USING THE PRINCIPLE OF LEAST INTEREST TO DERIVE A DOMINANCE HIERARCHY FROM INTERACTION OR EXCHANGE DATA*

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The principle of least interest has a venerable tradition in social science. Perhaps the first published appearance of the idea was what E. A. Ross (1921) called the law of personal exploitation: "In any sentimental relation the one who cares less can exploit the one who cares more" (p. 136). Waller (1938) generalized Ross's idea to "a principle which we may accurately, if somewhat ungrammatically, designate as the principle of least interest: that person is able to dictate the conditions of association whose interest in the continuation of the affair is least" (p. 191). This idea has been incorporated in exchange theory elaborated under the general rubric of "equity theory" in social psychology (Walster, Walster and Berscheid 1978).

One implication of the least interest principle is that dependence and attraction are associated, a possibility which reconciles theories of personal power based on attraction to a relationship (e.g., Festinger, Schachter and Back 1950, pp. 164 ff.) and those based on dependence and what Thibaut and Kelley (1959) call "fate control," the possibility that, "by varying his behavior, A can affect B's outcomes regardless of what B does" (pp. 102-3). A theory of such power-dependence relations has been elaborated by Emerson (1962). Homans (1974) generalizes dependence theory and the principle of least interest to an aspect of power differentials in exchange: "The party to the exchange who gets the lesser reward from it is less likely to change his behavior in favor of the other than is the party who gets the greater. He is less dependent for reward on the other than the other is on him" (p. 73).

The idea that power depends on the relative interests of parties to an exchange relationship extends to large systems of exchange, with many actors, as well as to exchanges involving nonhuman and collective actors (other species, groups, organizations, cities, economic sectors, nation states, etc.). This paper attempts to reconcile the concepts of hierarchy and dominance in exchange from a variety of specialties, including behavioral ecology, small groups, sociometry, citation studies, geography, input-output economics and international transactions. The next section generalizes the principle of least interest to a set of theoretical propositions concerning relative dominance in exchange relations. Quantitative measures are then developed that apply to any input-output or exchange matrix, and that can be used to test the earlier propositions. These are tested, in a later section, against 16 empirical matrices involving exchanges of dominance behavior, interpersonal communication, sociometric choices, scientific citations and economic commodities.

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Comparisons of Relative Interest

Exchanges between any two actors, A_i and A_j ($i \neq j$), involve reciprocal flows of sizes n_{ij} and n_{ji} to and from A_j , respectively. The principle of least interest suggests that the power relation or direction of dominance between A_i and A_j will depend, not only on the direct flows between them (i.e., on n_{ij} and n_{ji}), but also on the relative interests in these flows, with the actor with less interest dominating the relationship.

Direct measures of relative interest, ones that do not depend on knowledge of actors' subjective states and are conveniently applied to other species, aggregates and abstract sectors, are suggested by comparisons of actual flow sizes to marginal totals of all flows for the actors involved. For example, the relative interests of actors A_i and A_j in their exchange relationship will depend on comparisons of the direct reciprocal flows (n_{ij} and n_{ji}) with the sums of those with all other actors. There are four such marginal totals: of all relations from A_i (n_{i+}), to A_j (n_{+j}), and reciprocally, from A_j (n_{j+}) and to A_i (n_{+i}). These six quantities (two reciprocal flows and four marginal totals), which figure in exchanges between any two actors involved in a larger exchange system, are presented schematically in Figure 1.

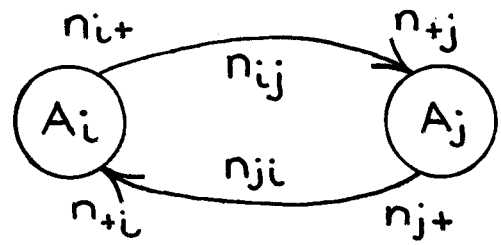

FIGURE 1.

