Continuities in Structural Inquiry

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STRUCTURES OF ECONOMIC INTERDEPENDENCE AMONG NATIONS

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> One cannot reasonably explain the strength of various state-machineries at specific moments of the history of the modern world-system primarily in terms of a genetic-cultural line of argumentation, but rather in terms of the structural role a country plays in the world-economy at that moment in time.
>
> Wallerstein (1974b, p. 403)

Despite the renewed interest of sociologists in international patterns of economic (inter)dependence, structural conceptualizations driven by analytical power and tuned with empirical precision have been few. The definition of social structure as a non-homogeneous space of differentiated positions (Blau, 1977) leads us to view the economists' theories of international trade as *non*-structural in important respects.[1] Since Ricardo's treatment of comparative advantage, the economists' theories of trade may be seen as straightforward generalizations from the two-nation, two-commodity case. The units of analysis have been dyadic (pairs of nations) rather than multiple. The theories have focused on explaining levels of aggregate exports and imports. There have been few attempts to depict the overall structure with its major concentrations and fissures. Studies seeking to identify patterns in world trade (such as League of Nations, 1942; Woolley, 1958) have imposed highly idealized definitional aggregation both on the types of transaction

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under study ('goods,' 'services') and on the macro units of analysis ('the sterling area,' 'Latin America'). Despite a tendency since World War II toward stability in the geographical *shares* of trade, 'no...clear-cut regional pattern has yet been established' (Michaely, 1968, p. 113).

Seen from this vantage point, one of the major contributions of world-system theory (Wallerstein, 1974a; Chirot, 1977) has been to rephrase the entire discussion of international trade by raising and grappling with three analytical problems: 'the structure of the world economy, its cyclical patterns including the present conjuncture, and the ways in which the positions of particular states may change within this structure' (Wallerstein, 1974c). The definitive characteristic of the world economic system is its single division of labor, such that various sectors are dependent upon economic exchanges with others, forming 'a grid which is substantially interdependent' (Wallerstein, 1974b, pp. 390, 397). For analytical purposes world-system theorists partition this grid of unequal exchange relations into three general zones or 'positions' identified on the basis of world market trade in bulk commodities that are necessities for everyday consumption. In brief: *core* states appropriate the surplus of the world economy as a whole and in particular of those states located in the *periphery*, which produce 'lower-ranking' (labor-intensive) goods, while states located in the *semiperiphery* are 'both exploited and exploiters' (Wallerstein, 1974b, pp. 401-5).[2]

ORIENTATION

Goals of This Paper

Along with the excitement generated by world-system theory — indeed, as an intrinsic component of the promise of this approach — are a number of questions concerning its underlying conception of macro-social structure. Among these questions are the following.

(1) Can operational procedures be developed to identify core, peripheral, and semiperipheral states on the sole basis of the structural positions they occupy in international exchange networks?

(2) What are the distinctive elements of a core-periphery structure, in contrast to other ideal-type structures that might characterize international exchange? Therefore, how might transformations of this structure be identified?
(3) Should we expect to discover the same pattern within each type of exchange that we study — capital flows, trade in manufactures, trade in foodstuffs, military interventions? How do these patterns themselves interlock?
(4) Precisely in what sense are core-periphery structures monolithic, and to what extent do they permit the existence of multiple, competing centers?

This paper directly addresses the first and fourth questions and draws implications for the other two. The first question has been posed in a related context by Terence Hopkins (1978, p. 207), who observes the tendency of world-system theorists to treat positions in the world economy (such as 'the core-periphery relational conception') as mere categories, so that 'the relation which the joined terms designates slips into the background, sometimes out of sight entirely.' In this paper a specific empirical framework is developed, which is consistent with Hopkins' directive that the

> acting units or agencies can only be thought of as *formed*, and continually reformed, by the relations between them. Perversely, we often think of the relations as only going between the end points ['core' and 'periphery'], ...as if the latter made the relations instead of the relations making the units. [Hopkins, 1978, p. 205; original emphasis]

The choice of a strategy for addressing this first question (namely, how to derive reduced-form 'positions,' each occupied by numerous states and identified on the basis of the similarity of nations' interchanges across multiple networks of transnational interaction) also implies analytical commitments on related issues. With respect to the second and third questions listed above, this paper will argue that a variety of ideal-type hypotheses specifying relations among macro-level 'positions' (like core and periphery) may be formulated conceptually and tested empirically against data on international trade, and that the issue of the interaction among these networks (for example, a different network for each type of commodity traded among nations) may be as crucial for an adequate theory of the world system, as is the issue of interactions among states.

Beyond these conceptual problems regarding the derivation of 'positions' in the world economy for multiple and complex networks of economic exchange, this paper addresses a major substantive claim of world-system theorists (the fourth question listed above) concerning the existence of a single core. To anticipate the discussion of Figures 3 and 6 below: the suggestion is raised that the finding (Snyder and Kick, 1979) of a unitary center within international trade networks may confound the pattern of trade with attributes of nations' overall economic strength. The states with the largest total trade do indeed tend to occupy a unitary 'core' position. However, after adjusting for the overall import and export levels of each country, a considerably more differentiated pattern of relations may be uncovered — a pattern evidencing multiple, competing centers. Implications are drawn for empirical research following from world-system theory.

