\cdot\cdot}^h}\right)\left(\frac{X_{\cdot i}^h}{X_{\cdot\cdot}^h}\right)\right]}.$$

In our analysis, only five units need this adjustment, which does not seem to alter our results considerably.

(3) Six commodity classification covers all important commodities traded, which is required to derive unbiased estimates for the degree of complementarity. However, each commodity category is often too broad to catch important changes of commodity specialization.

Let a commodity category c consists of two sub-commodities a and b. Then the index of export specialization in commodity c is the weighted average of those of the two subcommodities.

$$S_i^c=\frac{X_{i.}^a+X_{i.}^b}{X_{i.}}\Big/\frac{X_{..}^a+X_{..}^b}{X_{..}}$$
$$=\left(\frac{X_{..}^a}{X_{..}^c}\right)S_i^a+\left(\frac{X_{..}^a}{X_{..}^c}\right)S_i^b \tag{24}$$

The excess of the variance of country i's export specializations under the commodity classification with the commodity c separated into the two sub-commodities (σ^2) over that under the aggregated commodity classification ($\hat{\sigma}^2$), others being equal between the alternative classifications, is

$$\sigma_i^2-\hat{\sigma}_i^2=\left(\frac{X_{..}^a}{X_{..}}\right)(S_i^a-1)^2+\left(\frac{X_{..}^b}{X_{..}}\right)(S_i^b-1)^2-\left(\frac{X_{..}^c}{X_{..}}\right)(S_i^c-1)^2$$
$$=\frac{X_{..}^a\cdot X_{..}^b}{X_{..}\cdot X_{..}^c}(S_i^a-S_i^b)^2 \tag{25}$$

Therefore, so far as $S_i^a\neq S_i^b$, $\sigma_i^2>\hat{\sigma}_i^2$. That is, so long as a commodity category is composed of sub-categories with different values of export specialization, the degree of diversification in trade specialization calculated from aggregated commodity classifications tends to underestimate its true value.

On the contrary, the degree of complementarity calculated from the aggregated commodity classification ($\hat{C}_{ij}$) tend to over- or under-estimate the true values of complementarity (C_{ij}). Their difference is represented by

$$C_{ij}-\hat{C}_{ij}=\left(\frac{X_{..}^aX_{..}^b}{X_{..}X_{..}^c}\right)(S_i^a-S_i^b)(R_j^a-R_j^b), \tag{26}$$

If the specialization of both country i's export and country j's import are stronger in one sub-commodity than in the other of the commodity c, $\hat{C}_{ij}$ falls short of C_{ij}. If on the contrary they are stronger in different sub-commodities, $\hat{C}_{ij}$ exceeds C_{ij}. Since the former is likely to be the case between countries with contrary specialization structures whereas the latter is the case between countries with similar specialization structures, the degrees of complementarity estimated from aggregated commodity classification tend to under-estimate the departures of their true values from unity.

Since the value of I_{ij} is not affected by the degree of aggregation in commodity classification, then with given value of I_{ij} the under-estimation of C_{ij} due to aggregation tends to over-estimate B_{ij} when both B_{ij} and C_{ij} are over or under unity, while it tends to underestimate B_{ij} in other cases.

VII. *Complementarity among Fifteen Regions*

Table 2-6 give the calculations of trade indexes in II–IV among fifteen regions of the world at three periods. This and the following two sections are concerned with the global structures of C_{ij}, B_{ij} and I_{ij} and their overtime changes. In this section the structure of export specialization are explored for each region at three consecutive periods, which is summed up to the analysis of the structure of C_{ij} and its overtime changes. It will be shown that the growing

industrialization of traditional primary exportors has made the structure of trade specialization more diversified in most countries and caused the tendency of C_{ij} converging to unity.

In the next section an off-hand analysis depicts some factors affecting the structure of B_{ij} and the symmetricity of their effects. The tendency of B_{ij} converging to unity is pointed out and associated with the reformation of the existing trade ties. The structure of C_{ij} is superimposed by that of B_{ij} to produce trade intensity relationships among fifteen regions in the last section. It will be interesting to note that B_{ij} dominates the structure of I_{ij} in one of eight and that there exists a strong tendency of I_{ij} converging to unity. These propositions on the global structure of trade flow and its overtime changes are derived by means of contingency tables, but they are to be supplemented by more rigorous regression analyses described in III and IV.

To begin with the commodity composition of world trade (the first three rows in Table 2a and 2b), primary goods (SITC Section 0+1, 2+4, 3) and manufactured goods (5, 7, 6+8) are balanced in 1955-57 (.4910 vs .5090). Each category in the former group has declined and each of the latter has increased steadily in the following decade. (The combined share of the manufactures is .5623 in 1960-62, and .6294 in 1965-67).

There are two groups distinguished clearly from each other by the structures of export and import specialization. One is the group of such industrial exporters (Group I) as US, UK, EEC, and Japan, and the other, the group of primary goods suppliers (Group P), consists of the rest of the regions except O EFTA and E EUR. The last two regions are classified as the first group in the structures of their export specialization but as the second group in those of their import specialization.

Typically Group I regions have indexes of export specialization over unity in manufactures but those of under unity in primary commodities, while Group P regions have contrary structures of export specialization. But the details differ within groups according to stages of development. US has strong export specialization in categories 7 and 5 but rather weak one in category 6+8. UK and EEC are strong in all three categories, and Japan has the strogest in 6+8 but her export specialization has just risen above unity in categories 7 and 5 by 1965-67. Since export specialization in primary commodities are considerably weak both for Japan and U.K. but not very weak for US and EEC, the latter two regions have more diversified structures and smaller standard deviations than Japan and UK.

Group P regions have strong export specialization in one or two categories of 0+1, 2+4, and 3, but they are divided into two groups according to how much they are industrialized in their export specialization. CAN, S.AFR, OTH ASIA, CHN MX, O W EUR constitute Group P1 whose export specialization in category 6+8 reached the level of unity and import specialization in the same category is weaker and even below unity. On the other hand LAT AM, OTH AFR, W ASIA, and ANZ constitute Group P2 whose export specialization in category 6+8, let alone categories 5 and 7, is weak and they have to depend mainly on the export of primary commodities. Structures of export specialization are more concentrated and the standard deviations are greater in Group P2 regions.

Structures of import specialization both in Group I and Group P regions are contrary to those of their export specialization and are generally more diversified and have much smaller standard deviations than the latter. This may well be explained by the similarity of demand patterns in comparison with skewness of resource endowments among countries on one hand,

and protective commercial policies on the other.

Structures of export specialization of O EFTA and E EUR become similar to those of Group I but their relative shares do not deviate much from unity in any categories and are characterized by much diversified structures. On the contrary their import specializations are close to those of Group P with low values in primary commodities and over unity values in manufactures. These intermediate characteristics result from the fact that the two regions are mixtures of various countries and constitute somewhat self-sufficient regions.

There appear in Table 2 distinct overtime changes in the structures of export and import specialization. For US, UK and EEC export specialization have weakened and import specialization strengthened in all categories of manufactures. As these categories are increasing their shares in world trade, this tendency reflects that the exports from these countries are getting behind of the world export and their imports are growing faster than the world totals. This implies in relative sense that these countries are losing their competitive power or comparative advantage in all categories of manufactures (in all three broad categories at least) in world market.[15]

On the otherhand in categories 0+1 and 2+4 their export specialization increases and import specialization declines. This trend in commodity categories of declining shares in world trade appears to reflect protectionistic agricultural policy and substitution of raw materials by synthetic ones. These growing diversification in the structure of export and import specialization are represented clearly by distinct declines in standard deviations of exports and imports.

Japan, on the contrary, although weakening in the exports of categories 6+8, is gaining rapidly her share in categories 7 and 5, which reflects her increasing competitive power in world market. Import specialization in primary commodities and category 6+8 are increasing but those of categories 7 and 5 stay still, which is contrary to overtime changes in other Group I regions. O EFTA shows the similar changes to those of Japan and E EUR follows the rests of Group I countries.

For Group P regions export specialization increases in all categories of manufactures and import specialization decreases in category 6+8. This seems to reflect the industrialization of primary exporting regions, especially import substitution and export promotion in category 6+8 in them. (Such an advanced country in this group as Canada has followed the line of overtime change similar to Japan in which export specialization decreases in category 6+8 but it increases drastically in category 7.) There appear no distinct overtime changes in either export or import specialization in primary commodities. Thus the tendency toward more diversified structures of export and import specialization are depicted for group P regions.

Standard deviations of export specialization (a) increase consecutively over the decade in two regions, (b) show upward trends in one regions, (c) show downward trends in three, and (d) decrease consecutively in eight regions.[16] Similarly those of import specialization are (a)

[15] Increase in import specialization in manufactures may be attributed partly to the increase in mutual trade of differentiated manufactures among industrial exporters. It will not be ascertained until structures of trade specializations are studied in more disaggregated commodity classification.

