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Source: *American Journal of Sociology*, Vol. 84, No. 5 (Mar., 1979), pp. 1096-1126
Published by: The University of Chicago Press
Stable URL: https://www.jstor.org/stable/2778218
Accessed: 24-11-2019 20:48 UTC

Structural Position in the World System and Economic Growth, 1955–1970: A Multiple-Network Analysis of Transnational Interactions[1]

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This paper addresses world-system/dependency theories of differential economic growth among nations. We grant that such perspectives have considerable analytic potential but have serious reservations concerning their current empirical status. Our criticisms focus particularly on the absence of evidence on the theoretically specified structural positions (core, semiperiphery, periphery) in the world system and the dynamic relations among them. After indicating why extant quantitative studies that claim to represent "position" are inadequate, we propose that blockmodel analyses of social structure through multiple networks address world-system formulations far more appropriately. We present a blockmodel of the world system circa 1965 that is based on four types of international networks: trade flows, military interventions, diplomatic relations, and conjoint treaty memberships. While we invite replications with additional network data, this blockmodel provides strong evidence for a core-semiperiphery-periphery structure. We then report regression analyses of the effects of these structural positions on nations' economic growth (change in GNP per capita) from 1955 to 1970. Net of other plausible determinants, these effects are large in magnitude and entirely consistent with world-system/dependency theories. Further analyses reinforce the interpretation of these findings as the structural, accumulative advantage of location in the core over that in the periphery. Substantively, our results suggest that exogenetic theories of economic growth are even more powerful than previous analyses have indicated. Moreover, they demonstrate the natural wedding of a conceptual framework (the world system) with an empirically grounded theory of social structure (blockmodel analysis), which has applicability much beyond issues of economic growth.

INTRODUCTION

Differential economic growth among countries constitutes both a central dimension of international stratification and an important determinant of other characteristics (transnational power, individuals' life chances) that

[1] Financial support for this research was provided by the Center for International Policy Studies, Indiana University, under an institutional grant from the Ford Foundation. We

are delimited by geopolitical boundaries (e.g., Horowitz 1972). The arena of economic growth has now become a widely used testing ground for alternative theoretical approaches that also frequently address broader issues concerning processes of modernization, societal development, etc. (Portes 1976). Recent perspectives emphasizing the "world economy" as the appropriate level of inquiry and the dynamic, exploitative linkages among its constituent political units as a substantive corollary appear to have considerable analytic power (see Wallerstein 1974; Chirot 1977; Portes 1976; Chase-Dunn 1975; Rubinson 1976). These world-system/dependency theories therefore serve as a sharp counterpoint to the ontogenetic assumptions of more conventional developmental treatments (Rostow 1960; Inkeles and Smith 1974; see Portes [1976] and Chase-Dunn [1975] for cogent reviews of both literatures).[2]

While several analyses attempt to adjudicate hypotheses derived from the alternative theoretical models of economic growth (e.g., Chase-Dunn 1975; Delacroix and Ragin 1978), that is not our purpose here. In fact, we treat developmental theories largely as straw men. That is not because they lack any merits. Available arguments and evidence (Portes 1976; Delacroix and Ragin 1978) suggest that national development and economic growth in particular reflect a complex interaction of inter- *and* intranational factors (especially state strategies and educational institutions). Nevertheless, we are in accord with Portes's (1976, p. 80) assessment that "newer perspectives [world-system/dependency approaches] . . . represent a potentially more useful guide for future investigation." An exogenetic vantage point can easily incorporate domestic factors (world-system approaches consider this to be mandatory), while the converse would be conceptually more difficult.

Consequently, we take world-system/dependency analysis as our point of substantive departure in this paper. But the main premise underlying our treatment is that, despite its analytic potential, the empirical status of this

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are also grateful to Mark Hayward and Pamela Hecht for software development and consulting, to Steven Brams for making available his diplomatic exchange data, and to Jacques Delacroix for providing some of the cross-national measures used here. For helpful comments (not all of which we were able or willing to incorporate) we wish to thank Howard Aldrich, Christopher Chase-Dunn, Jacques Delacroix, Lawrence Hazelrigg, Michael Hout, Paula Hudis, Larry Isaac, Peter Oberto, Harvey Starr, and the anonymous referees. The authors are responsible for all views expressed here.

[2] We are well aware that longstanding theories of imperialism (e.g., Lenin's) underlie world-system/dependency analyses (see Portes 1976; Chase-Dunn 1975; Chirot 1977). However, recent variants of such arguments (Wallerstein 1974; Chirot 1977) are more directly central to our current aims. We also recognize that world-system and dependency theories are not necessarily identical. The latter arguably refer more strictly to certain structural aspects of Latin American nations specified by a group of radical economists from those areas (see McDaniel [1976–77] for a review). These distinctions are again unimportant for present purposes, and other treatments (e.g., Delacroix 1977) consider world-system/dependency analysis as a single line of argument.

formulation remains open to serious challenge. We shall develop in detail criticisms concerning the absence of clear operational criteria for identifying the location of nations in the world system, and the corresponding lack of evidence that exploitative structural relations in that system operate as theoretically specified. We also discuss related problems which characterize recent quantitative studies of the effects of dependency on economic growth in the post–World War II period. We argue that, despite explicit claims to the contrary, these studies do not adequately measure the concepts of "position" and "control" in the world system and do not fully test the relevant hypotheses. We propose instead that the blockmodel analyses developed by White and his associates (e.g., White, Boorman, and Breiger 1976) more closely capture these structural aspects of the world economy. The bulk of the paper reports two separate but related investigations that bear on world-system theory. The first is a multiple-network (blockmodel) treatment of transnational flows in the 1960s. This analysis delineates structure in the world system and various positions within it. The second addresses the specific issue of the effect of structural position in the system on nations' economic growth from 1955 to 1970.[3] Although these analyses are empirically independent, they converge on similar substantive conclusions concerning the operation of the world economy in the postwar period. We focus primarily on economic growth but also suggest the utility of our line of inquiry for other hypotheses suggested by exogenetic perspectives on domestic processes.

EXPLAINING DIFFERENTIAL ECONOMIC GROWTH AMONG NATIONS

Several cogent expositions of the alternative theoretical statements have recently appeared (e.g., Chase-Dunn 1975; Portes 1976; Chirot 1977; Delacroix and Ragin 1978). Therefore, we briefly summarize the relevant substantive themes and then focus more intensively on the empirical work that is of primary interest here.