The relative interests of A_i and A_j in their exchange relationship will involve comparisons of actual flows with marginal totals. There are four such relative interests:

(1) A_i's interest in that which it directs at A_j (n_{ij}), a function of the total relations it directs at all actors in the system (n_{i+});
(2) A_j's interest in that which it receives from A_i (also n_{ij}), a function of the total relations it receives from all actors (n_{+j}).
(3) A_j's interest in that which it directs at A_i (n_{ji}), a function of the total relations it directs at all actors (n_{j+});
(4) A_i's interest in that which it receives from A_j (also n_{ji}), a function of the total relations it receives from all actors (n_{+i}).

Comparisons like these are conveniently modeled as ratios of actual flows to marginal totals:

(1) n_{ij}/n_{i+} (3) n_{ji}/n_{j+}
(2) n_{ij}/n_{+j} (4) n_{ji}/n_{+i}

These four ratios (the numbers correspond to those for the four relative interests listed immediately above) represent an exhaustive set of measures for the relative interests of <u>any</u> two actors involved in a larger exchange system.

From Interests to Dominance

The next task is to determine the relationship between the measures of relative interest and directions of power or dominance among actors. One such relationship derives directly from the principle of least interest:

(P1) For any pair of actors and a single exchange relationship, if one actor has <u>less</u> interest in <u>both</u> giving and receiving than does the other, the former actor will dominate the latter for that particular commodity.

If the dominant actor is represented as A_i, and the subordinate one by A_j, Proposition P1 implies two inequalities:

(I1) $n_{ij}/n_{i+} < n_{ij}/n_{+j}$
(I2) $n_{ji}/n_{+i} < n_{ji}/n_{j+}$

In order to derive a second proposition concerning exchange dominance from the principle of least interest, it is necessary first to distinguish two types of asymmetrical or exchange relations (i.e., those for which n_{ij} does not necessarily equal n_{ji}). These are status-in-giving and status-in-receiving relations, for convenience abbreviated as SIG and SIR relations, respectively.

SIG relations are those for which a higher status is implied by giving than by receiving. Dominance behavior, charity, official orders and foreign trade are all examples of commodities exchanged in SIG relations. SIR relations, by contrast, are those for which a higher status is implied by receiving than by giving. Attention, esteem, friendship choices and academic citations are all examples of commodities exchanged in SIR relations. No claim is made here that <u>all</u> asymmetrical or exchange relations are necessarily either SIG or SIR, only that some such relations are better understood as one of these two types.

Given that an exchange can be identified as either SIG or SIR, a second proposition concerning exchange dominance derives directly from the principle of least interest:

(P2) For any pair of actors and a single exchange relationship, if one actor has <u>greater</u> interest in the flow in the direction to which status accrues than in the opposite flow, while the other actor has the <u>opposite</u> relative interests, i.e., <u>less</u> interest in the flow in the direction to which status accrues than in the opposite flow, the former actor will dominate the latter for that particular commodity.

If the dominant actor is again represented as A_i and the subordinate one as A_j, Proposition P2 implies additional inequalities:

(I3a) $n_{ij}/n_{i+} > n_{ji}/n_{+i}$ (for SIG relations)
(I3b) $n_{ij}/n_{i+} < n_{ji}/n_{+i}$ (for SIR relations)

(I4a) $n_{ij}/n_{+j} < n_{ji}/n_{j+}$ (for SIG relations)
(I4b) $n_{ij}/n_{+j} > n_{ji}/n_{j+}$ (for SIR relations)

To the two propositions concerning exchange dominance that have already been derived from the principle of least interest might be added two additional propositions. These appeal to general properties of symmetry in status or power relationships, i.e., to the expectation that between either flows or directions of flows, the <u>opposite</u> interest relations will prevail for dominant and subordinate actors. The first proposition argues for reciprocal relative interests in giving and receiving between the dominant and subordinate actors in a pair; the second proposition argues for reciprocal relative interests in the two flows themselves, again between the dominant and subordinate actors:

(P3) For any pair of actors in which one actor dominates the other for a particular exchange, if <u>either</u> actor has <u>greater</u> interest in the flow given than in the flow received, the <u>other</u> actor will have the <u>opposite</u> relative interests, i.e., <u>less</u> interest in the flow given than in the flow received.