[16] These four types of overtime changes are defined as follow. Let x_1, x_2, x_3 be values of x at consecutive periods 1, 2, and 3.

$x_1 < x_2 < x_3$ (a)

$x_1 < x_3 \leqq x_2$, $x_2 \leqq x_1 < x_3$ (b)

$x_2 \leqq x_3 < x_1$, $x_3 < x_1 \leqq x_2$ (c)

$x_3 < x_2 < x_1$ (d)

in one, (b) in none, (C) in five, and (d) in nine.

Degree of complementarity between a pair of regions is represented by correlation coefficients r_{ij}. Group I regions and Group P regions are distinguished from each other by the sign of r_{ij}; r_{ij} is negative between a pair of regions within the same group but it is positive between a pair of regions belonging to different groups. O EFTA and E EUR has negative r_{ij} with Group I regions and positive r_{ij} with Group P regions in their export trades, while they have the contrary structures of r_{ij} in their import trades. Especially, UK and EEC of Group I and ANZ, OTH AFR, and S AFR of Group P show clear structures of export and import specialization characteristic of their own group, apart from their degrees of concentration, which reveal in high absolute values of r_{ij} both in export and import trades.

Since the structure of export specialization and that of import specialization of a region are negatively correlated in general (that is $r_{ii}<0$), there appears symmetricity in the sign of r_{ij} and r_{ji}; out of 630 pairs r_{ij} and r_{ij} have opposite signs in 72 pairs, most of which are associated with either O EFTA or E EUR whose correlation coefficient within regions is positive ($r_{ii}>0$).

The symmetricity is also depicted in overtime changes in r_{ij} and r_{ji}. (See Table 7a.) Out of 105 pairs r_{ij} and r_{ji} move in the same direction in 62 pairs (toward zero in 36 pairs and depart from zero in 26 pairs). Symmetrical movement is significant at 5% level and the coefficient of association is 0.3684.

Degree of complementarity (C_{ij}) is determined by the degree of match (r_{ij}) and that of diversification ($\sigma(S_i)$, $\sigma(R_j)$) of the structures of export and import specialization. That is, the essential structure of C_{ij} is determined by that of r_{ij}, but the departure of C_{ij} from unity is affected by standard deviations. Great departures of C_{ij} from unity are depicted in such countries with relatively high absolute values of r_{ij} and great standard deviations in export or import specialization as UK, J among Group I and ANZ, OTH AFR, LAT AM, OTH ASIA, S AFR among Group P. On the contrary C_{ij} are close to unity in such countries as OTH EFTA, EEC, US, E EUR with small r_{ij} values and small standard deviations.

Although symmetricity between C_{ij} and C_{ji} results from that between r_{ij} and r_{ji}, the symmetricity in their movements over the decade is not statistically significant (see Table 7b). In 60 out of 105 pairs both C_{ij} and C_{ji} move toward unity, but this is mainly because there exists a strong tendency for C_{ij} to converge to unity. Out of 225 cases (a) C_{ij} converges consecutively to unity in 108 cases, (b) tends to converge to unity in 66 cases, (c) tends to diverge from unity in 34 cases, and (d) diverges consecutively from unity in 17 cases. The ratio of convergence ((a)+(b)) is 0.7733, which is statistically significant at 1% level, that is, the null hypothesis that there exists no tendency for C_{ij} to move in particular direction is rejected at the risk of 1% possibility of error.

The tendency of C_{ij} toward unity is explained not only by the decline in both $\sigma(S)$ and $\sigma(R)$ but also by the tendecy of r_{ij} toward zero (see Table 7c). The association between the two tendencies is significant at 1% level and the association coefficient is 0.8783. That is, the tendency for the degree of complementarity to move toward independence level is not only explained by the growing diversification in both export and import specialization of most regions, but also by the fact that patterns of trade specialization become similar between Group I regions and Group P regions. This tendency has been caused by the decrease of export specialization and increase of import specialization in manufactures (especially in category 6+8) on Group I regions' side and the contrary changes in the structure of trade specialization in the same categories of Group P regions' side, that is, rapid industrialization of tradi-

tionally primary goods exporters in category 6+8 and the corresponding decrease in competitive power of industrial exporters in the same commodity category.

VIII. *Special Country Biases among Fifteen Regions*

An off-hand analysis of the figures in Table 5 reveals some characteristics of the structure of B_{ij}.

Firstly, high values of B_{ij} are depicted in such intra-regional trade as in LAT AM, EEC, OTH EFTA, E EUR, OTH AFR, W ASIA, ANZ and trades between neighboring countries such as US and CAN, Regions in Europe (EEC, OTH EFTA, O W EUR and UK), OTH AFR and S AFR, and Asian regions (J, OTH ASIA and CHN MX). Secondly, trades between an industrial exporter and its raw material suppliers are characterized by high B_{ij}, such as between UK and its former dependents CAN, ANZ and S AFR, between EEC and OTH AFR, between US and LAT AM, between J and ANZ, OTH ASIA, W ASIA, in which there exists no high special country biases among raw material suppliers with each other. Thirdly, political relationships give rise to high special country biases as are shown between E EUR and CHN MX, and between J and US.

Overtime changes of special country biases give light to their determinants. Distinguished increases in B_{ij} are found in CAN-US trade, intra-ANZ trade, intra-LAT AM trade, intra-EEC trade, intra-EFTA trade, and intra-OTH AFR trade, all of which are explained by economic integration or other new trade agreements. Similarly increase in B_{ij} in trades between US and ANZ, J and ANZ, CAN and J, and US's export trade with OTH ASIA and J's export trade with US seem to reflect the increasing intensity of intra-Pacific trade. On the contrary, B_{ij} declines in trade between ANZ and UK, CAN and UK, EEC and OTH EFTA, which reflect the breakdown of the British Common Wealth and the establishment of EEC. An unambiguous trend is found in a rapid decline in B_{ij} between E EUR and CHN MX, and a rapid increase of each's trade with the rest of the world; trades of CHN MX, with ANZ, J, OTH ASIA, W ASIA, OTH AFR, and LAT AM, and trades of E EUR with OTH ASIA, LAT AM, OTH AFR, J, CAN, and UK.

Above observations suggest the symmetricity between B_{ij} and B_{ji} and their movements. The conflict case in which either B_{ij} and B_{ji} exceeds unity while the other falls short of unity occurs in less than one in seven and the symmetricity is significant at 1% level (the association coefficient is .9419. See Table 7d). Similarly, the symmetric movement of B_{ij} and B_{ji} (both increase or both decrease) is significant at 1% level (the association coefficient is .5501. See Table 7c). These statistical evidences support our hypothesis of the reciprocity in the effects of determinants of special country biases.

Is there any tendency for B_{ij} to move in any particular direction? It does not make any sense to count the number of increase and that of decrease in B_{ij} since they tend to be balanced under the equation (17). Convergence of B_{ij} toward unity is depicted in 132 cases out of 219, that is, 60.27%, which is large enough to reject at 1% level of significance the null hypothesis that there exists no particular tendency of overtime changes. The convergence toward unity of special country biases seems to reflect the break up of traditional trade blocs and the strengthening of new trade ties over the world.

IX. *Intensity of Trade among Fifteen Regions*

The structure of I_{ij} is the structure of C_{ij} multiplied by that of B_{ij}. Namely the high complementarity between Group I regions and Group P regions and low complementarity within each group multiplied by high or low country biases resulting from geographical closeness or other relationships produce the structure of intensity of trade among fifteen regions.

Each industrial exporter has high intensity of trade with particular Group P regions which is located in its neighbourhood or from which it obtains its raw materials, where high C_{ij} and high B_{ij} reinforce each other (US-CAN, LAT AM; UK-S AFR, ANZ; EEC-OTH AFR). It has, on the contrary, very low intensity of trade with other industrial exporters which are located in distance, where low C_{ij} and low B_{ij} reinforce each other (J-EEC, UK). Low intensity of trade is common among Group P regions where low C_{ij} and low B_{ij} reinforce each other (ANZ-LAT AM-CAN-OTH AFR-S AFR-OTH ASIA). Trade intensity of about unity is obtained in such intermediate cases with high C_{ij} offset by low B_{ij} as between an industrial exporter and primary exporter not closely associated to itself (J-S AFR, LAT AM; EEC-ANZ, S AFR). Such intra-regional trades as in LAT AM, EEC, OTH AFR, OTH ASIA, W ASIA, and ANZ are characterized by intensity of trade of more than unity resulting from low C_{ij} dominated by high B_{ij}.