Many developmental explanations treat economic growth largely as a

[3] In order to avoid terminological confusion at the outset: *Wealth* refers to the average economic welfare of a population (which we operationalize as GNP per capita) at a single point in time. *Economic growth* designates only changes over time in wealth. We use the term *economic development* (only in a few necessary instances) in its conventional, loose sense of a complex of institutional changes that typically facilitate sustained economic growth. Economic growth and economic development are not identical; the former can occur without the latter (e.g., the Spanish bullion trade). *Differential economic growth* simply identifies variations among nations on this criterion. *Position* (in its verbal world-system and formal blockmodel usages) and economic growth are separate though plausibly empirically related dimensions of international stratification. Position is a discrete variable whose values (e.g., core) are understood in relation to other values (e.g., periphery). Economic growth, wealth, etc. are continuous variables whose values (e.g., $500 per capita) have independent meaning. Perhaps the best analogue is the distinction between class and income (see Wright and Perrone 1977).

process endogenous to nations and as an ordered sequence in which currently poor countries can repeat the strategies and experiences of wealthy nations. For example, neoclassical economic formulations (e.g., Rostow 1960) stress the importance of internal mechanisms that reduce consumption and increase savings, investment, and capital formation.[4] That is not to claim that such processes operate entirely independent of exogenous influences. Economic development in poor nations is enhanced by importation of investments and by more direct forms of foreign aid (both in money and technical knowledge). What has loosely been termed "modernization theory" in sociology makes roughly similar assumptions, although its substantive focus is more on shifts in attitudes, aspirations, and values engendered by contact with modern institutions (Inkeles and Smith 1974).[5]

Developmental explanations have been criticized on a variety of general theoretical (Bendix 1967; Portes 1976) and specific empirical grounds (e.g., Landes 1969, pp. 77–80).[6] More important in generating alternative formulations, however, is simply the prima facie evidence: Despite decades (in some cases, centuries) of cultural contact, foreign investment, etc., there has been relatively little change in international economic stratification. With few exceptions, poverty is endemic in the Third World while rich nations continue to increment their wealth more rapidly (Horowitz 1972; Portes 1976, pp. 56–59).[7]

World-system/dependency theories (e.g., Wallerstein 1974; Chirot 1977; Galtung 1971) attempt to explain those phenomena and are characterized by the following major themes. First, the world system is the appropriate point of conceptual orientation. The behavior and experiences of its constituent geopolitical units depend fundamentally on features of the system

[4] According to Rostow, an investment rate of roughly 10%–12% of net national product is required for the "takeoff" into "self-sustained" economic growth. He also develops a parallel but secondary model of intersectoral linkages, which we ignore here.

[5] There are differences between evolutionary theories such as Rostow's and theories emphasizing development of values (see Portes 1976). We combine them here because of similar assumptions concerning economic growth as a largely endogenous process and the positive effects of international contact that does occur. We also acknowledge that some theories subsumed within the developmental approach (Weber on religious values and capitalism is probably most widely known) do not make all the assumptions we have attributed to this line of argument. Although our characterization of developmental theories is therefore a restricted one, it pertains to most arguments that inform current analyses of economic growth.

[6] For example, the general criticisms typically involve arguments that structural changes over time (e.g., in the scale of enterprise) render it impossible for poor nations to repeat the historical experience of rich ones. Among a variety of empirical points, Landes cites evidence that early capital formation in Britain and France most likely never approached Rostow's "takeoff" level.

[7] Given strict assumptions of unilinear processes of economic growth, there may be no reason to expect shifts in countries' relative wealth. However, the positive effects of international economic and value transmission predicted by most current developmental approaches imply that some reordering should occur as a function of those factors.

as a whole (e.g., a capitalist world economy) which reflect transnational linkages (Wallerstein 1974). Second, the modern world system is composed of three structural positions: core, semiperiphery, and periphery (see Wallerstein [1974, pp. 301–2, 349–50] and Chirot [1977, p. 13] for defining characteristics of each).[8] Third, these labels are not merely descriptive. They indicate an international division of labor in which the core is linked to the periphery (and semiperiphery) in dynamic and exploitative ways. Chase-Dunn (1975), Delacroix (1977), and Portes (1976) summarize several mechanisms that in principle reinforce structural barriers against economic growth in peripheral countries. For example, net resource flows are lost to the core as returns on investments. Additionally, peripheral economies are poorly integrated because of production that is both externally oriented and specialized in raw-material commodities. Other arguments deal not with economic development per se, but with increased inequality within nations as a function of national elite control of the export economy and alliances with core powers (Chase-Dunn 1975; Rubinson 1976). Finally, this world system is currently a capitalist world economy (Chirot 1977) and has been for several centuries (Wallerstein 1974). While the bases of this conclusion are obvious from the foregoing discussion, it is useful to recognize (as Chirot and Wallerstein do) that alternative forms of the world system are possible.

Empirical evidence concerning the development of the modern world system is fragmented and descriptive because long-run historical data are typically unavailable (Wallerstein 1974, p. 8). However, several efforts address the effects of indicators of international dependency on economic growth in the post–World War II period. More complete data for this recent period permit using rigorous analytic methods to test hypotheses derived from world-system/dependency theory. For example, Chase-Dunn (1975) uses a sample of poor countries and a panel regression model of change in GNP per capita from 1950 to 1970 to examine neoclassical and dependency models of the impact of foreign investment on economic growth and inequality. His most important finding is that the influence of domestic investment (capital formation) is positive and that of foreign investment negative. This result supports the dependency argument that it is not capital per se but the institutional locus of capital that is central. Chase-Dunn also finds expected effects of dependency measures on inequality within nations, as does Rubinson (1976) in a related but more elaborate analysis.[9] Although neither study

[8] Chirot (1974, pp. 179–81) maintains that the semiperiphery/periphery distinction may have less validity and utility in the post–World War II period than previously, because almost all noncore nations are now semiperipheral. While we recognize that possibility, we retain the conventional definitions of core, semiperiphery, and periphery pending any changes necessitated by our analysis of structure and position in the world system.

[9] We are not substantively concerned with intranational inequality in this paper. However, these studies are relevant here insofar as their independent variables attempt to capture dimensions of the world economy.

can directly represent the hypothesized intervening mechanisms, they provide clear empirical support for world-system/dependency arguments in the postwar period.

This is not to claim that all empirical results in these studies are consistent with world-system hypotheses. Delacroix (1977) reports that extent of specialization in export of raw materials (a measure that addresses world-system arguments of Galtung and Wallerstein) has no effect, net of initial wealth and secondary school enrollment, on economic growth. Given the poor performance of the world-system variable and the important effects of the endogenous measures, he properly cautions against dismissing ontogenetic processes from models of development. In a similar vein, Delacroix and Ragin (1978) analyze the influence of one form of cultural imperialism (film imports). They find that Westernized information flows have a negative effect on economic growth, but one that can be deflected by endogenous factors (particularly "mobilizing regimes"). Substantively, their results suggest that economic growth of nations is a joint function of exogenetic and ontogenetic variables.