In contrast to the broad scope and historical sensitivity of the world-system theorists, the research reported in this paper is restricted and self-consciously naive. It is restricted in that I confine my analysis to 24 highly industrialized nations (essentially, the contemporary membership of the OECD) during a recent year (1972). It is self-consciously naive in its neglect of most factors that historians and social scientists would usually take into account in analyzing these nations, and in its single-minded focus, instead, on patterns of trade of four major types of commodites among these nations. In juxtaposition to world-system theorists, then, the attempt here is to determine the extent to which an explicit analysis of trade structure can aid accounts of the broader, more complex, and more subtle relations among these nations at the present time.[3]

Conceptual Framework

Owing to the emphasis of world-system theory on the structural positions of nations that engage in multiple types of exchange, several researchers who seek empirically to address these issues (Snyder and Kick, 1979; see also Breiger, 1977) have proposed a 'natural wedding' between world-system theory and a general analytical strategy for the analysis of multiple networks, termed block-model analysis.[4] From this network perspective, three concepts emerge that have both methodological and theoretical salience. In short-hand terms, we may refer to them as (1) structural similarity, (2) pattern, and (3) interlock.

In an important paper reporting a block-model analysis for 118 countries, Snyder and Kick (1979) fault world-system theorists for their inability to specify operational criteria for classifying nations into the theoretically specified structural positions (core, semiperiphery, periphery), and for the tendency of researchers in this tradition (for instance, Rubinson, 1976; Delacroix and Ragin, 1978) to substitute statistical indicators such as investment dependence and trade concentration for measures of 'position' or 'control' in the world system. As White and Breiger (1975, p. 68) assert, 'variate distributions measure selected consequences of structural pattern (of the actual ties among individuals or organizations); they are useful indicators of questions to be asked in analyzing social structure directly, but they are neither descriptions nor analyses of the structure itself.'

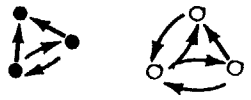
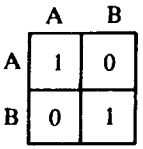
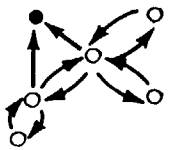
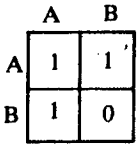
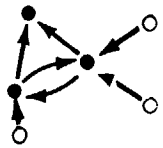
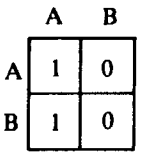
International trade has a natural representation as a series of matrices, each matrix reporting trade among all pairs of nations with respect to a given commodity type and a given time period. Thus, a focus on total export levels or on trade concentration indicators implies a concern only for the marginals of these interaction matrices, without providing a sound basis for generalization to the interior cell values (that is, to the internal boundaries for relations among states). Hopkins points out that

> the total rows and columns, which one literally obtains by some summing operation across rows [to obtain aggregate exports] or down columns [to obtain aggregate imports], are the 'distributions.' ... When we address ourselves to the distributions without remembering to see them as summaries of conditions continually resulting from processes among the units, we give up our central focus on relations, and perforce become eclectic and ad hoc in our efforts to set forth coherent accounts of 'distributions.'[5] [Hopkins, 1978, p. 205]

In contrast, a block-model approach to international trade assigns states to positions according to the structural similarity of the nations' imports and exports to all other states, across various types of economic exchange, rather than on the basis of definitional aggregation.[6]

Having obtained a partition of nations into structurally similar positions (or 'blocks'), a second goal of this network approach is to examine the possibly distinctive patterns that these blocks induce on the original network data. Within any commodity type, the pattern might well be one of segregation (separate trading areas), hier-

FIGURE 1
Examples of Ideal-Type Patterns that might Characterize International Networks

Trade relations among six states (fictitious)	Reduced-form block-model images among positions in each network	Type of pattern
		I. Separate trading areas
		II. Center-periphery pattern
		III. Hierarchical pattern

In each example, block 'A' includes the nations represented by dark circles, block 'B' includes the others, and arrows indicate the flow of exports among nations.

archy, core-periphery, or some other. If one seeks an empirical procedure to identify and distinguish these overall patterns, the emphasis must be on structural similarity rather than on 'clique' identification or other sociometric procedures.[7] This is an obvious but important point. To illustrate it in a manner similar to the ideal-type diagrams presented by Chase-Dunn (1978, p. 163), consider various possibilities for the trade relationships among six nations with respect to a given commodity (Figure 1). The arrows in Figure 1 are meant to indicate the flow of export trade of this commodity among the nations at their end-points. The examples of Figure 1 are fictitious but will serve to introduce the subsequent analysis of data. In each of the three examples, consider the pattern that is induced by aggregating or grouping together the nations depicted by dark circles ('block A') as against the others ('block B').

The first panel of Figure 1 ('separate trading areas') portrays two clusters of nations with each cluster evidencing internal relations, but with no trade between the clusters. The reduced-form block-model image of this network (White et al., 1976, pp. 741-2) is reported in Figure 1 as a 2×2 table with one row and column for each position or aggregate grouping of states that has been identified. The symbol '0' at the intersection of a pair of positions indicates the absence of all trade between their constituent states; otherwise, the symbol '1' appears (White et al., 1976, pp. 737-40).

In principle, this block-model image for 'separate trading areas' might be found to represent a large observed network of international trade in a particular commodity, but it is clear that this image is not one implied by world-system theory. This theory specifies that nations in the periphery are tied to the world economy by virtue of their trade with core states. The 'periphery' may in fact appear as a block evidencing no ties among its constituent nations; rather, its structural coherence arises from its dependence on other states within an overall pattern of 'unequal exchange' (Wallerstein, 1974b, p. 397; see also Brams, 1968). In contrast, the second and third panels of Figure 1 (the 'center-periphery' and the 'hierarchical' patterns discussed in Breiger, 1979, pp. 26-31) both satisfy these conditions, with block 'A' identified as the 'core' in each case. These patterns differ only as to whether the periphery maintains bilateral trade with the core (as implied in Chase-Dunn, 1978, p. 163), or unilateral trade (Chase-Dunn, 1978, pp. 165-6). Block-model analysis offers specific procedures for relating ideal-type images such as those shown in Figure 1 to detailed networks of international trade; indeed, states are grouped into positions or 'blocks' in the first instance by the criterion of the coherence of the overall pattern of relations that such a grouping of states induces.