It appears that the structure of B_{ij} dominates that of I_{ij}, since the divergence of C_{ij} from unity is much smaller than that of B_{ij}; most of C_{ij} are included in the range between 0.5 and 2.0, whereas more than a half of B_{ij} (336/657=.5114) are located outside the range, and thus dominate I_{ij}. The conflict case of B_{ij} and C_{ij} being on the opposite side of unity occurs in 275 out of 657 cases (that is, 41.85%), out of which in 34 cases (12.4%) C_{ij} dominates I_{ij}. (Note that this is independent from the estimation bias of C_{ij} and B_{ij} since both of them tend to be either overestimated or underestimated to the same extent) On the other hand, overtime changes of C_{ij} conflict with those of B_{ij} in 215 cases out of 438 (e.i. 49.08%) and C_{ij} dominates the overtime changes of I_{ij} in 52 cases (e.i. 24.18%). The dominance of C_{ij} is small in determining the value of I_{ij}, but it has been strengthened twice in determining the overtime changes of I_{ij}.

There appears a strong tendency for I_{ij} to converge to unity; (a) in 86 out of 219 cases I_{ij} converge consecutively to unity, (b) it tends to converge in 51 cases, (c) it tends to diverge from unity in 37 cases, and (d) it tends to diverge consecutively from unity in 45 cases. The tendency of convergence to unity is significant at 1% level. However, its association with the tendency for C_{ij} to converge to unity is not significant (See Table 7f). Thus the convergence of special country biases causes the intensity of trade to coverge to unity.

Above analyses are tentative and need to be supplemented by more rigorous analysis suggested in III and IV, but several propositions follow from them.

(1) Although the use of broad commodity classification have forced us to make even the structures of export and import specialization and to underestimate the degree of complementarity, it has not missed the basic structure of international division of labour and its overtime changes. C_{ij} is dominant in determining the value of I_{ij} only in one of eight, while it is twice as dominant in determining their overtime changes.

(2) Factors of special country bias are more important in determining intensity of trade among regions than have been expected in traditional theory of international trade. This implies the importance of such factors as space, preferential trade arrangements, and so on,

in determining the pattern of trade in many country world, which encourages us to introduce space factor into the theory of international trade.[17]

(3) The convergence both of C_{ij} and B_{ij} toward unity reflects two important structural changes of world trade flow; industrialization of primary goods exporters and the breakup of traditional trade relationships. Consequent convergence of I_{ij} toward unity will provide valuable implications for policy purposes.

APPENDIX: EXTREME VALUES OF THE TRADE INDEXES

Degree of aggregation in country groupings and commodity classification affect the values of I_{ij}, C_{ij}, S_i^h and R_j^h, through limiting their maximum values.

I_{ij} takes the minimum value of 0 when $X_{ij}=0$ and the maximum value of the smaller of $(X../X_{i.})$ and $(X../X_{.j})$ since X_{ij} cannot exceed $X_{i.}$ and $X_{.j}$ $(X_{ij}\leqq X_{i.}, X_{ij}\leqq X_{.j})$.

$$0\leqq I_{ij}\leqq \min\left(\frac{X..}{X_{i.}}, \frac{X..}{X_{.j}}\right)$$

That is, the larger is either exporting or importing country, the smaller the maximum values of I_{ij} is.

Similarly, since $X_{i.}^h$ cannot exceeds $X_{i.}$ and $X..^h$ $(0\leqq X_{i.}^h\leqq X_{i.}, 0\leqq X_{i.}^h\leqq X..^h)$, S_i^h is limited by the smaller value of $(X../X_{i.})$ and $(X../X_{.j})$.

$$0\leqq S_i^h\leqq \min\left(\frac{X..}{X_{i.}}, \frac{X..}{X..^h}\right)$$

The larger is the exporting country's share, and the larger is the share of the commodity in the world trade, the smaller the index of export specialization is. Similar constraints are imposed on the index of import specialization.

$$0\leqq R_j^h\leqq \min\left(\frac{X..}{X_{.j}}, \frac{X..}{X..^h}\right)$$

C_{ij} takes the minimum value of zero when either S_i^h or R_j^h or both of them are zero for all commodities ($S_i^h\cdot R_j^h=0$ for all h). The maximum value of C_{ij} depends upon the maximum values of $\sigma(R_j)$ and $\sigma(S_i)$ since

$$C_{ij}-1=\mathrm{cov}(S_i, R_j)\leqq\sqrt{\sigma^2(R_j)\,\sigma^2(S_i)}$$

The maximum values of variance of export or import specialization are obtained when the trade specialization index of a commodity with the smallest share in world trade takes a positive value and those of the other commodity are all zero.

$$\max\sigma^2(S_i)=\max\sigma^2(R_j)=\min\left(\frac{X..}{X..^h}\right)-1$$

Thus the maximum value of $\mathrm{cov}(R_j, S_i)$ is

$$\max\mathrm{cov}(S_i, R_j)=\sqrt{\max\sigma^2(S_i)\max\sigma^2(R_j)}=\min\left(\frac{X..}{X..^h}\right)-1$$

Then the range of values of C_{ij} is

$$0\leqq C_{ij}\leqq \min\left(\frac{X..}{X..^h}\right)$$

That is, it is not independent from the degree of aggregation in commodity classification.

[17] Some factors of special country biases have been introduced explicitly into the theory of international trade by H. G. Johnson in his Wicksell Lecture, *Comparative Cost and Commercial Policy Theory for a Developing World Economy*. Stockholm, 1968.

TABLE 2a. INDEXES OF EXPORT SPECIALIZATION 1955-7, 60-2, 65-7

	0+1	2+4	3	5	7	6+8	$\sigma(S_i)$
	0.1933	0.1832	0.1142	0.0519	0.1949	0.2622	
WOR SHAR	0.1764	0.1586	0.1024	0.0601	0.2296	0.2726	
	0.1637	0.1283	0.0966	0.0868	0.2589	0.2837	
	0.7157	0.7204	0.7268	1.3638	1.8028	0.8549	0.4201
US	0.9506	0.8922	0.3819	1.4821	1.5949	0.7192	0.3978
	1.0335	0.9494	0.3681	1.3468	1.5300	0.6510	0.3932
	1.0770	1.6425	0.2366	1.0221	0.3561	1.3012	0.4980
CAN	1.1223	1.9949	0.4019	0.5559	0.3824	1.1846	0.5523
	1.0751	1.9968	0.5294	0.5215	0.8190	0.9469	0.4181
	2.4257	1.0239	2.2193	0.1943	0.0069	0.2986	0.9581
LAT AM	2.4154	1.2773	2.7007	0.2081	0.0127	0.2896	1.0301
	2.6466	1.4834	2.5009	0.2627	0.0300	0.3836	1.0393
	0.6103	0.3523	0.7175	1.6740	1.3049	1.5026	0.4725
EEC	0.5676	0.3593	0.5862	1.5338	1.3876	1.3639	0.4510
	0.6076	0.4040	0.4572	1.5166	1.3040	1.2782	0.4043
	0.3178	0.2092	0.4371	1.5706	2.0384	1.4156	0.7164
UK	0.3319	0.2371	0.3606	1.5121	1.9281	1.2218	0.6633
	0.4066	0.2487	0.2863	1.4216	1.6890	1.1943	0.5702
	0.9008	1.1850	0.0454	1.3088	0.9968	1.3008	0.3755
OTH EFTA	0.8586	1.0335	0.0812	1.2935	1.0739	1.2901	0.3457
	0.8324	1.0311	0.1215	1.2764	1.0437	1.2748	0.3262
	2.0314	1.7649	0.1396	0.2671	0.2776	0.7621	0.7361
O W EUR	2.1020	1.6541	0.1938	0.3541	0.3711	0.8811	0.6845
	2.0713	1.4982	0.1689	0.5458	0.4577	1.0440	0.6142
	0.7124	0.9094	1.2670	0.7774	1.4811	0.8453	0.2821
E EUR	0.8164	0.8424	1.2356	0.8282	1.2187	0.9755	0.1688
	0.7649	0.9660	1.1664	0.7639	1.2014	0.9676	0.1627
	1.2586	2.0587	0.1496	0.8962	0.2723	1.0016	0.6362
S AFR	1.5089	2.4768	0.1608	0.6233	0.1769	0.9027	0.7940
	1.4108	2.4433	0.3907	0.5136	0.2063	1.1594	0.7192
	1.9388	2.3943	0.0671	0.1657	0.0270	0.6286	0.9396
OTH AFR	2.0060	2.4417	0.8325	0.1946	0.0166	0.5786	0.9059
	1.7290	2.2096	2.3535	0.1896	0.0220	0.6598	0.8816
	0.3526	0.2642	0.0274	0.8505	0.9513	2.4810	0.9301
J	0.3754	0.2409	0.0421	0.7801	1.0946	2.1748	0.7971
	0.2355	0.2008	0.0344	0.9701	1.3231	1.8435	0.7048
	0.3451	0.4206	7.1101	0.0623	0.0171	0.1417	2.1994
W ASIA	0.3049	0.3386	8.1786	0.0567	0.0187	0.1717	2.4281
	0.2997	0.3299	8.6933	0.1023	0.0213	0.1983	2.5181
	1.3459	2.4193	0.8030	0.2654	0.0620	0.6819	0.7891
OTH ASIA	1.5009	2.5359	0.7164	0.2425	0.0887	0.8230	0.8127
	1.5602	2.4616	0.6829	0.2693	0.1267	1.0972	0.7563
	1.6316	2.2617	0.1111	0.5050	0.0373	0.8537	0.8112
CHN MX	1.1416	1.8070	0.0951	0.3457	0.0636	1.7118	0.7456
	1.9575	2.0082	0.1447	0.5194	0.0655	1.2514	0.7817
	1.9764	2.8364	0.0819	0.1778	0.0890	0.2371	1.1172
ANZ	2.3784	2.8170	0.2379	0.2174	0.0964	0.2703	1.1349
	2.6479	2.9582	0.2905	0.3693	0.1358	0.3459	1.1521