THE EMPIRICAL STATUS OF WORLD-SYSTEM/DEPENDENCY THEORY: A CRITICAL APPRAISAL

We view the studies cited above as extremely important in establishing, though sometimes with qualifications, the merits of world-system/dependency explanations of econmic growth during the past few decades. Nevertheless, we propose three related criticisms concerning the empirical status and quantitative treatments of these arguments, although all points do not necessarily apply to each study.

1. There are no operational criteria for classifying countries according to core, semiperipheral, or peripheral location in the system or for assessing temporal shifts in nations' positions. It is obvious that multiple dimensions underlie the concept of position and that such positions are correlated with but by no means identical to economic development (Chirot 1977; Galtung 1971; Wallerstein 1974). However, we find no precise rules of classification, a problem that is perhaps best highlighted by Chirot's (1977) admitted difficulty in specifying where Communist bloc nations are structurally located in the postwar period. Moreover, there is no strong indication that a three-tiered model (core, semiperiphery, periphery) characterizes the operation of the system as a whole. Put another way, empirical treatments have no clear way in which to validate either the specified number of positions or the structural relations among them. These issues would be less problematic if the three-tiered model were simply a heuristic device. However, at least some world-system arguments indicate that the core-semiperiphery-periph-

ery distinctions are structurally necessary in a capitalist world economy (see Wallerstein 1974, p. 349).

2. Previous regression analyses of dependency hypotheses typically require a choice between two less than optimal research strategies. Some studies limit examination to samples of poor countries (Chase-Dunn 1975; Delacroix and Ragin 1978) because they want to address the effects of economic or cultural imperialism on economic growth. But if core and periphery are dynamically linked in theory, we would argue that empirical treatments should represent not only the "costs" of location in the periphery but also the "gains" of core position. The practical difficulty of doing so is that the substantive meaning of standard dependency measures plausibly differs by location in the world system. As Portes (1976; see also Chirot 1977) points out, countries such as Canada are highly investment dependent but they are also wealthy. The alternative choice—including all nations for which data are available in a single analysis—therefore often (but not always; we would exempt Delacroix [1977] from this criticism) necessitates dubious arguments. For example, Rubinson (1976, p. 654) maintains that greater dollar value of a nation's exports and imports (as a percentage of gross domestic product) "puts the state and its economic actors in a position of less power and control in the world-economy." That argument may hold for poor countries, but we do not find it compelling for nations such as the United States and (especially) Japan, whose core location appears to rest in part on ability to increase their trade in the world market.

3. Despite explicit claims that indicators such as investment dependence, trade concentration, etc. measure "position" or "control" in the world system (Rubinson 1976; Delacroix and Ragin 1978), that is not the case. These are continuous variables that stratify nations on given criteria, and no doubt partially reflect position.[10] But they do not represent such position any more than an individual's income or education measures his or her (discrete) class position (Wright and Perrone 1977; see also White and Breiger 1975, p. 68). Moreover, standard dependency measures do not fully specify the institutional locus of transnational flows. For example, the value of investment dependence of a given (say, peripheral) nation does indicate the degree of foreign investment in that country. However, it does not identify whether transnational capital flows originate entirely, partly, or negligibly from core versus other groups of nations. The differential effect of those origins is theoretically plausible and also promises to have considerable policy relevance. Finally, we want to stress that these arguments do not maintain that the use of continuous dependency indicators in models of the

[10] In making this argument, we follow theoretical proponents of world-system approaches (Wallerstein 1974; Chirot 1977; Galtung 1971) in conceptualizing position as a discrete location in the system and control as one possible form of structural relations among positions or actors.

determinants of economic growth is inappropriate. Trade concentration, investment dependence, etc. do address dimensions of international interaction which are at least partially independent of position as we conceptualize it. There is no necessary reason why these indicators should be less important than position or the origin-destination patterns of transactions in explaining countries' differential economic growth.[11] In fact, it is quite possible that both the magnitudes of international interactions and the positions of actors involved in them must be incorporated into analyses of economic growth.

WORLD-SYSTEM THEORY AND BLOCKMODEL APPROACHES

Taken together, the foregoing criticisms indicate a pressing need for empirical approaches that address world-system theories more closely via identification of structure and position. We have indicated that the substantive themes of the world-system/dependency perspective encompass (*a*) specification of discrete structural positions (core, etc.) in a single system; (*b*) identification of the units in each position and temporal shifts in those locations (e.g., Wallerstein's discussion of Spain's movement from core to semiperiphery); (*c*) structural relations among positions (exploitative links between core and periphery); and (*d*) the consequences of one position versus another for individual nations (e.g., accumulative advantage of core location vs. endemic poverty in the periphery). As White et al. (1976) point out, the general theme that actors' behaviors are influenced by their positions in a social structure is a venerable one and has generated various methods of representing structure and position empirically. White et al. also demonstrate several advantages of their blockmodel treatment over previous approaches to identifying social structure (see also Arabie, Boorman, and Levitt 1978). One reason why we prefer blockmodel analysis relative to alternative procedures is that it constitutes more than simply a technique (though we emphasize its technical aspects and applications here). In providing concrete statements concerning "structure," "position," "role," and relations among these constructs, blockmodel analysis contains the elements for a formal (though still very abstract) theory of social structure.

We consider that the general logic, procedures, and substantive utility of blockmodels are sufficiently well established that they need no extended discussion here (see also Breiger, Boorman, and Arabie 1975; White and

[11] As earlier indicated, there are two separate issues to be addressed: (1) a general inquiry into the form and operation of world-system structure in the post–World War II period, in which position is a necessary component; and (2) an analysis of a specific outcome (differential economic growth), in which position is merely expected on theoretical grounds to be an important determinant. Conventional dependency indicators are inappropriate only for the first of these two investigations.

Breiger 1975; Boorman and White 1976; Breiger 1976; Mullins et al. 1977). However, three central features warrant emphasis. First, the social structure of a population (arbitrarily defined) is specified by the multiple networks of interaction among members of that population. Second, positions ("blocks") in the structure are aggregates of actors who manifest similar patterns of interaction across all relevant networks. This second feature begins to differentiate blockmodel analysis from conventional (e.g., sociometric) approaches (White et al. 1976, pp. 736–37). Finally, the presence or absence of "bonds" (links on each type of network relation) among positions facilitates inferences concerning the form and operation of the social structure.[12]

These features of blockmodel approaches and the substantive questions posed by world-system/dependency theories are clearly complementary. Such methods plausibly resolve, at least in part, the problems discussed above with respect to empirical treatments of world-system structure. In fact, while blockmodel analysis has been largely applied to networks of individual actors, it has some special advantages concerning international interactions.[13] Such advantages are (1) the relative durability and nonreactivity of recorded information on interactions (e.g., compared with questionnaire data), and (2) the inclusion of almost all (depending on data availability) actors in the population of interest.