A third distinctive feature of block-model analysis — one that has potentially broader implications for sociological theory than have been realized to date by the world-system researchers — is the identification of *interlock* among the various patterns ('block-model images') that have been identified. Taken as a whole, the patterns drawn from all arenas under study — for example, agricultural goods, manufactured commodities, energy resources — may themselves interlock in a coherent fashion. The classic, idealized paradigm for this interlock is triangular trade involving slaves, sugar, and manufactured goods (see Hirschman, 1945, pp. 123-4). Although this conceptualization has not systematically

been applied to the structure of world trade (however, see the pioneering work of Hirschman, 1945, pp. 117-51), its importance has been recognized by various writers. Haas (1964, p. 53), in his book *Beyond the Nation-State*, for example, clearly expresses this point of view with reference to the world system. He writes that 'the kind of "system" to which we shall address ourselves is the network of relationships among relationships; not merely the relations among nations, but the relations among the abstractions that can be used to summarize the relations among nations.'

This emphasis on the interrelationships among patterns of relationships is a very general and distinctive feature of a sociological theory of social structure (see for instance, the discussion of Blau, 1975, and of Boorman and White, 1976, in Breiger and Pattison, 1978; see also Lorrain, 1975, and Pattison, 1977). The identification of contemporary equations between types of international exchange — if such equations are to be discovered at all — will probably rely on procedures implied by the first two points above.

Data

Twenty-four highly industrialized countries systematically report trade statistics disaggregated by commodity type (SITC level) to the United Nations. These countries, listed alphabetically in Figure 2,[8] form a natural field for analysis in that they exactly comprise the members and associated members of the Organization for Economic Co-operation and Development (OECD), plus one other state (Israel).[9] The OECD was established to increase the standardization of national economic policies among its members (Aubrey, 1967). Moreover, these 24 states appear to form a natural field for analysis in that virtually all of them are labeled as 'core' states by Snyder and Kick (1979).[10] As a group, their trade accounted for over 70 percent of the world totals in 1972.[11]

The data for this study are drawn from systematic United Nations statistics (UN Statistical Office, 1974) on the trade among these nations in 1972 with respect to four broad classes of commodity (SITC Section Codes 0, 2, 3, and 6). Detailed specifications of these classes may be found elsewhere (UN Statistical Office, n.d.); I will briefly refer to them as follows. 'Agricultural pruducts' include cereals, animal feed, fruit, vegetables, dairy products, meat and fish preparations, and related goods. 'Raw materials' include

ores, crude and synthetic rubber, wood, lumber, unmanufactured textile fibers, and crude minerals. 'Manufactured goods' include iron and steel products, textile yarns, paper, wood and rubber manufactures, etc. 'Energy resources' include electrical energy, natural and manufactured gas, coal, coke, and petroleum products. Trade in these four commodity classes among the 24 nations studied accounted for 22 percent of all world trade (among all nations) in 1972. The year 1972 was chosen as the initial year of study as a base year for further research, since it was immediately prior to immense changes in world petroleum prices (see Arrighi, 1978, pp. 88-107; Blumenthal, 1978), as well as the year prior to the entry of Britain and other countries into the European Common Market.

The problems inherent in trade-flow data have received considerable scholarly attention (see especially Allen and Ely, 1953; Linnemann, 1966). In brief: the bases, methods of estimation, methods of data collection, extent of coverage, precision of definition, scope of territory, and margins of error undoubtedly differ for various items within a particular country, and for like items for different countries. However, in the 30 years during which these data have been systematically reported, great strides have been made in the implementation of standardized definitions, reporting procedures, and comparability. The rationale for employing these trade-flow data is that they are the best data available.[12]

RESULTS

Inside the Core

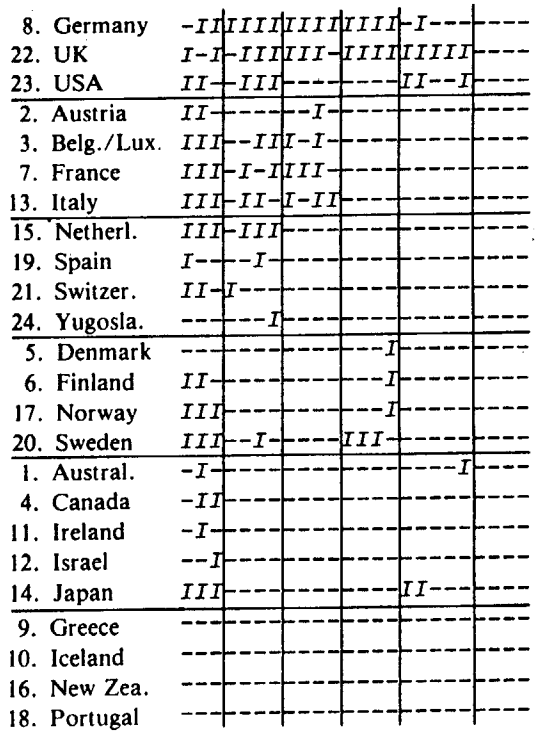
Figure 2 reports the trade in manufactured goods among 24 nations. Both rows and columns are ordered identically but arbitrarily (an alphabetical listing by country). Only the highest fifth of the interior cell values are coded as present ('*1*'); the rest appear as blanks ('_').

Figure 3 reports exactly the same data, but now the countries have been re-arranged and partitioned, by an algorithm widely used in block-model analysis (Breiger et al., 1975), to block together nations that have the most similar sets of trading partners, with respect to both imports and exports. The other trade matrices (not

FIGURE 2
Trade in Manufactured Goods among 24 Nations

Rows and columns are ordered arbitarily but identically (an alphabetical listing by country). Only the highest fifth of the interior cell values are coded as present ('*I*').