TABLE 2b. INDEXES OF IMPORT SPECIALIZATION 1955–7, 60–2, 65–7

	0+1	2+4	3	5	7	6+8	$\sigma(R_j)$
WOR SHAR	0.1933	0.1832	0.1142	0.0519	0.1949	0.2622	
	0.1764	0.1586	0.1024	0.0601	0.2296	0.2726	
	0.1637	0.1283	0.0966	0.0686	0.2589	0.2837	
US	1.4270	1.2886	0.9512	0.5551	0.2769	1.1304	0.4092
	1.3046	1.2711	1.0984	0.5118	0.4774	1.1559	0.3357
	1.0937	1.0292	0.9606	0.4900	0.7831	1.2673	0.2280
CAN	0.4915	0.4570	0.9502	1.0774	1.7846	1.1772	0.4825
	0.6341	0.5101	0.8609	1.0946	1.6180	1.0326	0.3901
	0.5179	0.5742	0.7708	0.8355	1.7211	0.9305	0.4519
LAT AM	0.6169	0.3701	0.8119	1.7602	1.7673	1.0833	0.5017
	0.6321	0.3924	0.7245	1.7563	1.7312	0.9122	0.4995
	0.7326	0.5249	0.6695	1.7763	1.4782	0.8574	0.3969
EEC	1.1122	1.4530	1.0652	0.8904	0.6528	0.8520	0.2653
	1.0558	1.2795	1.0395	0.9714	0.7747	0.9823	0.1578
	1.0681	1.1917	1.0799	0.9858	0.7889	1.0427	0.1347
UK	1.9318	1.5536	0.9599	0.5467	0.2193	0.6137	0.6267
	1.9079	1.4376	1.0397	0.6214	0.3568	0.7679	0.5425
	1.7312	1.4049	1.1619	0.7111	0.4666	0.8963	0.4399
OTH EFTA	0.3536	0.3748	0.9044	1.6227	1.4710	1.4814	0.5269
	0.5843	0.5966	0.8596	1.3220	1.3452	1.1946	0.3197
	0.6748	0.6289	0.8462	1.2326	1.1950	1.1734	0.2436
O W EUR	0.8150	0.7577	1.0754	1.4806	1.3712	0.9015	0.2437
	0.7403	0.7045	0.9136	1.4324	1.4603	0.8893	0.2996
	0.7353	0.8754	0.8893	1.3739	1.2733	0.9068	0.2145
E EUR	0.9317	1.3591	0.7954	0.7021	1.1580	0.8300	0.2153
	0.8504	1.1253	0.7172	0.7279	1.1350	1.0764	0.1576
	0.9588	1.0717	0.6866	0.8828	1.1986	0.9450	0.1497
S AFR	1.0167	0.3650	0.5933	1.0116	1.5730	1.1800	0.4066
	0.2783	0.4808	0.7144	1.2640	1.6072	1.3067	0.5075
	0.3141	0.4283	0.6128	1.1699	1.7366	1.0728	0.5267
OTH AFR	0.6790	0.2456	0.7477	1.2836	1.5004	1.4454	0.4863
	1.0711	0.2815	0.8107	1.1976	1.2253	1.2098	0.3353
	1.0048	0.3631	0.6489	1.1529	1.3299	1.0666	0.3082
J	0.9628	2.8001	0.9699	0.9468	0.3129	0.3039	0.9018
	0.7802	2.8651	1.4716	1.0163	0.4991	0.2977	0.8805
	1.0589	2.8876	2.0185	0.7658	0.3500	0.4148	0.8765
W ASIA	0.9463	0.3566	1.0268	1.0575	1.1797	1.3323	0.3345
	0.9923	0.4106	0.9631	1.0368	1.2110	1.1759	0.2720
	1.0257	0.4970	0.7960	0.9856	1.1634	1.1363	0.2208
OTH ASIA	0.9890	0.6883	0.7465	1.4309	1.0337	1.2258	0.2200
	1.0718	0.7392	0.7426	1.3463	1.0783	1.0595	0.1675
	1.1774	0.7220	0.7213	1.3275	1.0871	0.9593	0.1799
CHN MX	0.2162	0.7095	0.6011	1.6057	2.2226	0.9255	0.6814
	1.2050	0.9807	0.8820	1.0378	1.1761	0.7660	0.1761
	1.3786	1.1902	0.2715	1.7142	0.9582	0.8086	0.3539
ANZ	0.4065	0.4343	0.9515	1.1807	1.5319	1.4225	0.4803
	0.3759	0.5062	1.0222	1.3574	1.3922	1.2736	0.4133
	0.3470	0.5274	0.8084	1.3646	1.5450	1.0702	0.4352

TABLE 3. INDICES OF TRADE INTENSITY:

	US	CAN	LAT AM	EEC	UK	OTH EFTA	O W EUR
US		4.1528	2.7942	0.7303	0.5647	0.5161	0.9502
		4.3911	2.6890	0.8378	0.6943	0.5422	1.0448
		4.9228	2.6975	0.7400	0.8292	0.5104	0.8958
CAN	5.0091		0.5325	0.3629	1.7611	0.3063	0.1067
	5.0571		0.6057	0.3401	1.8620	0.2800	0.1645
	5.1588		0.6738	0.2608	1.5814	0.2097	0.1673
LAT AM	3.7104	0.3385	1.1516	0.8261	0.8532	0.5242	0.5979
	3.4132	0.5533	1.2015	0.8238	0.9455	0.4082	0.5174
	2.7492	0.6140	2.0021	0.8147	0.8300	0.4300	0.7362
EEC	0.5605	0.1970	0.8418	1.5757	0.6610	2.2970	1.4381
	0.6399	0.2290	0.8430	1.6143	0.6616	2.0577	1.3327
	0.6427	0.2262	0.6900	1.7599	0.6801	1.7521	1.3113
UK	0.6035	1.1503	0.5897	0.6756		1.4282	2.0961
	0.8017	1.3455	0.7301	0.7534		1.4287	1.9451
	0.9901	0.9643	0.6519	0.7657		1.6212	1.7756
OTH EFTA	0.6274	0.1856	0.8242	1.7126	1.6449	1.9601	1.1858
	0.5721	0.2383	0.7269	1.5278	1.5690	1.9888	1.4384
	0.6563	0.2736	0.7003	1.2538	1.8095	2.4124	1.5929
O W EUR	0.7841	0.0704	0.6668	1.3452	2.4664	1.0384	1.0199
	0.7411	0.1113	0.5922	1.1832	2.6216	1.0188	0.8333
	0.7855	0.1220	0.8796	1.1069	2.5659	1.1559	0.6921
E EUR	0.0576	0.0231	0.1642	0.3122	0.3664	0.5678	1.3781
	0.0489	0.0293	0.5117	0.3150	0.3473	0.4459	0.9473
	0.0658	0.0633	0.6685	0.3284	0.4177	0.4393	1.0727
S AFR	0.6244	0.1208	0.0812	0.9538	3.2916	0.2227	0.1864
	1.1725	0.2405	0.0909	0.8241	3.4962	0.2422	0.3209
	0.8734	0.3585	0.0864	0.7338	4.3876	0.2918	0.8257
OTH AFR	0.8019	0.1236	0.0426	2.3531	2.3541	0.5855	0.4145
	0.7886	0.1150	0.1174	2.0138	2.0759	0.4911	0.7918
	0.6274	0.1849	0.1063	1.8052	1.9753	0.5575	0.6971
J	1.8337	0.5119	0.9006	0.2213	0.2895	0.3009	0.7017
	2.4173	0.6602	1.1361	0.2192	0.3801	0.3522	0.4992
	2.5212	0.5904	0.9549	0.2293	0.3472	0.4280	0.3781
W ASIA	0.6258	0.1793	0.2150	1.3980	1.3097	0.5066	0.9620
	0.6356	0.5317	0.2321	1.1895	1.7083	0.3805	1.0899
	0.4236	0.2789	0.2954	1.1673	1.6989	0.4129	0.9785
OTH ASIA	1.2678	0.2698	0.2656	0.6215	1.4245	0.1780	0.2824
	1.4059	0.3429	0.2905	0.4600	1.5299	0.1791	0.3626
	1.5718	0.3561	0.2236	0.4392	1.2393	0.2039	0.3106
CHN MX	0.0000	0.0648	0.0221	0.2290	0.2199	0.1888	0.1101
	0.0133	0.0590	0.5879	0.2451	0.4477	0.1840	0.0727
	0.0132	0.1923	0.8582	0.3877	0.5101	0.2764	0.1682
ANZ	0.6227	0.3049	0.0679	0.9811	4.2413	0.1412	0.1716
	1.0621	0.3922	0.1038	0.7243	3.3900	0.0919	0.4361
	1.0611	0.3540	0.2084	0.5615	3.1096	0.1201	0.3485