CONSTRUCTING A BLOCKMODEL OF THE WORLD SYSTEM: DATA AND SUBSTANTIVE CONSIDERATIONS

Nations are the constituent units or members of the "population" in our analysis. Beyond the practical consideration that network data for geopolitical units are typically available on an international basis, it is also the case that national boundaries sharply delimit the relevant interactions discussed below. Moreover, it is hardly controversial to specify nation states as the most important actors in the modern world system (Wallerstein 1974;

[12] Further aggregation and decomposition of these networks of bonds (analysis of "role structures" [see Boorman and White 1976]) generate higher-order inferences concerning the operation of social systems. We do not pursue these additional analyses because they (1) introduce questions concerning roles at a level of complexity not yet substantively addressed by world-system theory, and (2) are especially suited for comparing structures across space and/or time. Although we raise possibilities for longitudinal studies of the world system in our conclusions, the network data employed here pertain to system structure at a single time period.

[13] This is not to claim the absence of other network approaches to international flows. The basic substantive ideas that underlie blockmodels of the world system are stated in Haas (1964, p. 53) and Brams (1966, pp. 880–82). And in an innovative analysis Brams (1965, 1966) applies a hierarchical decomposition technique to transnational flows. However, his approach is entirely "sociometric" in its search for "cliques," neglect of isolate nations, and separate analysis of each network. It therefore differs from blockmodel treatments in several important ways (White et al. 1976, pp. 736–37).

Chirot 1977). We operationally define the structure of that system according to four types of international networks: trade flows, military interventions, diplomatic exchanges, and conjoint treaty memberships. We first present the organization, sources, and coding procedures used for each type of network data and then discuss the general substantive considerations and limitations that pertain to our operationalization.

The four networks are represented by separate $N \times N$ matrices of countries. The matrices are all coded in binary form as follows. Each "claim" or "instance of a tie from one member of a population to another" (White et al. 1976, p. 768) is designated "1" in the appropriate cell of the matrix, and the absence of a claim coded "0." For the present analysis, we limited collection of data to a period circa 1965 in order to ensure a large number of cases while retaining the diplomatic relations information (which is available at only one point in time). Our blockmodel analyses are based on 118 nations for which data were available for all networks.[14] Where possible, our coding procedures also utilized a short (and arbitrarily selected) series of years circa 1965 in an attempt to minimize idiosyncratic characteristics of a single year.[15] Details concerning construction of each matrix follow.

Trade.—Each country's yearly dollar value of exports to every other country is reported in a serial publication of the International Monetary Fund and the International Bank for Reconstruction and Development (n.d.). Import data are also published, though they virtually mirror the export figures (there are minor accounting variations). Our criterion for the presence of a "tie" or "claim" is a nonzero value of exports from country A to country B in at least two of the five years from 1963 to 1967 inclusive.[16] We also note that the data contain an underreporting bias. The figures for all "Soviet areas" (Albania, Bulgaria, Cuba, China, East Germany, Czechoslovakia, Hungary, Mongolian Republic, North Korea, North Vietnam, Poland, Rumania, and the Soviet Union) and 21 other nations in the sample are at least partially reconstructed from export and import values of reporting countries. We coded trade ties as present among Soviet area countries,

[14] There is one minor exception: the trade data only were published for Belgium and Luxembourg combined. We attributed the reported flows to each country, which probably slightly overestimates the breadth of their trade networks. However, we considered this procedure preferable to dropping both countries from the analysis.

[15] Single-year information would be particularly problematic with the interventions data. For example, given extreme hostility between countries A and B, whether A intervenes into B in 1964 or 1965 (as well as lag time for B's possible retaliation) appears highly susceptible to idiosyncratic factors in the short run.

[16] The smallest nonzero value reported is $100,000. We use the criterion of at least two years to eliminate one-time-only transactions, though very few such instances are actually found in the data. We originally coded the data in several categories, but the vast bulk of trade flows falls into the two extreme categories: no link whatsoever or else large amounts of exports in each year. Therefore, we suspect that the actual cutting point used makes little empirical difference.

which appeared more valid than assuming the absence of all such ties. Of the remaining 21, only 11 nations had reconstructed data for more than three of the five years on which our coding is based. Therefore, links among these 11 nations and between any of them and the 13 Soviet areas could not have been reported in the data source. We doubt that this bias is drastic because most of the 11 countries with entirely reconstructed data had very few trade links even with reporting nations.

Interventions.—The Taylor-Hudson (1972) World Handbook II Project coded every military intervention (land, air, or sea incursion of one nation into the territory of another) reported in the *New York Times Index* from 1948 through 1967. We obtained a copy of the individual intervention events data file (described in Inter-University Consortium for Political Research [1971, sec. IV]). Our criterion for a tie is at least one intervention of country A into country B during any of the years from 1960 through 1967 inclusive. We suspect that events of the magnitude of military interventions are nearly fully reported (see Snyder and Kelly 1977). Pearson's (1974) attempt to validate portions of these data suggests that is the case, although he finds one intervention omitted in each of the two years he surveys.

Diplomats.—Steven Brams provided an origin-destination matrix of the number of career-level diplomats in either 1963 or 1964 (exact date varies by country). These data were gathered from lists published by host nations, supplemented with questionnaire information, and are elsewhere described in more detail (Brams 1965, 1966). Our criterion for a tie is at least one diplomat sent from country A to the national capital of country B.

Treaties.—Small and Singer (1969, pp. 264–70) list all international treaties in effect during the years 1946 through 1965, with information on dates of inception and termination (if any) and signatory countries.[17] From their tabular data, we coded the presence of a tie as any conjoint partnership in a treaty by countries A and B during any portion of the years 1960 to 1965 inclusive.