FIGURE 3
A Partition of the Rows and Columns of Figure 2



Mean Values of Trade Within and Between Blocks ($ millions)

	Block 1	*Block 2*	*Block 3*	*Block 4*	*Block 5*	*Block 6*
Block 1	(483)	(407)	(246)	(130)	(233)	32
Block 2	(539)	(319)	(157)	44	28	14
Block 3	(189)	(108)	19	21	11	5
Block 4	(177)	36	24	(109)	11	5
Block 5	(448)	19	11	8	45	12
Block 6	22	8	3	6	5	0

Computed from the original (non-binarized) data and rounded. Mean values in excess of $100 million have been circled. Compare the pattern of circled values to the 'center-periphery' pattern of Figure 1.

shown here) have very similar patterns to Figure 3 under the same partition of countries.

The major finding from Figure 3 is the emergence of a strong center-periphery pattern (in the specific sense of the second panel of Figure 1 and of Breiger, 1976, pp. 128-9) among these countries located within the 'core.' Purely in terms of the aggregate pattern revealed, the first-listed block has extensive trade (both imports and exports) with each other block except the last, which appears to be outside this system of the exchange of manufactured goods.The second block has extensive trade with each of the first three (including trade among its own members). The position of the third-listed block derives form its extensive trade with blocks 1 and 2, but not among its own members: hence its peripheral role. Block 5 is even more peripheral, trading extensively only with the USA and the UK (in block 1). The fourth block — comprising the Scandinavian countries of Denmark, Finland, Norway, and Sweden — occupies a distinctive position within the overall pattern in that these countries trade heavily with one of its members (Sweden) and also with two members of block 1 (Germany and the UK).

What is perhaps most remarkable about this pattern is its great resemblance to the one discovered by Snyder and Kick (1979, p. 1111) for a world-wide sample of 118 nations. What are we to make of the evident replication of this pattern among those very states that Snyder and Kick (1979) identify as 'core' states?

First, it is not at all clear that a world-system theorist would accept the procedures employed by Snyder and Kick or by the present study.[13] Second, this consideration notwithstanding, we have the empirical fact of a 'center-periphery' pattern. It may thus be argued that the central nexus of the world economy — as this nexus has been defined by previous researchers — is itself a highly unified structure, bound together by the predominant position of just three core states.

The third point to make about Figure 3 is that it provides an unsatisfactory picture on substantive grounds. Notice, for example, the tendency toward symmetry. (In general, although not exclusively, countries importing large amounts of manufactured goods from, say, the US also tend to export large quantities of goods to the US.) We must also consider the possibility of asymmetric exchange (Wallerstein, 1974b) across a variety of product types. Moreover, Figure 3 is based on analysis of binary data (as is the research of Snyder and Kick, 1979, p. 1105), with no explicit adjustment for the fact that some countries export (and import) vastly higher quantities of material than others. Therefore, I now turn to a set of procedures for grappling with these issues.

Identifying Blocks of Nations

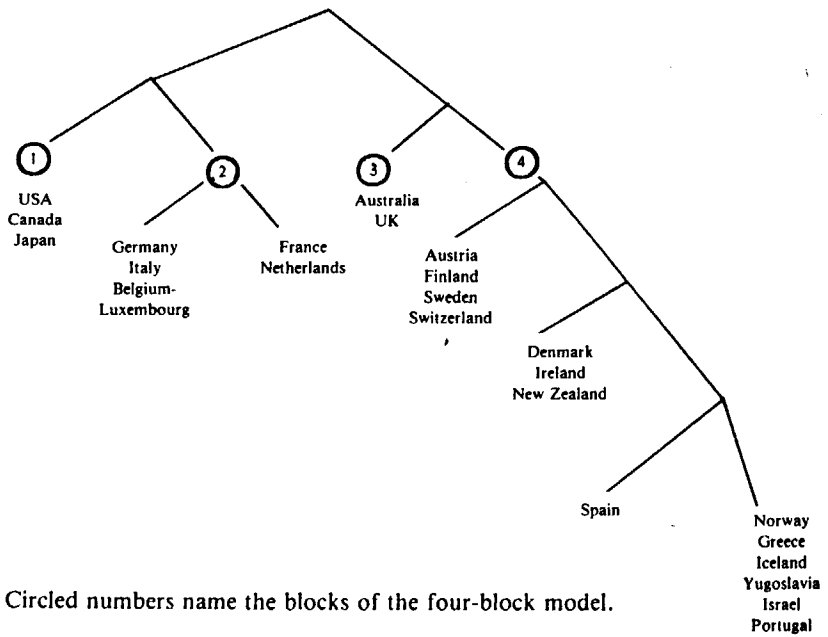
Various techniques have been proposed to 'net out' the effects of countries' total imports and exports in order to obtain, for example, indices of the 'intensity' of trade (see for example, Savage and Deutsch, 1960; Goodman, 1963; Brams, 1966). The procedure I employ here was suggested by Schwartz (1977, pp. 267-8) for the analysis of network data. Row and column means were subtracted from each matrix, leaving residuals from an additive, two-way analysis of variance model.[14] Entries greater than zero indicate positive (statistical) interactions for the trade of a given commodity between pairs of countries, and conversely for negative values. These numbers were not binarized, so as to permit no loss of information (and since binarization is unnecessary for the block-model algorithm that was applied).

The fundamental difference between this analysis and the one reported previously is that I now seek a *single* partition of countries that distinguishes patterns across *multiple* matrices: those reporting trade in agricultural products, raw materials, and manufactured goods, respectively.