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E EUR	S AFR	OTH AFR	J	W ASIA	OTH ASIA	CHN MX	ANZ
0.0235	1.1218	0.3660	1.9052	0.7929	0.9904	0.0011	0.5780
0.0694	1.1055	0.6370	2.3019	1.0876	1.4263	0.0000	1.0673
0.0599	1.2001	0.6696	1.9524	1.2217	1.6463	0.0000	1.5380
0.0889	0.8299	0.1031	0.9617	0.1150	0.2234	0.0227	0.6715
0.1130	0.6946	0.1213	1.1087	0.1600	0.2515	1.2653	1.0060
0.2916	0.6476	0.1005	1.0268	0.1202	0.3156	1.1143	0.8991
0.2019	0.1020	0.1221	1.1422	0.1002	0.0450	0.0311	0.0562
0.4592	0.1606	0.1415	1.0541	0.1028	0.0759	0.7836	0.1088
0.6250	0.1468	0.1400	1.1323	0.1852	0.1018	1.2462	0.0560
0.3127	0.7329	2.1895	0.2432	1.1751	0.7029	0.2766	0.4316
0.3254	0.8253	1.7817	0.2603	1.0589	0.4831	0.3940	0.4268
0.3351	0.8762	1.3634	0.2067	0.9642	0.4197	0.5730	0.4259
0.1855	3.8888	1.9670	0.2582	2.2093	1.6196	0.2165	5.5047
0.2492	3.9648	1.8415	0.3113	2.0543	1.4455	0.3826	4.4358
0.2902	4.3718	1.6618	0.3218	1.9476	1.1243	0.5742	3.9019
0.5712	0.7196	0.8155	0.1808	0.8100	0.4059	0.5555	0.5993
0.5110	0.7836	0.6901	0.2455	0.7706	0.3777	0.2356	0.5835
0.5120	0.7304	0.7840	0.2522	0.7877	0.3350	0.4196	0.5379
1.9243	0.1450	0.4244	0.1640	0.9020	0.1047	0.3097	0.2397
1.2874	0.1392	0.5049	0.1388	1.9470	0.2644	0.1542	0.2167
1.7662	0.2514	0.7158	0.1962	0.8155	0.2594	0.2400	0.2878
7.4529	0.0686	0.3286	0.0378	0.4645	0.2086	8.5673	0.0289
6.0834	0.0507	0.4498	0.2415	0.4752	0.3287	5.2533	0.0336
6.1659	0.0000	0.7290	0.3531	0.6165	0.4133	3.2107	0.0432
0.1802		3.7750	0.7040	0.1735	0.2359	0.0000	0.4243
0.0660		3.3419	1.7899	0.2862	0.4338	0.2202	0.7155
0.0159		3.8370	2.2574	0.0898	0.2400	0.0000	0.5305
0.4757	1.7200	0.9266	0.4646	0.8823	0.4421	0.5279	0.0236
0.5063	1.4477	1.0656	0.4432	0.7646	0.4290	0.7533	0.1681
0.5789	1.3051	1.6997	0.6956	0.6720	0.3185	0.9620	0.1731
0.0542	1.0740	2.5452		1.6894	4.4858	1.3847	0.9198
0.2218	1.2313	1.4224		1.4239	4.2970	0.5016	1.6440
0.2518	1.2485	1.6558		1.3643	3.9208	2.7577	2.0445
0.2361	1.7978	0.8773	2.1351	5.1311	1.0056	0.2072	2.0180
0.1871	1.6205	0.9979	2.4566	3.6891	0.9734	0.2503	1.5416
0.1808	1.3006	0.8877	3.8962	3.1574	0.9062	0.2700	1.3690
0.2178	0.7094	0.5404	3.1311	1.0699	3.9129	1.2446	1.5603
0.4642	0.7915	0.6015	3.0161	0.9967	3.7462	1.3365	1.6065
0.5947	0.4961	0.7923	3.3134	1.0408	3.5429	1.3848	1.4946
8.2507	0.0248	0.3867	1.9508	0.1622	2.2017		0.1747
5.6970	0.0709	0.4968	0.7363	0.2839	2.6945		0.2794
2.5955	0.0000	1.2963	3.0153	0.9861	4.4956		0.6522
0.2826	0.2337	0.0099	3.7468	0.3608	0.8995	0.3849	2.3003
0.2423	0.6805	0.1667	4.1138	0.5202	1.0104	2.7200	2.6471
0.2417	0.9024	0.2204	3.9729	0.7022	1.2992	3.5096	2.7599

TABLE 4. DEGREE OF COMPLEMENTARITY:

	US	CAN	LAT AM	EEC	UK	OTH EFTA	O W EUR
US	(0.8368) (0.8890) (0.9344)	1.1748 1.1050 1.1160	1.1905 1.1595 1.1200	0.9178 0.9620 0.9608	0.8056 0.9011 0.9217	1.1377 1.0610 1.0251	1.0911 1.0966 1.0617
CAN	1.1451 1.1383 1.0295	(0.8485) (0.8348) (0.9227)	0.8477 0.7847 0.9052	1.0810 1.0747 1.0314	1.1495 1.1759 1.0894	0.9048 0.8882 0.9362	0.9084 0.8707 0.9622
LAT AM	1.2468 1.2167 1.0549	0.6628 0.7119 0.6498	0.6697 0.6486 0.7161	1.1410 1.0889 1.0881	1.4949 1.4617 1.4125	0.6000 0.7227 0.7760	0.8846 0.8036 0.8336
EEC	0.8938 0.8983 0.9798	1.1770 1.1449 1.1209	1.1929 1.1821 1.1247	0.8917 0.9430 0.9631	0.7522 0.7922 0.8532	1.2392 1.1390 1.0946	1.0661 1.0974 1.0597
UK	0.7597 0.8079 0.9521	1.3294 1.2481 1.2237	1.3408 1.3088 1.1944	0.8257 0.9071 0.9337	(0.5859) (0.6746) (0.7695)	1.3482 1.2023 1.1290	1.1333 1.1767 1.0998
OTH EFTA	1.0105 0.9795 1.0096	1.0115 1.0343 1.0305	1.0248 1.0507 1.0425	0.9929 0.9907 0.9928	0.9681 0.9400 0.9483	1.0493 1.0483 1.0406	0.9869 1.0197 1.0190
O W EUR	1.2410 1.1686 1.0711	0.7029 0.7956 0.8097	0.7116 0.7561 0.8562	1.1417 1.0008 1.0484	1.4186 1.3338 1.2237	0.6728 0.8203 0.8992	0.8573 0.8463 0.9033
E EUR	0.9021 0.9635 0.9902	1.1012 1.0505 1.0576	1.0858 1.0499 1.0207	0.9630 0.9813 0.9867	0.8855 0.9338 0.9506	1.0608 1.0328 1.0164	1.0498 1.0331 1.0180
S AFR	1.1871 1.1881 1.0877	0.7625 0.7445 0.7564	0.7640 0.6953 0.7829	1.1369 1.1108 1.0811	1.2709 1.3169 1.2292	0.7857 0.8026 0.8785	0.8812 0.8210 0.8928
OTH AFR	1.3002 1.2381 1.0680	0.6049 0.6775 0.6797	0.6030 0.6088 0.7007	1.2141 1.1274 1.0984	1.5202 1.4508 1.3324	0.5699 0.7205 0.8045	0.8149 0.7756 0.8536
J	0.9741 0.9692 1.0358	1.2031 1.1356 1.1694	1.1729 1.1185 1.1172	0.8644 0.9462 0.9570	0.6742 0.7601 0.7830	1.3534 1.1737 1.1504	1.0019 1.0415 1.0560
W ASIA	1.0121 1.1168 0.9831	0.8933 0.8420 0.7648	0.7813 0.7184 0.6894	1.0883 1.0492 1.0797	1.0538 1.0907 1.1782	0.8526 0.8501 0.8518	1.0294 0.8961 0.8877
OTH ASIA	1.2430 1.2142 1.0972	0.6647 0.7171 0.7263	0.6385 0.6442 0.7455	1.2038 1.1212 1.0893	1.3994 1.3488 1.2703	0.6463 0.7728 0.8544	0.8450 0.7969 0.8727
CHN MX	1.2659 1.1950 1.1101	0.6614 0.8108 0.7143	0.6600 0.7346 0.7725	1.1854 1.0796 1.0834	1.4188 1.1832 1.2848	0.6634 0.9019 0.8713	0.8355 0.8262 0.8665
ANZ	1.3042 1.2449 1.0563	0.5484 0.6415 0.6374	0.5500 0.5870 0.7170	1.2627 1.1427 1.1010	1.6017 1.5413 1.4390	0.3711 0.6681 0.7437	0.8089 0.7646 0.8448