(P4) For any pair of actors in which one actor dominates the other for a particular exchange, if one actor has greater interest in <u>giving</u> a flow than the other has interest in <u>receiving</u> it, the reciprocal flow will be of greater interest for the former actor to <u>receive</u> than for the latter to give.

If the dominant actor is again represented as A_i and the subordinate one as A_j, Proposition P3 implies the inequalities:

(I5a) <u>Either</u> $n_{ij}/n_{i+} > n_{ji}/n_{+i}$ (I3a)
<u>and</u> $n_{ij}/n_{+j} > n_{ji}/n_{j+}$ (I4a)

(I5b) <u>Or</u> $n_{ij}/n_{i+} < n_{ji}/n_{+i}$ (I3b)
<u>and</u> $n_{ij}/n_{+j} < n_{ji}/n_{j+}$ (I4b)

In other words, Proposition P3, based entirely on the general property of symmetry in status or power relationships, implies <u>either</u> that inequalities I3a and I4a hold, or that inequalities I3b and I4b hold. Because Proposition P2, derived directly from the principle of least interest, has already implied that inequalities I3a and I4a hold for SIG relations, and that inequalities I3b and I4b hold for SIR relations, it follows that Propositions P2 and P3 are entirely compatible, though based on different premises (the former on the principle of least interest, the latter on symmetry). Proposition P2 is also seen to be more specific than P3 and consequently to subsume the latter.

With the same meanings given to A_i and A_j, Proposition P4 implies the inequalities:

(I6a) <u>Either</u> $n_{ij}/n_{i+} > n_{ij}/n_{+j}$
<u>and</u> $n_{ji}/n_{+i} > n_{ji}/n_{j+}$

(I6b) <u>Or</u> $n_{ij}/n_{i+} < n_{ij}/n_{+j}$ (I1)
<u>and</u> $n_{ji}/n_{+i} < n_{ji}/n_{j+}$ (I2)

In other words, Proposition P4 implies that either inequalities I1 and I2 <u>both</u> hold or that <u>neither</u> does. Because Proposition P1 has already implied

I1 and I2, it follows that the two propositions, again based on different premises, are entirely compatible. Proposition P1 is more specific than P4 and consequently subsumes the latter.

To summarize this section, four propositions have been advanced concerning the relationship between measures of relative interest and directions of power or dominance among actors. Two of these propositions (P1 and P2) derive directly from the principle of least interest, the other two (P3 and P4) from general properties of symmetry in status relationships (i.e., that between either flows or directions of flows, the opposite interest relations must prevail for dominant and subordinate actors). The propositions based on symmetry are subsumed by those derived from the principle of least interest, thereby establishing a more general foundation for the latter in principles of status in exchange.

Inequalities I1-I6 can be combined in a pair of testable hypotheses concerning actors involved in systems of social exchange:

(H1) For any system of SIG exchange, if actor A_i dominates actor A_j for all i and j ($i \neq j$),

$$n_{ji}/n_{+i} < n_{ij}/n_{i+}\ ,\ n_{ji}/n_{j+} < n_{ij}/n_{+j}$$

and conversely, if this inequality holds for any i and j ($i \neq j$), it implies that actor A_i dominates A_j.

(H2) For any system of SIR exchange, if actor A_i dominates actor A_j for all i and j ($i \neq j$),

$$n_{ij}/n_{i+} < n_{ji}/n_{+i}\ ,\ n_{ij}/n_{+j} < n_{ji}/n_{j+}$$

and conversely, if this inequality holds for any i and j ($i \neq j$), it implies that actor A_i dominates A_j.