While these four networks clearly do not exhaust the forms of international contact, each of them captures a substantively important dimension of transnational interaction. The centrality of economic and military relations (trade and interventions) in almost all approaches to international system structure is obvious (e.g., the work surveyed in Christopherson [1976]). More specifically, theories of imperialism typically emphasize the domination of the world economy by core powers (though they are not always so designated) and the use or threat of superior armed force as the means of ensuring economic domination. We also consider that diplomatic

[17] These treaties are limited to formal military defense agreements of three types: defense pacts, nonaggression pacts, and ententes (see Small and Singer [1969] for definitions of each, as well as coding criteria and original sources). We used all three types (which do not include general agreements of friendship) in coding our treaty matrix.

exchanges constitute a salient form of information flow in the world system. For sending nations, diplomatic missions provide regular and ostensibly reliable information concerning local economic opportunities, political conditions, etc. in the host country.[18] Such missions may also facilitate trade agreements and sometimes serve as a base for attempts to manipulate local conditions. We attach much less significance to the receiving of diplomats. Whatever information is transmitted about the sending country is both geographically removed from the occurrence of events and "filtered" through representatives of that country. As such, we suspect that such information is actually and perceptually less useful to host nations. Finally, we included the treaty data on the rationale that they would address networks of defense commitments or reflect attempts by some nations (e.g., core powers) to legitimate potential military intervention in others (peripheral countries).

We recognize that operationalizing our approach to structure in the world system via these four networks may be controversial. For example, why employ the diplomat and treaty networks, given the clear precedence of economic and military relations in some influential treatments (e.g., Wallerstein 1974) of world-system structure? Why not substitute types of commodities exchanged, which plausibly capture better the core-periphery division of labor, for the trade network? Our decisions on these issues were based on several conceptual and practical considerations. The most important of these concerns the relationship between blockmodel analysis and world-system theory. Blockmodel analysis is a formal network approach that generalizes across populations and particular substantive issues. In principle, investigators would employ all networks of interaction among members of a population in such analyses, particularly since no given network necessarily has any precedence over any other in the blockmodel procedures. In practice, of course, some selection of interactions is required because of resource and data availability constraints. Therefore, investigators attempt to represent "important" dimensions insofar as they (1) provide the most independent information, and (2) facilitate interpretation of the network patterns of interaction among positions in the blockmodel. For example, blockmodel studies typically include networks of both cooperative (positive affect in the case of interpersonal ties) and conflict (antagonistic) interactions.

The world-system perspective is, among other things, a particular theory of the form and operation of international-system structure (see Christopherson [1976] for alternative models). Although each of our four networks could be conceptualized in terms of core-periphery exploitative dynamics (see the discussion above), it is not necessary to do so. In fact, it would be inappropriate if the generalized approach to social structure

[18] Wallerstein (1974, p. 22) cites an interesting medieval parallel to this argument. In addition, the empirical results we present subsequently provide at least a partial validation of our reasoning concerning diplomatic relations.

(blockmodel analysis) were based solely upon networks specified by a variant (which stresses economic relations, such as Wallerstein [1974] and Chirot [1977]) of a single theory of that structure. Many alternative models of international-system structure also emphasize the importance of noneconomic transactions (e.g., Brams 1966; Christopherson 1976). Moreover, even some analyses that view the world system in essentially core-periphery terms (Galtung 1971) identify system structure as a joint function of economic, military, political, and cultural relations.

While this specification of the relationship between blockmodel analysis and world-system theory justifies the inclusion of noneconomic dimensions such as diplomatic exchanges and treaties, it does not constitute a warrant for excluding more detailed economic transaction data (e.g., types of commodities exchanged, investment capital flows). In this case, data availability influenced our strategic decisions. For the mid-1960s period, information on commodities and other types of economic interactions can be constructed only for a substantially attenuated set of nations (relative to the 118 in the present analysis). We could have employed more recent commodity data, which have greatly expanded coverage. However, information on interventions, diplomats, and treaties is not yet available for the 1970s. We have already indicated the undesirability of deleting such networks. Therefore, we chose to represent multiple dimensions of interaction for nearly the universe of nations, even though our network of economic relations would be a crude one. Moreover, we wanted to avoid the possibility that certain results (e.g., a core-periphery structure) might be based only on the economic indicators most likely to produce them.

This is not to claim that our operationalization is optimal. We invite replications with additional or different networks as they become available. We also recognize that different results could be obtained (though that becomes less likely as more networks add successively less independent information). While such issues are far from trivial, they are subsidiary to our main purpose of demonstrating the potential power of blockmodel approaches to the substantive questions posed by world-system theory.

Two further issues require brief mention preliminary to the presentation of our blockmodel findings. First, our empirical analysis necessarily specifies a single world system that encompasses all nations, although it may identify "isolates" as a unique structural position (see White et al. 1976). Some areas may lie entirely outside the world economy, especially historically (see Wallerstein 1974). However, the fact that all nations had ties to other countries in the 1960s suggests that the assumption of a single world economy during the recent period covered by our data is largely warranted. Put another way, if there are a few exceptions (e.g., stateless societies not included in our sample), they should have no material bearing on our analysis. Second, we want to emphasize that our results bear upon the world system

only at a single point in time. They are not intended to address either the historical development of that system (though knowledge of past occurrences can inform our interpretation) or the mechanisms internal to nation states on which we lack direct measures.[19]

STRUCTURE AND POSITION IN THE WORLD SYSTEM: BLOCKMODEL RESULTS AND DISCUSSION

We applied CONCOR (see Breiger et al. 1975; White et al. 1976) to the matrices described above.[20] Figure 1 displays the number of countries in each successive partition of the data, with blocks designated by arbitrary letter "names." Here we deal only with the 10-block partition of the data (those sets of countries labeled A through F'). While the 10-block split is necessarily consistent with four- and six-block partitions, it presents a more refined picture of the overall structure and also generates the greatest ex-

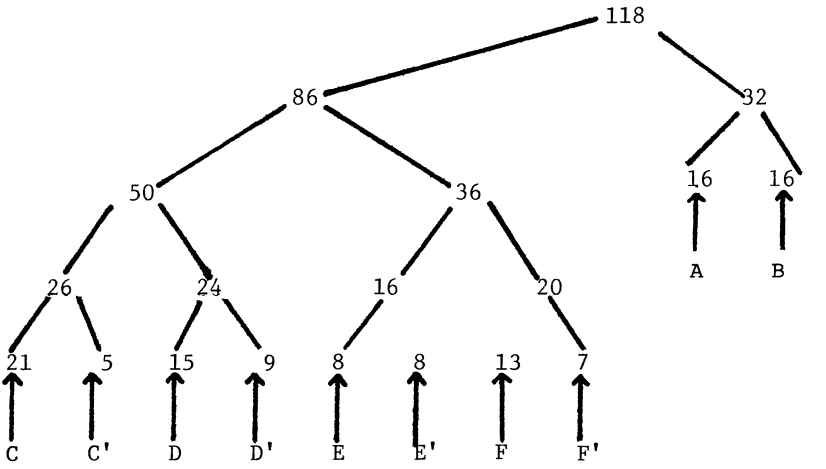

FIG. 1.—Blockmodel "tree" of hierarchical decompositions: 118 nations circa 1965. Letters designate block "names" in 10-block model. See table 1 for list of countries located in each block.