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E EUR	S AFR	OTH AFR	J	W ASIA	OTH ASIA	CHN MX	ANZ
1.0173	1.1273	1.1309	0.8287	1.0516	1.0293	1.2760	1.1337
1.0217	1.1003	1.0441	0.9260	1.0289	1.0363	1.0490	1.0554
1.0483	1.1214	1.0679	0.8891	1.0244	1.0435	1.0755	1.0876
1.0255	0.9033	0.9011	1.2452	0.9249	0.9994	0.8303	0.8956
1.0258	0.8423	0.8731	1.2960	0.8870	0.9588	0.9709	0.8559
1.0182	0.8949	0.9131	1.2428	0.9361	0.9651	1.0434	0.9017
0.9674	0.8006	0.6824	1.2567	0.8879	0.8942	0.4787	0.6389
0.8865	0.5375	0.8521	1.3581	0.8821	0.9159	1.0333	0.6674
0.9136	0.5172	0.8087	1.5583	0.8821	0.9589	1.0160	0.5993
0.9457	1.1454	1.2202	0.6557	1.1360	1.0928	1.1904	1.2070
1.0215	1.2129	1.1228	0.6935	1.0994	1.0559	0.9850	1.1704
1.0207	1.1778	1.1034	0.6928	1.0706	1.0397	1.0062	1.1495
0.9748	1.2519	1.3261	0.5295	1.1728	1.1071	1.4285	1.3224
1.0460	1.3227	1.1577	0.6206	1.1314	1.0709	1.0104	1.2430
1.0476	1.2887	1.1521	0.5870	1.0963	1.0515	0.9978	1.2338
1.0175	1.0365	1.0474	1.0096	1.0033	1.0420	1.0517	1.0333
1.0345	1.0813	1.0361	0.9073	1.0186	1.0332	0.9911	1.0454
1.0237	1.0666	1.0389	0.8621	1.0268	1.0217	1.0503	1.0508
1.0565	0.8620	0.7460	1.3900	0.8483	0.9439	0.6516	0.6990
0.9959	0.7215	0.9079	1.2063	0.9028	0.9815	1.0283	0.7462
0.9976	0.7665	0.9381	1.1406	0.9680	1.0127	1.1182	0.7837
1.0167	1.0435	1.0482	0.9357	1.0171	0.9871	1.1469	1.0715
1.0039	1.0551	1.0189	0.9513	1.0231	0.9980	1.0010	1.0472
1.0090	1.0576	1.0110	0.9812	1.0054	0.9896	0.9609	1.0459
1.0652	(0.8359)	0.7898	1.4477	0.8443	0.9567	0.7665	0.7891
1.0188	(0.7092)	0.8017	1.4897	0.8190	0.9433	0.9962	0.7369
0.9896	(0.7171)	0.8332	1.4085	0.8937	0.9462	1.0796	0.7589
1.1006	0.7575	0.6253	1.6568	0.7541	0.8984	0.5751	0.6031
0.9809	0.5729	0.7670	1.5725	0.7948	0.9163	1.0193	0.6386
0.9268	0.5758	0.7574	1.6674	0.8446	0.9053	0.9688	0.6586
0.9177	1.1931	1.3359	(0.5020)	1.2173	1.1556	1.1363	1.3135
1.0601	1.2780	1.1667	(0.5173)	1.1359	1.0649	0.9198	1.2174
1.0307	1.2593	1.1407	(0.5100)	1.1137	1.0291	0.9503	1.2097
0.8502	0.6305	0.7347	1.0835	0.9819	0 7793	0.6041	0.8956
0.7650	0.7120	0.8181	1.4485	0.9463	0.7786	0.9011	0.9743
0.7351	0.6264	0.6851	1.9000	0.8172	0.7635	0.4089	0.7967
1.0900	0.7249	0.6486	1.6520	0.7657	0.8825	0.6405	0.8749
1.0059	0.6641	0.7704	1.5593	0.8025	0.9153	0.9896	0.7123
0.9788	0.6687	0.8113	1.4709	0.8819	0.9355	1.0610	0.7178
1.0799	0.7818	0.6938	1.5717	0.7941	0.9263	(0.6355)	0.6810
1.0350	0.8605	0.9118	1.1604	0.9151	0.9734	(0.9289)	0.8738
0.9807	0.6719	0.8673	1.2926	0.9265	0.9801	(1.1170)	0.7135
1.1480	0.6939	0.5219	1.8654	0.6697	0.8501	0.5680	0.5160
0.9915	0.4977	0.7272	1.6903	0.7506	0.9180	1.0617	0.5515
0.9993	0.5122	0.7725	1.6848	0.8333	0.9710	1.2138	0.5675

TABLE 5. CORRELATION COEFFICIENTS OF EXPORT

	US	CAN	LAT AM	EEC	UK	OTH EFTA	O W EUR
	−0.9496	0.8623	0.9036	−0.7373	−0.7381	0.6220	0.8899
US	−0.8314	0.6770	0.8033	−0.6059	−0.4588	0.4798	0.8114
	−0.7320	0.6528	0.7688	−0.7412	−0.4525	0·2623	0.7316
	0.7122	−0.6306	−0.6096	0.6136	0.4789	−0.3631	−0.7552
CAN	0.7460	−0.7668	−0.7803	0.8575	0.5870	−0.6330	−0.7817
	0.3101	−0.4091	−0.5711	0.5580	0.4863	−0.6269	−0.4218
	0.6294	−0.7293	−0.6870	0.5547	0.8240	−0.7924	−0.4941
LAT AM	0.6266	−0.7168	−0.6829	0.5473	0.8262	−0.8418	−0.6364
	0.2316	−0.7456	−0.6881	0.6290	0.9020	−0.8848	−0.7461
	−0.5493	0.7765	0.8135	−0.8638	−0.8366	0.9608	0.5743
EEC	−0.6717	0.8234	0.8086	−0.8019	−0.8496	0.9641	0.7207
	−0.2195	0.6621	0.7727	−0.6786	−0.8255	0.9605	0.6888
	−0.8199	0.9528	0.9483	−0.9170	−0.9223	0.9226	0.7633
UK	−0.8629	0.9588	0.9319	−0.8882	−0.9042	0.9537	0.8894
	−0.3685	0.8682	0.8591	−0.8631	−0.9187	0.9289	0.8156
	0.0684	0.0635	0.1316	−0.0715	−0.1359	0.2492	−0.1440
OTH EFTA	−0.1773	0.2546	0.2935	−0.1712	−0.3199	0.4375	0.1904
	0.1290	0.2074	0.3281	−0.1639	−0.3608	0.5111	0.2726
	0.8001	−0.8363	−0.7807	0.7258	0.9073	−0.8435	−0.7951
O W EUR	0.7338	−0.7656	−0.7135	0.6556	0.8989	−0.8213	−0.7495
	0.5079	−0.6857	−0.5900	0.5847	0.8279	−0.6740	−0.7336
	−0.8486	0.7437	0.6061	−0.4950	−0.6476	0.4093	0.7249
E EUR	−0.6441	0.7680	0.5923	−0.7037	−0.7232	0.6089	0.6544
	−0.2658	0.7834	0.3205	−0.6083	−0.6909	0.4151	0.5152
	0.7187	−0.7738	−0.7393	0.8113	0.6794	−0.6392	−0.7665
S AFR	0.7056	−0.8247	−0.7682	0.8844	0.7357	−0.7777	−0.7523
	0.5348	−0.7494	−0.7605	0.8374	0.7243	−0.6935	−0.6947
	0.7806	−0.8714	−0.8421	0.8590	0.8832	−0.8686	−0.8083
OTH AFR	0.7830	−0.9124	−0.8645	0.8916	0.9173	−0.9650	−0.8267
	0.3385	−0.8039	−0.8554	0.8286	0.8570	−0.9104	−0.7739
	−0.0682	0.4526	0.3705	−0.5498	−0.5590	0.7212	0.0085
J	−0.1152	0.4359	0.2976	−0.4281	−0.5548	0.6815	0.1738
	0.2229	0.5319	0.4192	−0.4533	−0.6998	0.8761	0.3705
	0.0134	−0.1005	−0.1982	0.1514	0.0390	−0.1272	0.0549
W ASIA	0.1433	−0.1668	−0.2321	0.1284	0.0688	−0.1931	−0.1428
	−0.0295	−0.2066	−0.3107	0.2349	0.1608	−0.2416	−0.2078
	0.7526	−0.8805	−0.9129	0.9736	0.8076	−0.8507	−0.8061
OTH ASIA	0.7851	−0.8921	−0.8764	0.9451	0.7910	−0.8744	−0.8342
	0.5639	−0.8009	−0.8477	0.8769	0.8122	−0.7906	−0.7848
	0.8012	−0.8649	−0.8354	0.8617	0.8237	−0.7875	−0.8318
CHN MX	0.7791	−0.6506	−0.7127	0.6772	0.4529	−0.4117	−0.7779
	0.6176	−0.8087	−0.7333	0.7923	0.8281	−0.6760	−0.7963
	0.6654	−0.8376	−0.8027	0.8863	0.8529	−0.8985	−0.7017
ANZ	0.6429	−0.8097	−0.7285	0.7967	0.8792	−0.9146	−0.6924
	0.2144	−0.6965	−0.6188	0.6505	0.8661	−0.9131	−0.6277