Using a standard block-model procedure (Breiger et al., 1975), the CONCOR algorithm was applied simultaneously to the rows and columns of these three matrices. This divisive hierarchical clustering algorithm produces progressively finer discriminations among countries. The natural representation for these various levels of discrimination is a 'tree' (see Figure 4).

In order to explore this partition of countries, a single nation-by-nation correlation matrix was computed across rows and columns of all three trade tables (adjusted as described above and in Schwartz, 1977), and the eigenstructure of this matrix was examined. The first two eigenvectors (accounting, respectively, for 50 and 15 percent of the total variance) are plotted in figure 5.[15] The first dimension of Figure 5 (the horizontal axis) corresponds to the block-model split between the first two blocks and the others (compare Figure 4), while the second dimension separates blocks 1 and 3

FIGURE 4
The CONCOR Tree



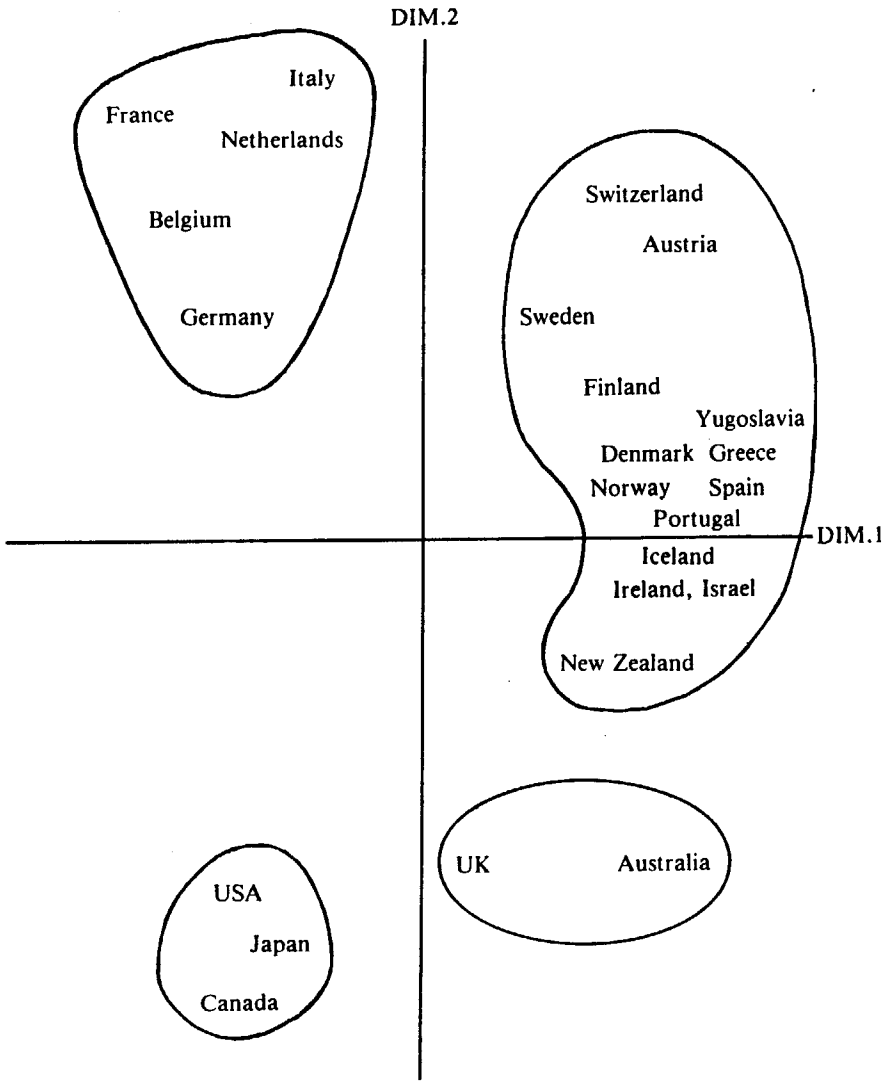
Circled numbers name the blocks of the four-block model.

from blocks 2 and 4 (see also Schwartz, 1977; Arabie et al., 1978, pp. 38-40).

Block 2 includes exactly the five original members of the European Common Market. Recall that these countries were not grouped together in the previous analysis, based on the total volume of pair-wise trade (Figure 3). The first dimension of Figure 5 joins these EEC nations with the USA, Canada, and Japan, while the second dimension separates them, linking these latter countries (block 1) instead with the UK and Australia and — to a lesser extent — with Iceland, Ireland, Israel, and New Zealand.

The first dimension of the trade structure discriminates among nations with respect to their overall economic strength (see Table 1, column 1). The second dimension, joining the blocks containing the USA and UK against the others, is with equal clarity unrelated to overall economic strength (Table 1, column 2). Rather, one might choose to view the second dimension as demarcating an Anglo-American-Japanese sphere of influence from a distinctively European sphere of influence, above and beyond national differences of economic power.

FIGURE 5
A Plot of the First Two Eigenvectors of a Correlation Matrix Described in the Text. The 4-block Partition from Figure 4 Has Been Imposed



In this respect, the greatest value of the constellation of Figure 5 will emerge from its analysis over time — for example, whether or not the formal entry of the UK into the EEC in the year after these data were collected in fact serves to move its overall position closer

TABLE 1
Coefficients of Determination (r^2) Between Selected Variables and the Dimensions of Figure 4

Variable	Dimension 1	Dimension 2
1972 Total reserve assets*	0.487	0.007
1973 Gross national product	0.259	0.099
1973 GNP per capita	0.074	0.009
1973 Average monthly imports	0.684	0.009
1973 Average monthly exports	0.665	0.007

* Assets include gold stock, holdings of convertjble foreign currencies, special drawing rights, and IMF reserve position.