[19] By stating these limitations (which also apply to other empirical analyses of world-system issues), we want to avoid metatheoretical criticisms of the form advanced by Bach (1977) and Irwin (1977). We grant the validity of some of their points. However, they apply more to analyses of issues (e.g., intranational inequality) in which unmeasured domestic attributes such as class structure are central, and which lack time-ordered data. These points are not directly relevant at the level of analysis on which we are operating in this paper

[20] CONCOR involves weaker assumptions than the alternative BLOCKER algorithm discussed by White et al. (1976). We employed CONCOR because this first application of blockmodels to world-system structure is exploratory. We also note that studies which employ both algorithms report highly consistent partitions of the data.

planatory power in our subsequent empirical analyses. Table 1 lists the countries in each block for the reader's convenience. However, most of our interpretation does not rely directly on this information.

Table 2 presents the set of binary-image matrices that indicates the presence or absence of "bonds" among blocks on each type of network. The image matrices reflect in more simplified form the patterns of ties among blocks depicted in the density matrices of table 3. With the exception of the treaty matrix (wihch is symmetric by definition), the rows for each dimension indicate the "sending" blocks and the columns the "receiving" ones. For example, the fifth entry in the first row of the trade-density matrix (.744) in table 3 indicates the proportion of actual relative to possible export links from block C nations to block E nations. The binary entries in the image matrices reflect whether each density displayed in table 3 is greater (coded "1") or less (coded "0") than the mean density for that matrix. Although this criterion is of course arbitrary, the overall patterns described below are not highly sensitive to the particular cutting point chosen.

In general, though with some deviations, we interpret the pattern of bonds depicted in the image matrices as a core-semiperiphery-periphery structure

TABLE 1

LISTING OF COUNTRIES IN EACH BLOCK: FOUR-NETWORK BLOCKMODEL
(Trade, Interventions, Diplomats, and Treaties)
FOR 118 NATIONS CIRCA 1965

Block	Nations
A.....	Chad, Congo (Brazzaville), Congo (Kinshasa), Uganda, Burundi, Rwanda, Somalia, Ethiopia, Malagasy Republic, Morocco, Algeria, Tunisia, Libya, Sudan, United Arab Republic,* Yemen*
B.....	Mali,* Mauritania,* Ghana,* Upper Volta,* Senegal, Dahomey, Niger, Ivory Coast, Republic of Guinea, Liberia, Sierra Leone, Togo, Cameroun, Nigeria, Gabon, Central African Republic
C.....	Canada, United States, United Kingdom, Netherlands, Belgium, Luxembourg, France, Switzerland, Spain, Portugal, West Germany, Austria, Italy, Yugoslavia, Greece, Sweden, Norway, Denmark, South Africa, Japan, Australia
C'.....	Venezuela, Peru, Argentina, Uruguay, South Korea
D.....	Cuba, Ireland, East Germany, Hungary, Cyprus, Bulgaria, Rumania, USSR, Kenya, Iran, Turkey, Iraq, Lebanon, Jordan, Israel
D'.....	Finland, Saudi Arabia, Taiwan, India, Pakistan, Burma, Ceylon, Malaysia, Philippines
E.....	Panama, Colombia, Ecuador, Brazil, Bolivia, Paraguay, Chile, North Vietnam
E'.....	Haiti, Dominican Republic, Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica
F.....	Jamaica, Trinidad and Tobago, Poland, Czechoslovakia, Malta, China (People's Republic), Mongolian Republic, Nepal, Thailand, Cambodia, Laos, New Zealand, Iceland
F'.....	Albania, Syria, Kuwait, Afghanistan, North Korea, South Vietnam, Indonesia

* Starred countries in blocks A and B cluster together in further "splits" of the data, although they are not shown as separate blocks in the analyses.

TABLE 2 BINARY "IMAGES" OF TEN-BLOCK MODEL

TRADE

	C	C'	D	D'	E	E'	F	F'	A	B
C	1	1	1	1	1	1	1	1	1	1
C'	1	1	0	1	0	1	0	0	0	0
D	1	0	1	1	0	0	0	0	0	0
D'	1	1	1	1	0	0	0	1	0	0
E	1	0	0	0	1	0	0	0	0	0
E'	1	1	0	0	0	0	0	0	0	0
F	1	0	0	0	0	0	0	0	0	0
F'	1	0	0	0	0	0	0	0	0	0
A	1	0	0	0	0	0	0	0	0	0
B	1	0	0	0	0	0	0	0	0	0

INTERVENTIONS

	C	C'	D	D'	E	E'	F	F'	A	B
C	0	0	1	0	1	0	1	0	1	1
C'	0	0	0	0	1	1	0	1	0	0
D	0	1	1	0	1	1	0	0	1	0
D'	0	0	0	1	0	0	1	0	0	0
E	0	1	1	0	1	0	0	0	0	0
E'	0	0	0	0	1	1	1	0	0	0
F	0	0	0	0	0	0	1	0	0	0
F'	0	0	1	1	0	0	1	0	0	0
A	0	0	0	1	0	0	0	0	1	1
B	0	0	0	0	0	0	0	0	0	0

TABLE 2 (Continued)

DIPLOMATS

	C	C'	D	D'	E	E'	F	F'	A	B
C	1	0	1	1	1	1	1	1	1	1
C'	0	0	0	0	0	0	1	0	0	0
D	0	0	1	1	1	0	1	1	0	0
D'	0	0	1	0	1	0	1	1	0	1
E	0	0	0	0	1	1	1	1	0	0
E'	0	0	0	0	1	1	1	1	1	0
F	0	0	0	0	0	0	1	0	0	0
F'	0	0	0	0	0	0	1	0	0	0
A	0	0	0	0	0	0	1	0	0	0
B	0	0	0	0	0	0	1	0	0	0

TREATIES

	C	C'	D	D'	E	E'	F	F'	A	B
C	1	0	0	0	0	0	0	0	0	0
C'	0	1	0	0	1	1	0	0	0	0
D	0	0	1	0	0	0	0	1	0	0
D'	0	0	0	0	0	0	0	0	0	0
E	0	1	0	0	1	1	0	0	0	0
E'	0	1	0	0	1	1	0	0	0	0
F	0	0	0	0	0	0	0	0	0	0
F'	0	0	1	0	0	0	0	0	0	0
A	0	0	0	0	0	0	0	0	1	1
B	0	0	0	0	0	0	0	0	1	1

TABLE 3 TEN-BLOCK DENSITIES

TRADE (Mean Density = .3410)