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E EUR	S AFR	OTH AFR	J	W ASIA	OTH ASIA	CHN MX	ANZ
0.1914	0.7455	0.6406	−0.4520	0.3674	0.3170	0.9641	0.6625
0.3471	0.4974	0.3307	−0.2114	0.2672	0.5449	0.7005	0.5375
0.8206	0.5865	0.5602	−0.3218	0.2812	0.6159	0.5428	0.5123
0.2377	−0.4776	−0.4083	0.5459	−0.4509	−0.0058	−0.5001	−0.4364
0.2967	−0.5628	−0.6853	0.6087	−0.7519	−0.4451	−0.2994	−0.6315
0.2919	−0.4774	−0.6745	0.6626	−0.6927	−0.4644	0.2938	−0.5404
−0.1581	−0.5117	−0.6816	0.2971	−0.3499	−0.5019	−0.7983	−0.7846
−0.6991	−0.8846	−0.4282	0.3948	−0.4208	−0.4874	0.1839	−0.7811
−0.5551	−0.8820	−0.5973	0.6128	−0.5139	−0.2201	0.0436	−0.8858
−0.5335	0.7567	0.9583	−0.8078	0.8604	0.8930	0.5915	0.9122
0.3027	0.9301	0.8122	−0.7719	0.8108	0.7401	−0.1887	0.9139
0.3422	0.8351	0.8301	−0.8670	0.7907	0.5462	0.0438	0.8496
−0.1634	0.8648	0.9361	−0.7282	0.7213	0.6795	0.8777	0.9371
0.4398	0.9587	0.7092	−0.6496	0.7281	0.6379	0.0892	0.8863
0.5584	0.9615	0.8654	−0.8263	0.7645	0.5025	−0.0110	0.9423
0.2165	0.2393	0.2599	0.0285	0.0264	0.5084	0.2023	0.1851
0.6336	0.4635	0.3115	−0.3045	0.1985	0.5730	−0.1469	0.3179
0.4859	0.3877	0.3873	−0.4824	0.3718	0.3696	0.4361	0.3580
0.3563	−0.4612	−0.7094	0.5874	−0.6161	−0.3468	−0.6945	−0.8513
−0.0382	−0.8018	−0.4012	0.3423	−0.5220	−0.1615	0.2347	−0.8971
−0.0261	−0.7219	−0.3272	0.2612	−0.2362	0.1155	0.5439	−0.8093
0.2758	0.3792	0.3517	−0.2527	0.1821	−0.2083	0.7641	0.5281
0.1492	0.6442	0.3349	−0.3280	0.5037	−0.0731	0.0336	0.6775
0.3690	0.6724	0.2204	−0.1322	0.1508	−0.3581	−0.6787	0.6489
0.4761	−0.6794	−0.6794	0.7803	−0.7318	−0.3099	−0.5386	−0.6904
0.1505	−0.7216	−0.7447	0.7003	−0.8378	−0.4264	−0.0277	−0.8016
−0.0967	−0.7469	−0.7526	0.6480	−0.6693	−0.4159	0.3128	−0.7703
0.4973	−0.6348	−0.8199	0.7750	−0.7822	−0.4917	−0.6635	−0.8795
−0.1338	−0.9290	−0.7669	0.7177	−0.8325	−0.5518	−0.1209	−0.9651
−0.5544	−0.9135	−0.8929	0.8636	−0.7979	−0.5974	−0.1001	−0.8897
−0.4110	0.5105	0.7427	−0.5937	0.6986	0.7603	0.2151	0.7019
0.4786	0.6872	0.6236	−0.6876	0.6266	0.4860	−0.5717	0.6599
0.2910	0.6985	0.6476	−0.7932	0.7304	0.2300	−0.1992	0.6836
−0.3136	−0.4131	−0.2480	0.0421	−0.0247	−0.4562	−0.2638	−0.0988
−0.6138	−0.2337	−0.2233	0.2098	−0.0813	−0.5443	−0.2313	−0.0256
−0.7023	−0.2817	−0.4057	0.4077	−0.3286	−0.5221	−0.6632	−0.1855
0.5299	−0.8573	−0.9158	0.9161	−0.8874	−0.6768	−0.6682	−0.8578
0.0467	−0.8144	−0.8422	0.7816	−0.8934	−0.6223	−0.0727	−0.8563
−0.1877	−0.8317	−0.8093	0.7102	−0.7074	−0.4745	0.2280	−0.8574
0.4577	−0.6614	−0.7763	0.7813	−0.7589	−0.4129	−0.6594	−0.8187
0.2979	−0.3686	−0.3527	0.2443	−0.4186	−0.2133	−0.5416	−0.4094
−0.1656	−0.7969	−0.5509	0.4271	−0.4257	−0.1415	0.4230	−0.8422
0.6154	−0.6783	−0.8799	0.8589	−0.8837	−0.6099	−0.5674	−0.9020
−0.0480	−0.8722	−0.7164	0.6907	−0.8078	−0.4311	0.3088	−0.9560
−0.0044	−0.8039	−0.6405	0.6780	−0.6550	−0.1399	0.5243	−0.8626

TABLE 6. DEGREE OF SPECIAL COUNTRY BIAS:

	US	CAN	LAT AM	EEC	UK	OTH EFTA	O W EUR
US		3.5347	2.3470	0.7957	0.7010	0.4536	0.8708
		3.9737	2.3189	0.8710	0.7706	0.5110	0.9527
		4.4111	2.4084	0.7702	0.8996	0.4979	0.8437
CAN	4.3741		0.6282	0.33571	1.5320	0.3386	0.1175
	4.4424		0.7718	0.3164	1.5835	0.3152	0.1889
	5.0106		0.7444	0.2528	1.4515	0.2240	0.1739
LAT AM	2.9759	0.5108	1.7196	0.7240	0.5707	0.8737	0.6759
	2.8053	0.7772	1.8527	0.7565	0.6468	0.5649	0.6439
	2.6001	0.9450	2.7959	0.7487	0.5876	0.5542	0.8832
EEC	0.6272	0.1673	0.7056	1.7671	0.8788	1.8535	1.3489
	0.7124	0.2000	0.7131	1.7120	0.8352	1.8065	1.2144
	0.6560	0.2018	0.6135	1.8275	0.7971	1.6006	1.2373
UK	0.7945	0.8653	0.4398	0.8182		1.0593	1.8495
	0.9924	1.0780	0.5578	0.8306		1.1883	1.6529
	1.0399	0.7880	0.5458	0.8202		1.4358	1.6144
OTH EFTA	0.6209	0.1834	0.8042	1.7249	1.6993	1.8680	1.2016
	0.5841	0.2304	0.6918	1.5422	1.6692	1.8970	1.4105
	0.6500	0.2655	0.6717	1.2629	1.9083	2.3182	1.5631
O W EUR	0.6318	0.1002	0.9371	1.1782	1.7385	1.5434	1.1897
	0.6399	0.1399	0.7833	1.1050	1.9654	1.2423	0.9846
	0.7333	0.1507	1.0275	1.0558	2.0967	1.2856	0.7662
E EUR	0.0639	0.0210	0.1512	0.3242	0.4137	0.5352	1.3126
	0.0508	0.0279	0.4874	0.3210	0.3719	0.4317	0.9169
	0.0664	0.0599	0.6549	0.3328	0.4395	0.4322	1.0538
S AFR	0.5260	0.1585	0.1062	0.8389	2.5899	0.2835	0.2115
	0.9869	0.3230	0.1308	0.7418	2.6547	0.3025	0.3909
	0.8029	0.4739	0.1103	0.6787	3.5694	0.3322	0.9249
OTH AFR	0.6168	0.2044	0.0706	1.9372	1.5485	1.0274	0.5088
	0.6369	0.1698	0.1929	1.7861	1.4308	0.6816	1.0209
	0.5874	0.2720	0.1518	1.6434	1.4824	0.6931	0.8166
J	1.8826	0.4254	0.7678	0.2561	0.4295	0.2223	0.7003
	2.4943	0.5814	1.0157	0.2317	0.5001	0.3000	0.4793
	2.4340	0.5048	0.8547	0.2396	0.4434	0.3720	0.3580
W ASIA	0.6183	0.2008	0.2752	1.2845	1.2427	0.5943	0.9345
	0.5691	0.6315	0.3230	1.1337	1.5662	0.4476	1.2164
	0.4310	0.3647	0.4285	1.0811	1.4418	0.4848	1.1024
OTH ASIA	1.0199	0.4059	0.4161	0.5162	1.0179	0.2754	0.3343
	1.1579	0.4782	0.4510	0.4103	1.1342	0.2317	0.4551
	1.4325	0.4903	0.2999	0.4031	0.9756	0.2386	0.3559
CHN MX	0.0000	0.0980	0.0335	0.1932	0.1550	0.2846	0.1317
	0.0117	0.0728	0.8003	0.2270	0.3784	0.2040	0.0880
	0.0119	0.2692	1.1111	0.3578	0.3970	0.3172	0.1941
ANZ	0.4774	0.5561	0.1235	0.7769	2.6480	0.2999	0.2121
	0.8531	0.6115	0.1769	0.6339	2.1993	0.1375	0.5705
	1.0045	0.5555	0.2907	0.5100	2.1609	0.1615	0.4125