Measures Associated with Exchange Dominance

The theoretical interrelationships between relative interests and power or dominance in exchange relations have been set out in testable hypotheses (H1 and H2) in the previous section. These hypotheses are likely to be only approximately realized in actual systems of exchange, however, for at least three reasons: First, cross-sectional data from any dynamic system of exchange will contain measurements with various degrees of lag for variables in transitional states. Second, theoretical models may be only approximately correct, even for systems in equilibrium, but nevertheless useful for their conceptual elegance and predictive power. Third, all empirical data are likely to contain measurement error, while statistical data are also subject to sampling variation.

For these reasons, it will be useful to devise a battery of measures that can be used to test in specific detail the extent to which H1 and H2 are realized in any particular empirical application. Each of the four ratios of relative interest in Figure 2 can be meaningfully compared with any one of the other three ratios. Thus the four ratios determine six distinct pairs of ratios or comparisons of relative interest like those in H1 and H2. These six comparisons are of three types, what might be seen as horizontal, vertical and diagonal comparisons in terms of their orientation in Figure 2:

(1) Horizontal or "within flow" comparisons,

$$n_{ij}/n_{i+} \ :\ n_{ij}/n_{+j}$$
$$n_{ji}/n_{+i} \ :\ n_{ji}/n_{j+}$$

(2) Vertical or "within actor" comparisons,

$$n_{ij}/n_{i+} \ :\ n_{ji}/n_{+i}$$
$$n_{ij}/n_{+j} \ :\ n_{ji}/n_{j+}$$

(3) Diagonal or "within orientation" (i.e., within giving or receiving) comparisons,

$$n_{ij}/n_{i+} \ :\ n_{ji}/n_{j+}$$
$$n_{ji}/n_{+i} \ :\ n_{ij}/n_{+j}$$

Just as the initial comparisons of relative interest were conveniently modeled as ratios, so, too, can the above comparisons be given ratio measurements. For mnemonic reference, horizontal measures will be designated by H, vertical measures by V, and diagonal or "cross" measures by X. As further mnemonic aid, actor A_i is arbitrarily designated as "self" and A_j as "other" (following Mead 1934). Thus horizontal or "within flow" measures are either "from" (H_f) or "to" (H_t) A_i, vertical or "within actor" measures involve either this "self" (V_s) or the "other" (V_o), and diagonal or "within orientation" measures compare either giving (X_g) or receiving (X_r). These six new measures, associated with relative interest and exchange dominance in any system of asymmetric relationships or exchange, can be formally defined as follows:

$$H_f = (n_{ij}/n_{i+})/(n_{ij}/n_{+j}) = n_{+j}/n_{i+}$$
$$H_t = (n_{ji}/n_{j+})/(n_{ji}/n_{+i}) = n_{+i}/n_{j+}$$
$$V_s = (n_{ij}/n_{i+})/(n_{ji}/n_{+i}) = n_{ij}n_{+i}/n_{ji}n_{i+}$$
$$V_o = (n_{ji}/n_{j+})/(n_{ij}/n_{+j}) = n_{ji}n_{+j}/n_{ij}n_{j+}$$
$$X_g = (n_{ij}/n_{i+})/(n_{ji}/n_{j+}) = n_{ij}n_{j+}/n_{ji}n_{i+}$$
$$X_r = (n_{ij}/n_{+j})/(n_{ji}/n_{+i}) = n_{ij}n_{+i}/n_{ji}n_{+j}$$

Choices of the directions of these ratios (i.e., of which composite ratio is to be numerator and which denominator) are of course arbitrary. The measures here have been carefully defined to facilitate computation using matrix methods. Note also that unlike the seemingly endless number of measures that might be advanced for exchange system phenomena, these six measures are motivated by a priori theoretical considerations. Indeed, the two hypotheses (H1 and H2) linking relative interests and power or dominance in exchange relations can be reexpressed in terms of predictions concerning the six measures. If actors are ordered so that A_i dominates A_j for all i and j ($i \neq j$), then:

(H1') In any system of SIG exchange,

$$H_f < 1 \qquad V_o < 1$$
$$H_t > 1 \qquad X_r > 1$$
$$V_s > 1$$

(H2') In any system of SIR exchange,

$$H_f < 1 \qquad V_o > 1$$
$$H_t > 1 \qquad X_g < 1$$
$$V_s < 1$$

If the underlying theoretical hypotheses prove correct, the six new measures can be used to assess the direction and degree of dominance among all pairs of actors in any exchange system. Once again, these definitions and hypotheses are likely to be only approximately realized in actual systems of exchange. The new measures are useful, however, because they are motivated by a priori

theoretical considerations reconciling three separate dimensions of any exchange system: whether exchanges are SIG or SIR, the relative interests of actors in exchanges, and the directions of power or dominance among actors, i.e., the status hierarchy of the system.

Two More Traditional Measures

It remains to test Hypotheses H1' and H2' with empirical data on actual exchange systems. This is the task of the next section. First, however, it is useful to introduce two more traditional measures of exchange dominance, so that values for the six new measures can be compared to more familiar quantities.

The simplest and perhaps most commonly used measure of dominance between two actors involves a direct comparison of the commodities exchanged, i.e., of n_{ij} and n_{ji}. For two nations engaged in commercial exchange, for example, A_i is said to dominate A_j whenever $n_{ij} > n_{ji}$, i.e., whenever A_i has an excess of exports to A_j over imports from A_j. Such a relationship is commonly known as a "favorable balance of trade" with respect to A_j.

In general, for any pair of actors and a single exchange relationship, if the dominant actor is represented as A_i and the subordinate one as A_j, the notion of "favorable balance of trade" implies two inequalities:

(I7a) $n_{ij} > n_{ji}$ (for SIG relations)
(I7b) $n_{ij} < n_{ji}$ (for SIR relations)

An obvious measure (call it U) for the degree of direct dominance of one actor over another, given the convenience of ratios for comparisons, is simply

$$U = n_{ij}/n_{ji} \qquad (n_{ji} \neq 0)$$

To extend the example of commercial exchange among nations, the aggregate dominance of nation A_i over all other nations in the system is commonly measured by n_{i+}/n_{+i}. This ratio represents the "aggregate balance of trade," a familiar measure of a nation's success in international commerce. Because commodity exchange is a SIG relation, a surplus of exports (n_{i+}) over imports (n_{+i}) is generally described as a "favorable" balance of trade. Conversely, a trade deficit (with $n_{i+}/n_{+i} < 1$) is considered "unfavorable."

These ideas of favorable and unfavorable ratios of marginals can be generalized to all exchange systems as a measure of aggregate dominance, the degree of an actor's dominance of the entire system, i.e., of all other actors taken together. Aggregate dominance, in turn, can be extended to the level of direct individual exchange. For any pair of actors and a single exchange relationship, if the dominant actor is represented as A_i and the subordinate one as A_j, relative aggregate dominance implies the inequality:

(I8a) $n_{i+}/n_{+i} > n_{ji}/n_{+j}$ (for SIG relations)
(I8b) $n_{i+}/n_{+i} < n_{j+}/n_{+j}$ (for SIR relations)

An obvious measure of relative aggregate dominance (call it A), again using ratios as a convenient means of comparison, is simply

$$A = (n_{i+}/n_{+i})/(n_{j+}/n_{+j}) = n_{i+}n_{+j}/n_{j+}n_{+i}$$

Measures U and A can be used to express the concepts of "favorable balance of trade" and "relative favorable balance of trade" as hypotheses. If actors are ordered so that A_i dominates A_j for all i and j ($i \neq j$), then:

(H3) In any system of SIG exchange,

$$U, A > 1$$

(H4) In any system of SIR exchange,

$$U, A < 1$$

Thus if these hypotheses prove correct, the two more traditional measures U and A can also be used to assess the direction and degree of dominance among all pairs of actors in any exchange system.