Sources for these variables: US Bureau of Census (1977; Tables 1452, 1453, 1466). For reserve assets, $N=23$ (excluding Iceland). For the two GNP measures, $N=22$ (excluding Israel and Yugoslavia). For the import and export measures, $N=23$ (excluding Israel). Exclusions resulted from unavailable data.

to that of 'Europe'. Analyses such as the one begun here may well allow us to address Dahrendorf's point that

> we are going through a period in which power is more diffuse in the international community than ever before. It is a period in which a past pattern which we know and a future pattern which we may suspect are intermingled.... This then is the position of Europe as a world power.... At times its existence becomes manifest through the institutions of the European Community, at other times through other institutions...; but more often its reality is latent.... Circumstances and constellations are more important than intentions and [individual] actions. [Dahrendorf, 1977, pp. 72, 74]

As a test of the block-model partition displayed in Figure 4, this partition was applied to a data set that had not been used in the construction of the partition. The reader will recall that three networks were employed: agricultural products, raw materials, and manufactured goods. Table 2 reports correlations among these three plus the new type, trade in energy resources, at the level of the individual data.[16] At this level, no two matrices share more than a moderate amount of common variance, ranging from 22 percent ($=0.470^2$) to 44 percent ($=0.661^2$). Despite these individual-level differences, the block-model partition discriminates a statistically significant structure of trade on the new network (energy resources).[17]

TABLE 2
Correlations among the Trade Matrices Employed in this Study*

	Agricultural products	Raw materials	Manufactured goods	Energy resources
Agricultural products	1.000	0.579	0.591	0.470
Raw materials		1.000	0.524	0.661
Manufactured goods			1.000	0.584
Energy resources				1.000

* See note 16.

The identification of a single blocking of countries that is alleged to hold across four matrices that differ so greatly at the individual level, however, begs us to look more directly at the specific patterns that this blocking induces. Spatial representations such as Figure 5 may well serve to identify the macro-positions of nations in an international economy, but they yield no information on the multiple networks among these positions. The essential feature of a social network is often the sharp breaks in its pattern — the asymmetries and the absence of interaction — rather than the existence of ties.

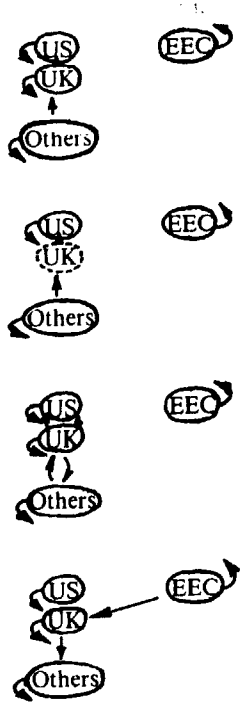
Structure Across Multiple Networks

The four-block CONCOR partition (Figure 4) was applied to the rows and columns of each of the trade matrices under study. Each matrix is non-binary, reporting the dollar value of trade among pairs of countries after adjusting for the total volume of each nation's imports and exports (as previously discussed). What patterns does this partition induce, and are the patterns distinctive?

Figure 6 reports the mean trade within each of the four blocks, and between all pairs of blocks. The highest entries in each table

FIGURE 6
Mean Trade Within and Between the Blocks of Figure 4, and the Resulting Block-Model Images

	US	EEC	UK	Others
I. Agricultural Products				
US	296,477	-37,509	-132	-28,939
EEC	-96,615	240,867	-60,740	-39,438
UK	126,984	-77,308	106,526	-7,210
Others	-25,989	-49,738	14,112	22,956
II. Raw Materials				
US	658,930	-24,800	-20,996	-82,276
EEC	-94,758	71,591	-19,408	2,585
UK	96,487	-10,254	-5,296	-16,635
Others	-74,139	-13,675	11,809	20,552
III. Manufactures				
US	969,973	-162,621	46,239	-87,094
EEC	-121,187	453,506	-116,496	-86,962
UK	11,731	-70,780	31,513	20,514
Others	-96,962	-84,614	29,446	50,390
IV. Energy Resources				
US	174,065	-21,227	-18,958	-14,577
EEC	-26,853	39,845	17,028	-8,063
UK	-19,196	-6,544	-13,389	7,407
Others	-12,534	-5,901	-1,062	5,325

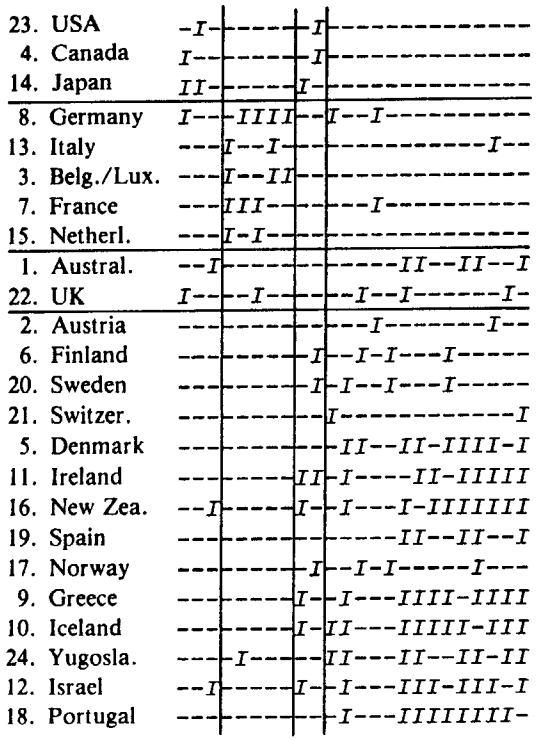


Row and column means have been subtracted from the individual-level data (as described in text). Reported values are in thousands of US dollars. The terms 'US', 'EEC,' 'UK', and 'Others' are shorthand designations for blocks 1, 2, 3, and 4 (respectively) identified in Figure 4.