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E EUR	S AFR	OTH AFR	J	W ASIA	OTH ASIA	CHN MX	ANZ
0.0231	0.9950	0.3236	2.2991	0.7539	0.9622	0.0009	0.5099
0.6797	1.0046	0.6101	2.4860	1.0570	1.3763	0.0000	1.0112
0.0571	1.0701	0.6270	2.1960	1.1925	0.5775	0.0000	1.4140
0.0867	0.9188	0.1144	0.7723	0.1244	0.2235	0.0273	0.7498
0.1101	0.8248	0.1389	0.8554	0.1804	0.2623	1.3032	1.1755
0.2863	0.7237	0.1101	0.8262	0.1285	0.3271	1.0679	0.9972
0.2087	0.1274	0.1790	0.9088	0.1129	0.0503	0.0650	0.0880
0.5180	0.2989	0.1661	0.7761	0.1165	0.0828	0.7583	0.1630
0.6841	0.2840	0.1732	0.7266	0.2100	0.1062	1.2265	0.0935
0.3307	0.6398	1.7943	0.3709	1.0344	0.6432	0.2323	0.3576
0.3185	0.6804	1.5868	0.3754	0.9631	0.4575	0.4000	0.3646
0.3283	0.7439	1.2355	0.2984	0.9006	0.4037	0.5694	0.3705
0.1903	3.1062	1.4833	0.4877	1.8836	1.4629	0.1516	4.1624
0.2383	2.9974	1.5905	0.5017	1.8157	1.3498	0.3786	3.5685
0.2770	3.3921	1.4424	0.5483	1.7765	1.0691	0.5754	3.1623
0.5613	0.6942	0.7786	0.1791	0.8074	0.3896	0.5282	0.5800
0.4939	0.7246	0.6660	0.2706	0.7564	0.3656	0.2377	0.5582
0.5001	0.6848	0.7546	0.2926	0.7672	0.3279	0.3995	0.5119
1.8214	0.1683	0.5690	0.1180	1.0634	0.1110	0.4753	0.3430
1.2927	0.1930	0.5564	0.1151	1.1599	0.2693	0.1501	0.2904
1.7705	0.3280	0.7631	0.1720	0.8425	0.2561	0.2146	0.3673
7.3301	0.0657	0.3135	0.0404	0.4566	0.2114	7.4697	0.0270
6.0594	0.0481	0.4414	0.2539	0.4644	0.3293	5.2480	0.0321
6.1109	0.0000	0.7210	0.3599	0.6132	0.4176	3.3414	0.0413
0.1692		4.7799	0.4862	0.2055	0.2466	0.0000	0.5378
0.0648		4.1687	1.2015	0.3494	0.4599	0.2210	0.9711
0.0161		4.6055	1.6026	0.1005	0.2536	0.0000	0.6991
0.4322	2.2709	1.4819	0.2804	1.1700	0.4922	0.9179	0.0391
0.5162	2.5273	1.3894	0.2818	0.9620	0.4682	0.7390	0.2633
0.6246	2.2668	2.2444	0.4171	0.7956	0.3518	0.9930	0.2628
0.0591	0.9001	1.9051		1.3877	3.8817	1.2185	0.7002
0.2093	0.9635	1.2191		1.2535	4.0350	0.5454	1.3503
0.2443	0.9914	1.4515		1.2250	3.8097	2.9019	1.6900
0.2777	2.8516	1.1942	1.9705	5.2261	1.2905	0.3428	2.2534
0.2447	2.2763	1.2198	1.6958	3.8985	1.2503	0.2778	1.5822
0.2459	2.0764	1.2958	2.0506	3.8637	1.1870	0.6605	1.7186
0.1998	0.9786	0.8333	1.8952	1.3973	4.4340	1.9429	2.3121
0.4614	1.1920	0.7808	1.9342	1.2421	4.0931	1.3506	2.2554
0.6077	0.7420	0.9766	2.2526	1.1803	3.7874	1.3051	2.0824
7.6397	0.0189	0.5575	1.2412	0.2043	2.3769		0.2566
5.5042	0.0824	0.5449	0.6345	0.3103	2.7683		0.3198
2.6468	0.0000	1.4948	2.3326	1.0644	4.5869		0.9142
0.2462	0.3368	0.0190	2.0085	0.5387	1.0581	0.6776	4.4585
0.2444	1.3675	0.2293	2.4337	0.6931	1.1006	2.5618	4.8001
0.2419	1.7621	0.2854	2.3580	0.8426	1.3380	2.8914	4.8639

TABLE 7. TESTS OF INDEPENDENCE IN TWO WAY CONTINGENCY TABLES

(a) Symmetric Movements of r_{ij} and r_{ji}.

	$r_{ij}\to 0$	± 1	
$r_{ji}\to 0$	35	30	65
± 1	14	26	40
	49	56	105

$u=3.5385$ (significant at 5% level)
$Q=0.3684$

(b) Symmetric Movements of C_{ij} and C_{ji}.

C_{ij} / C_{ji}	$C_{ij}\to 1$	$0,\ \infty$	
$C_{ji}\to 1$	60	22	82
$0,\ \infty$	17	6	23
	77	28	105

$u=0.0046$ (not significant)

(c) Convergence of C_{ij} and r_{ij}.

C_{ij} / r_{ij}	$C_{ij}\to 1$	$0,\ \infty$	
$r_{ij}\to 0$	117	6	123
± 1	57	45	102
	174	51	225

$u=48.9792$ (significant at 1% level)
$Q=0.8783$

(d) Symmetricity between B_{ij} and B_{ji}.

B_{ij} / B_{ji}	$B_{ij}>1$	$B_{ij}<1$	
$B_{ji}>1$	73	22	95
$B_{ji}<1$	20	200	220
	93	222	315

$u=170.03$ (significant at 1% level)
$Q=0.9419$

(e) Symmetric Movements of B_{ij} and B_{ji}.

B_{ij} / B_{ji}	Increase	Decrease	
Increase	43	13	56
Decrease	24	25	49
	67	38	105

$u=8.7577$ (significant at 1% level)
$Q=0.5501$

(f) Convergence of C_{ij} and I_{ij}.

C_{ij} / I_{ij}	$C_{ij}\to 1$	$0,\ \infty$	
$I_{ij}\to 1$	110	28	138
$0,\ \infty$	59	22	81
	169	50	219

$u=01.3698$ (not significant)

Note: The variable u is defined as

$$u=\sum_{i=1}^{2}\sum_{j=1}^{2}\frac{[M_{ij}-(M_{i\cdot}\cdot M_{\cdot j}/M)]}{M_{i\cdot}\cdot M_{\cdot j}/M}$$

and is approximately chi-square distributed of degree of freedom one for large value of n under the null hypothesis that two classifications are independent from each other. The variable Q is the coefficient of association between the two classifications

$$Q=\frac{M_{11}M_{22}-M_{12}M_{21}}{M_{11}M_{22}+M_{12}M_{21}}.$$

For more details, see Mood, A.M. *Introduction to the Theory of Statistics* 1950, Chap. 12.