Test Using 16 Empirical Exchange Matrices

In order to test Hypotheses H1' and H2', 16 empirical exchange matrices were gathered or constructed from published sources. These matrices, for exchanges ranging from dominance behavior among frogs and rats to direct interactions among major world powers, are summarized in Table 1. Equal numbers of SIG and SIR systems are represented; the numbers of actors range from five to 15.

Context-dependent criteria, independent of the eight measures associated with exchange dominance were used to rank actors in the 16 matrices; these criteria are listed in Table 1. As shown, five of the matrices (ID Nos. 1, 3, 4, 12 and 13) were ranked by criteria proposed by cited authors, four matrices (Nos. 7, 8, 9 and 11) were ranked by criteria at least partly independent of the exchange system, and seven matrices (Nos. 2, 5, 6, 10, 14, 15 and 16) were ranked by various criteria of exchange itself. In all cases, criteria were chosen to capture status independent of least-interest considerations, with actors of ambiguous status either dropped or not included in the matrix. Six of the matrices were used as published, five were modified by dropping one or more actors and five were newly compiled from independent data.

Limited space here does not permit a full report of the tests of H1' and H2' using the 16 exchange matrices, with the status rankings as dependent variables. A fuller account of these tests may be found in Beniger (1981). A summary is included here in Table 2, which reports the relative accuracy of predictions of status direction for each of the eight measures associated with exchange dominance. As Table 2 shows, in 100 of 112 cases (89.3 percent) relative status was correctly predicted for a majority of actor-pairs; of these 100 cases, 61 (54.7 percent) had numbers of correct predictions that were statistically significant at the .05 level. In only eight cases (7.1 percent) were only a minority of pairs correctly predicted by H1' and H2'. The success of prediction does not vary much between SIG and SIR exchanges, nor among measures, with the exception that V_S and especially V_O tend to be poorer predictors. At least X_r (for SIG exchanges) and X_g (for SIR exchanges) may be better predictors than the more traditional measures U and A.

In summary, this analysis suggests that three separate dimensions of exchange--whether it is SIG or SIR, the relative interests of actors, and the directions of power or dominance--can be reconciled in a wide range of different specialties. The idea that status and power depend on the relative interests of parties, aggregate groupings and

TABLE 1.