	C	C'	D	D'	E	E'	F	F'	A	B
C	.943	.895	.908	.889	.744	.714	.630	.612	.622	.500
C'	.829	.560	.320	.422	.250	.525	.215	.114	.087	.100
D	.854	.267	.613	.474	.033	.133	.282	.286	.271	.108
D'	.884	.533	.459	.617	.153	.194	.308	.349	.215	.069
E	.679	.225	.042	.139	.422	.172	.106	0	.023	0
E'	.643	.525	.125	.125	.125	.297	.135	.036	.039	.023
F	.634	.215	.262	.265	.029	.135	.183	.165	.144	.087
F'	.551	.171	.229	.317	.018	.018	.132	.082	.045	.009
A	.604	.037	.225	.181	0	.039	.115	.045	.141	.063
B	.533	.025	.092	.042	0	.008	.038	0	.070	.160

INTERVENTIONS (Mean Density = .0072)

	C	C'	D	D'	E	E'	F	F'	A	B
C	0	0	.016	0	.042	.006	.015	.007	.030	.030
C'	0	0	0	0	.025	.025	0	.029	0	0
D	0	.013	.013	0	.008	.008	.005	0	.017	.004
D'	0	0	0	.025	0	0	.017	0	.007	.007
E	0	.025	.008	0	.047	0	0	0	0	0
E'	0	0	0	0	.031	.016	.019	0	0	0
F	0	0	0	0	0	0	.018	0	.005	0
F'	0	0	.019	.016	0	0	.011	0	0	0
A	0	0	.004	.014	0	0	0	0	.070	.008
B	0	0	0	0	0	0	0	0	0	0

DIPLOMATS (Mean Density = .2644)

	C	C'	D	D'	E	E'	F	F'	A	B
C	.413	.200	.533	.434	.542	.548	.872	.626	.440	.342
C'	.133	0	.067	.044	.200	.225	.400	.257	.138	.075
D	.238	.040	.347	.304	.325	.242	.759	.314	.221	.246
D'	.143	0	.311	.259	.417	.222	.684	.429	.243	.285
E	.173	0	.108	.042	.266	.391	.442	.339	.203	.086
E'	.202	0	.175	.097	.297	.359	.635	.411	.313	.172
F	.117	0	.185	.188	.202	.163	.527	.132	.111	.139
F'	.136	0	.257	.175	.196	.196	.516	.163	.134	.161
A	.119	.050	.154	.118	.133	.133	.447	.143	.129	.133
B	.092	.075	.146	.104	.078	.141	.452	.098	.109	.141

TABLE 3 (Continued)

TREATIES (Mean Density = .1278)

	C	C'	D	D'	E	E'	F	F'	A	B
C	.324	.048	.044	.053	.048	.042	.073	0	.003	0
C'	.048	.480	0	0	.800	.700	0	0	0	0
D	.044	0	.142	.052	0	0	.067	.152	.092	0
D'	.053	0	.052	.025	0	0	.043	.032	.049	0
E	.048	.800	0	0	.875	.875	0	0	0	0
E'	.042	.700	0	0	.875	.656	0	0	0	0
F	.073	0	.067	.043	0	0	.024	.044	0	.010
F'	0	0	.152	.032	0	0	.044	.041	.125	0
A	.003	0	.092	.049	0	0	0	.125	.867	.938
B	0	0	0	0	0	0	.010	0	.938	.938

in which (1) block C constitutes the core; (2) blocks E through B (in the order shown) are the periphery; and (3) block D, and perhaps also C′ and D′, are located in the semiperiphery of the world system.[21] This three-tiered structure is most clearly reflected in the image matrix for trade (see White et al. [1976] for structurally similar patterns with different data). Block C is unambiguously at the core of the world economy. It maintains trade linkages to and from every other block in the system. The density matrix in table 3 similarly indicates that every block has more trade linkages with C than with any other block.[22] At the other extreme, blocks E through B are with minor exceptions integrated into the world economy only through their trade with the core block C. This pattern indicates a peripheral location in the overall structure. Blocks C′, D, and D′ differ from both the "core" and "periphery" (as we designate them). There are mutual trade links among and within these blocks, and these blocks are therefore partially independent of the core block in the world economy. However, blocks C′, D, and D′ are for the most part not directly linked to the peripheral blocks. In addition,

[21] We stress that the identification of blocks and inferences concerning system structure are based on a single (simultaneous) partitioning of all four interaction networks. Our discussion below of each network separately is intended only to convey information concerning variations in patterns across types of interaction; it does not imply that each network constitutes a separate blockmodel.

[22] CONCOR's dichotomous splits of the raw data (Schwartz 1977) and investigators' decisions of how many partitions to undertake necessarily result in arbitrarily determined numbers of blocks. Therefore, the location of countries in blocks is by no means definitive, and we are not wedded to the precise placement shown in table 1. For example, we could have further partitioned the core block of 21 nations, which would result in a smaller set of "core" nations and a larger set of "semiperipheral" countries. These further refinements do not materially affect our conclusions. For instance, deleting from the core all nations which are arguably semiperipheral would still leave very large differences between the core-periphery and semiperiphery-periphery trade densities depicted in table 3.

they are most "salient" to the core as trade partners (note the discontinuity in the densities after the fourth entry of the first row and col. in table 3). Structurally, blocks C′, D, and D′ reflect a "hangers-on" pattern (White et al. 1976) rather than being part of a simple hierarchy.[23] Substantively, we are therefore inclined to label blocks C′, D, and D′ as the semiperiphery, at least pending examination of the other networks.

The image matrix for interventions is largely consistent with conclusions based upon trade bonds. Although block C does not undertake military interventions into all other blocks, it polices much of the system (note in the density matrix that two of the zero images marginally fail to reach the criterion for a bond). Additionally, block C is the only one that receives no interventions (col. 1). Moreover, the density matrix demonstrates that these zero images are all "true" zeros, and thus entirely independent of the cutting point. No core nations experienced a single territorial incursion during the 1960–67 period covered by these data.[24] Block D is also a ubiquitous intervener, though it differs from C because it is also a frequent target of other blocks (including C). The less global intervention patterns of blocks C′ and D′ reduce our confidence in placing them in a semiperiphery. The remaining blocks vary a good deal in their intervention patterns. In general, there is somewhat more of a hierarchical structure in the intervention than in the trade images. For example, block A countries are intervened into by different, and apparently more powerful, blocks (C and D) than those into which they intervene (D′ and B; block A nations' interventions into each other also manifest the highest density by far in the entire matrix). Similar patterns characterize blocks C′, E′, F, and B. However, indications of any overall hierarchy in the system (except for the military dominance of C) are not strong.