FIGURE 7
Trade in Agricultural Products under the Four-block Partition of Figure 4

Block means from Figure 7 are reported in the first panel of Figure 6. Analysis was performed on the non-binarized data, with row and column means subtracted (see note 18).

FIGURE 8
Trade in Manufactured Goods under the Four-block Partition of Figure 4



Block means from Figure 8 are reported in the third panel of Figure 6.

(all those greater than $3 million) have been underlined. Adjacent to each table is the reduced-form network — or 'block-model image' (White et al., 1976) — representing the structure of these positive interactions. As shorthand names for the blocks of Figure 4, I use the terms 'US,' 'EEC,' 'UK,' and 'Others.' To illustrate the relation between these reduced-form patterns and the overall structure, Figures 7 and 8 reproduce the full, country-by-country matrices for two of the product types. For simplicity, only the highest entries in each matrix are shown there.[18] Figures 7 and 8 illustrate the general tendency for blocks with high mean trade to represent sub-matrices containing uniformly high values. In general, the exceptions to this statement are values of low magnitude.[19]

I will focus comments on Figure 6, which reports the mean aggregate trade between blocks, above and beyond their overall propensities to import and export each type of good. My theme will be the contrast between this structure and the earlier one of Figure 3, where overall imports and exports were not taken into account.

Figure 6 portrays the tendency toward separate trading areas (compare Figure 1) between the USA, Canada, and Japan (block 1) and the EEC countries (block 2). These blocks are segregated across trade in all product types. They have tendencies neither toward direct trade nor toward exchanges through third parties. This tendency toward polarization among the two strongest competing blocks was not evident from the data on direct trade — Figure 3 — but emerges when one adjusts for total imports and exports. In this sense, Figure 6 portrays not a monolithic structure (as in Figure 3), but an arena with competing centers.

Another facet of the Figure 6 structure is the success of the Common Market — but also its inward-looking tendencies — with respect to its six members as of 1972. Established to reduce barriers and promote internal trade, the underlying pattern of trade within the EEC overwhelms any inclination toward exchanges with external areas.[20] A notable feature of this within-block integration is that it is not apparent with respect to total trade. (Compare Figure 3, in which the strength of the German economy accounts for its central role, in conrast to the peripheral position of other EEC members.)

A third feature of Figure 6 is the role of the UK and Australia as intermediaries between blocks 1 and 2 and the OECD countries *not* included in the Common Market. The membership of block 4 in-

cludes the participants in the European Free Trade Association, to which Britain also belonged until 1973.[21] A popular view[22] is that these nations of block 4 comprise a natural part of the EEC's sphere of influence. Given the high relative interdependence between these countries and the UK block, a natural question concerns the extensiveness, over time, of the de facto integration of these areas within the European Community. Although beyond the scope of my discussion, this question may be posed and addressed in a straightforward manner within the framework of analysis developed here.

Finally, Figure 6 allows us to observe the interrelationships *among* these aggregate relational patterns. According to a traditional conception (reviewed in Hirschman, 1945, p. 117), world trade is based essentially upon a division of labor calling for the exchange of manufactures against foodstuffs and raw materials. This view finds expression at the macro-level of Figure 6 in the sense that every arrow in each of the first two images may be mapped into an arrow travelling in the opposite direction in the third image (the one for manufactures). However, observe that this traditional conception provides an inadequate characterization of the interlock of these patterns. Specifically: the macro-level trade in manufactures is more pervasive, and thus trade in manufactured goods is not always reciprocated by flows of raw materials or agricultural products. As a more extensive algebraic analysis (not reported here) confirms, the asymmetries in the flows of these latter commodities render them more useful than manufactured goods as indicators of a detailed structure.[23] Thus, while the flow of manufactured goods is — of course — ubiquitous among these countries and accounts for the greatest part of their total trade, it is precisely to the *other* types of commodity that one must turn in order to obtain the clearest picture of the hierarchical structure of 'strong' international ties.

CONCLUSIONS

This paper has explored possibilities for identifying the positions of nations in an international system on the basis of their simultaneous exchanges of multiple types of economic goods. The analytical linkage between nations' positions in the world economy, and the identification of distinctive patterns of trade in each network, has been illustrated within an operational framework emphasizing the mutual relevance of theory and data.

With respect to trade relations among the OECD countries in 1972, a unified structure has been identified which evidences a strong center-periphery pattern. This finding suggests the existence of a smaller and correspondingly more predominant 'core' within the contemporary world system than has been identified by other researchers (Snyder and Kick, 1979). However, this finding was shown to confound the patterns of trade with attributes of nations' overall economic strength. Adjusting for the total import and export levels of each country, a considerably more differentiated structure was shown to underlie the original finding. A major feature of this underlying structure is the existence of multiple, competing centers. To pursue the question of international trade patterns net of the individual attributes of countries, a more rigorous set of control variables should be incorporated in further work. Thus, the econometricians' multiple regression equations involving variables such as population size, national income, geographical distance, and mean import and export levels (for example, Linnemann, 1966) may be seen as providing data for an explicitly *structural* anlysis of trade flows.

More generally, this paper has pointed to certain overlaps between the concerns of a social network theory and world-system theory (Wallerstein, 1974a; Chirot, 1977), but — at least by implication — it should be clear that there are separate areas of development as well. The overlap arises from the interest of each approach in identifying nations' positions on the basis of their overall location in multiple world networks. However, world-systems theory is a richer approach, with more nuances, inseparable in its essentials from its historical investigation of the origins of sustained economic growth in Western Europe. Conversely, the contribution of a network formulation to the development of a macro-sociological theory of social structure is considerably more general, focusing (in the words of Haas, 1964, p. 53) 'not merely [on] the relations among nations, but [on] the relations among the abstractions that can be used to summarize [these] relations.'