16 EXCHANGE MATRICES, WITH CONTEXT-DEPENDENT CRITERIA USED TO RANK ACTORS (DEPENDENT VARIABLE)

ID No.	Actors	n	Commodity Exchanged	Status in Giving/ Receiving	Source of Data	Ranking Criteria
1	Frogs	12	Nips	SIG	Haubrich 1961	Rankings are those assigned frogs by Haubrich (1961) according to nips given.
2	Aggregated Rankings, Caged Rats	6	Dominance Behavior	SIG	Compiled from Grant and Chance 1958, pp. 186-87	For each cage, rats ranked according to number of others dominated, with ties counted as one-half. Aggregate ties decided by direction of dominance in tied pair. Where this is also a tie, larger ratio of total wins to losses ranked higher.
3	Members, Problem-Solving Group	5	Directed Communication	SIR	Bales 1950, p. 170	Following Bales et al (1951), individuals are ranked in order of communication both given and received.
4	Aggregated Rankings, Human Groups	6	Directed Communication	SIR	Bales et al 1951, p. 463	Aggregate rankings are those assigned by Bales et al for the matrix as published (1951, p. 463); these ranks are ordered by communication both given and received.
5	Members, Ninth-Grade Class	15	Choices for Collaboration	SIR	Bock and Husain 1952	Students ranked according to composite rank of choices received, with the single tie decided by direct comparison of order of reciprocal selection.
6	Blocs in a UN Committee	6	Directed Interaction	SIG	Galtung 1975, p. 106	Blocs ranked by number of others dominated (defined as interactions given exceeding received), with ties counted as one-half. Aggregate ties decided by direction of dominance in tied pair.
7	SES Classes in an Elementary School	5	Friendship Choices	SIR	Dahlke 1953, p. 333	SES classes ordered (professional, managerial, skilled, semi-skilled and clerical) according to composite ranking on seven criteria, including three based on choice status of children as published by Dahlke (1953, Table 1, p. 329).
8	Law Reviews	6	Citations	SIR	Compiled from Garfield 1979b, vol. 6	Journals selected to have the same ranking on four independent criteria (Garfield 1979b): total citations in 1978 to all years (column 1), citations in 1978 to 1976 and 1977 (column 4), impact factor (column 8) and immediacy index (column 11).
9	Science Journals	5	Citations	SIR	Compiled from Garfield 1979a, vol. 13	Same as in #8 above, except data from Garfield (1979a); columns same as in #8.
10	U.S. Coastal Ports	7	Coastal Shipping	SIG	Adapted from Pred 1973, pp. 116, 120 and 125	Port cities selected to have the same ranking on both departures and arrivals.
11	Cities in Washington State	6	Long-Distance Telephone Calls	SIR	Adapted from Nystuen and Dacey 1968, p. 415	Cities selected to have the same ranking on three independent criteria: 1960 population and the total number of long-distance calls both sent and received.
12	Sectors, Israeli Economy	7	Economic Commodities	SIG	Adapted from Leontief 1966, pp. 54-57	Sectors ranked from quaternary (services, then trade) to primary (mining) following Bell (1976, p. 117).
13	Sectors, World Model	7	Economic Commodites	SIG	Adapted from Stone 1977, pp. 62-63	Same as #12 above, with sectors ranked from quaternary (services) to primary (agriculture).
14	Nations, North and Central America	9	Imports-Exports	SIG	Compiled from IMF 1978	Countries selected to maximize composite rank distances on five criteria: total imports, total exports, ratio exports/imports, trade balance and number of countries for which balance favorable (IMF 1978).
15	Nations, Industrial Europe	8	Imports-Exports	SIG	Compiled from IMF 1978	Same as #14 above.
16	Major World Powers	7	Directed Interaction	SIR	Adapted from Azar and Sloan 1975, pp. 532-37	Same as #14 above, except that imports and exports are interactions given and received.

TABLE 2.

Relative Accuracy of Predictions of Status Direction in the 16 Matrices for Each of the Eight Measures Associated with Exchange Dominance

Measure	Majority of Pairs Correctly Predicted: Significant .05	Majority of Pairs Correctly Predicted: Not Significant	Half of Pairs Correctly Predicted	Minority of Pairs Correctly Predicted
STATUS-IN-GIVING (SIG) EXCHANGES				
U	5	3		
A	5	2	1	
H_f	4	3		1
H_t	4	2		2
V_s	4	4		
V_o	2	6		
X_r	6	2		
	30 (53.6%)	22 (39.3)	1 (1.8)	3 (5.4)
STATUS-IN-RECEIVING (SIR) EXCHANGES				
U	5	3		
A	5	3		
H_f	7			1
H_t	5	2		1
V_s	3	5		
V_o		3	2	3
X_g	6	1	1	
	31 (55.4%)	17 (30.4)	3 (5.4)	5 (8.9)
ALL MATRICES	61 (54.5%)	39 (34.8)	4 (3.6)	8 (7.1)

even abstract sectors in an exchange relationship apparently extends from small to large systems, and to those involving nonhuman as well as collective actors. The six quantitative measures developed here, measures which are defined and easily applied for any input-output or exchange matrix, merit testing in a large number and variety of areas if the venerable principle of least interest is to be fully exploited in a fuller understanding of stratification in exchange relations.

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