NOTES

1. On economic theories of international trade see, e.g. Chipman (1965), Kemp (1964), and Meade (1952). Also see the important empirical studies of Kindleberger (1962) and Linnemann (1966).

2. The analytical clarity of Wallerstein's 'semi-periphery' position has occasionally been questioned. For more complete definitions and discussion of these three positions, see Wallerstein (1974a, pp. 301-2, 359-50), Chirot (1977, p. 13), Skocpol (1977), and Snyder and Kick (1979, pp. 1098-1101).

3. For an argument in favor of a narrow interpretation of social structure as including social positions, patterns of social relations, and the nexus bonding positions and relations, but excluding 'its broader cultural and functional connotations,' see Blau (1977, pp. 1-18).

4. Introductions to block-model analysis may be found in White and Breiger (1975), White et al. (1976), Arabie et al. (1978), and Breiger (1979, pp. 22-34).

5. For a critique of researchers who 'collapse full network structures into single vectors of row-marginals (number of choices initiated...) and column-marginals (number of received choices)' rather than using 'network phenomenology itself' as a guide to the aggregation of social actors, see Breiger (1976, p. 118).

6.

> Some sort of self-consistent search procedure is necessary, since the membership of one set depends on the membership of the other sets, as well as on which sets are to have ties of a given type to which other sets. The meaning of a type of tie in the given population can be inferred from its pattern of incidence instead of solely from the cultural definition of that type of relation. [White and Breiger, 1975, p. 68]

For detailed discussion of the algorithms actually employed, see the references cited in note 4.

7. Contrast in this respect the studies of Brams (1966), Chadwick and Deutsch (1973), Merritt and Clark (1977), Russett (1966), Savage and Deutsch (1960), and Wish, Deutsch and Biener (1972). At a more explicitly theoretical level, contrast Arrighi (1978).

8. All figures for Belgium also include those for Luxembourg.

9. Yugoslavia and New Zealand are not formal members of the OECD, but are the only two countries affiliated with it in special status categories (US Bureau of Census, 1977, p. 863).

10. Nineteen of the nations listed in Figure 2 are termed 'core' states by Snyder and Kick (1979, p. 1110); the other nations of Figure 2 are Iceland, New Zealand, Israel, Ireland, and Finland. Conversely, all 'core' states of Snyder and Kick are included in Figure 2, with the exception of South Africa.

11. The imports of these nations totalled $304 billion out of the world total of $430 billion.

12. Each country reports its imports and exports separately to the UN. Apart from well-known differences in valuation — exports are valued at free-on-board (f.o.b.) prices and imports usually at cost-insurance-freight (c.i.f.) prices — these two sets of figures should correspond. Actually, their correspondence is far from perfect, for a number of reasons (Linnemann, 1966, pp. 61-2). If one is interested in tracing the countries of production and consumption (rather than the countries of consignment), the import statistics are more reliable than the export statistics (Durand, 1953, pp. 123-4; also see Linnemann, 1955, p. 62), and the import data are therefore the ones used here.

13. This is because world-system theory in general, and Wallerstein's work in particular, has been essentially historical rather than formal (however, note the observations of Skocpol, 1977, p. 1080 on this point). Perhaps the most formal of the world-system theorists is Hopkins (1978).

14. In general, the procedure used here results in the appearance of non-zero values on the diagonal of each matrix. Schwartz (1977) proposes a transformation of each matrix so as to have row-sums of zero, column-sums of zero, and main diagonal values all zero; this is the procedure I have employed. On the relevance of Schwartz (1977) for the CONCOR algorithm employed here, see Arabie et al. (1978, pp. 38-40).

15. Each eigenvector has been normed to unity.

16. Each matrix was in effect 'unraveled' into a vector of 552 ($=24\times23$) numbers, taking care to unravel each matrix in the identical order. Numbers are US dollar values of trade (for specific product types) between all pairs of countries. Correlations between these vectors are reported in Table 2.

17. Two-way analysis of variance performed on the matrix of trade in energy resources, with this 24×24 matrix partitioned according to the four blocks of Figure 4, leads to row, column, and row-column interaction effects that are significant at the 0.001 level. For a more comprehensive discussion of the statistical significance of block-model 'fit,' however, see White (1977).

18. In Figure 7, all entries above $25 million are coded as 'present'; in Figure 8, all entries above $50 million. The reader should bear in mind that all analyses were performed on the full, numerical data. The binarization of Figures 7 and 8 is for the sole purpose of lending simplicity of description to the resulting patterns.

19. These figures also suggest the relevance of the more detailed block structure. In Figure 7, for example, note the tendency of Ireland, New Zealand, Denmark, and Spain (all of which are grouped together in Figure 4) to export heavily to the UK, while each of the other nations of block 4 (Figure 4) exports heavily to Australia and among themselves.

20. The exception, trade of energy resources, involves an asymmetric exchange, with the EEC in a favorable position with respect to block 3.

21. The 1972 members of the European Free Trade Association (EFTA) were Austria, Finland, Switzerland, Sweden, Denmark, Norway, Iceland, Portugal, and the UK. Compare Figure 4.

22. *Business Week*, 24 July 1978: 79.

23. Breiger and Pattison (1978) recast Granovetter's (1973) 'strength of weak ties' argument as a proposition about the existence of a particular semigroup homomorphism (Boorman and White, 1976). Investigation of the algebraic semigroup

generated by the agricultural, raw-materials, and manufactures images confirms the proposed structure as a homomorphic reduction, with manufactures as the 'weak' ties.

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