The diplomatic exchange bonds are consistent with our previous hypothesis concerning the differential importance of sending and receiving missions. Block C clearly dominates the sending of these information flows in the system, but it does not receive diplomatic bonds from any other block (col. 1 of the image matrix). Block F is the main receiver, although the meaning of that is ambiguous. Given that block F is also the frequent target of interventions from other blocks, we originally suspected that receiving diplomats might reflect global "crisis locations." But a comparison of the interventions and diplomats matrices indicates no strong support for that contention. As in the interventions matrix, there are modest indications of a hierarchy in

[23] These three blocks do not manifest a clearly dominant pattern of trade over those that lie in the periphery. For example, block B's trade densities are greater among its constituent nations than with any other block except the core.

[24] This particular pattern would not of course be observed during some other periods (e.g., world wars). Multinational wars involving core nations plausibly constitute a primary source of reordering the nations in various positions, if not of altering the positions themselves.

which each location (core, semiperiphery, periphery) initiates but does not receive diplomatic flows from those below it in the status ordering.[25]

In summary, the structure defined by the blockmodel analysis is generally consistent with the core-semiperiphery-periphery model specified by world-system treatments. Block C constitutes the core of the system in each type of network. Only block D is clearly located in the semiperiphery, because it alone reflects the pattern of flows (though to a much weaker extent) that characterizes block C on all interaction dimensions. While blocks C′ and D′ have trade bonds similar to those of block D, their patterns of interventions and diplomatic exchanges are more in line with those of peripheral blocks. Therefore, the placement of blocks C′ and D′ in the semiperiphery is more questionable. Finally, blocks E, E′, F, F′, A, and B clearly comprise the periphery, although there are of course differences among them.

Indeed, there must be differences between all of the blocks because in strict terms the analytic technique has identified 10 separate structural positions (blocks) in the system. Although the exact number of blocks is arbitrary, how can that consideration be reconciled with our claims of a three-tiered model? In our view, the structural relations of blocks E through B are similar enough that they override the observed variations and warrant the "periphery" designation we have attributed to them. However, we also consider that differences among these blocks reflect varying characteristics of different parts of the periphery that may also be substantively important. Such differences plausibly reflect variations in historical experiences, state strategies, etc. Space limitations preclude discussion of these variations here. However, we stress their existence because they suggest that (*a*) national (or international) experiences are not solely determined by world-system position, and (*b*) methods other than those employed here (e.g., case studies, historical analyses) are necessary to explore national variations within particular positions in the system.

THE EFFECTS OF STRUCTURAL POSITION ON THE ECONOMIC GROWTH OF NATIONS, 1955–70

The blockmodel analysis bears only on the form and operation of the world system at a given point in time. Here we integrate the blockmodel findings with our substantive focus on the economic growth of nations. Simply stated, we want to answer two questions: does block location (position) make a difference and, if so, how much of a difference in countries' economic welfare? Therefore, we report multivariate analyses of the effects of block loca-

[25] We ignore the treaty matrix in our discussion because there is not much of substantive importance to be learned from it. Examination of the treaty links among individual nations in the raw-data matrix (not shown here) indicates that the bonds shown in tables 2 and 3 almost entirely reflect regionally based pacts.

tion on economic growth. These analyses constitute strong and independent (of the blockmodel results) tests of world-system/dependency arguments and of our interpretation of the blocks as structural positions.

Following Wallerstein, Chirot, and related arguments, some obvious hypotheses concerning the effects of block location on differential growth may be briefly specified. Block C, net of other factors, should experience the greatest economic growth in the system. By dominating the international trade network, it can largely determine the terms of trade with all other blocks except C′, D, and D′. Given its intervention pattern, block C can maintain its economic interests with the frequent use (and perhaps threat) of military force. Moreover, its apparent invulnerability to such intervention also favors economic growth. And because of its centrality in the diplomatic (information-flow) network, block C should achieve further advantages on the grounds discussed earlier. We expect that block D should experience, again ceteris paribus, the next greatest economic growth. Its trade network is somewhat independent of block C, and D is roughly "second" in initiating interventions and diplomatic missions. Block D should resemble block C in the consequences of those patterns, though to a considerably lesser extent. In addition, since D is a frequent target of outside military intervention, its nations' economic growth may be expected to suffer. Finally, the remaining blocks should, according to dependency arguments, manifest the largest decrements as a function of their structural position. Although we expect variations among the peripheral blocks, we are unable to specify their relative magnitudes. For example, blocks A and B are structurally similar on all except the intervention networks. Block A's greater initiation of military incursions, particularly its domination over B, might suggest an economic advantage. But A is also more often the target of interventions, which would suggest economic dislocations. The importance of these differences for economic growth cannot be readily ascertained a priori.

Our empirical analysis employs the change in gross national product (GNP) per capita from 1955 to 1970 as the dependent variable. This interval is long enough to observe substantial shifts and also increments the sample size considerably over an earlier (1950) starting point. Change in GNP/capita is regressed on initial (1955) GNP/capita (to control for its correlation with gain score: see Bohrnstedt [1969]) and on other independent variables of substantive interest. Although a panel or lagged dependent variable model is more typically employed in such analyses (Chase-Dunn 1975; Delacroix 1977), the two forms are equivalent in the parameters of primary interest (Treiman and Terrell 1975, p. 184n).[26] We use the change

[26] Metric partial regression coefficients and standard errors are identical, while the coefficient of the initial GNP/capita variable differs by a constant of 1.0. It should also be noted that the R^2 is generally considerably lower with the change dependent variable, because of the deletion of the autoregression coefficient which usually predominates empirically in the panel model.

score to emphasize our focus on economic growth (see Delacroix and Ragin [1978] for a similar treatment).

We begin with a basic model of change in GNP/capita which follows that of Delacroix (1977). It contains the 1955 GNP/capita and adjusted secondary school enrollment ratio (percentage of the secondary school age population enrolled in secondary education) as explanatory variables. The GNP/capita is the most conventional indicator of average economic welfare.[27] The secondary school ratio more likely influences changes in wealth than primary enrollment over the relatively short period covered by these data. It also minimizes comparability and multicollinearity problems relative to university-level enrollment figures (Delacroix 1977). Equation (1) in table 4 presents estimates of this basic model for the 90 countries for which all data are available. Nations higher in initial wealth experience greater increases over the 15-year period (we assume that this effect reflects a number of unspecified cultural and institutional factors).[28] The impact of secondary enrollment is consistent with Delacroix's findings. Each percentage point increase in 1955 enrollment generates an estimated net $21 gain in GNP/capita.

Equation (2) adds a series of nine dummy variables to the basic model, each representing block location (countries were coded "1" if they were located in the given block and "0" otherwise). Note that one category must be omitted because it is a perfect linear combination of the other dummy variables in the model. We arbitrarily omitted block C. Therefore, the coefficients of location in the other blocks are properly interpreted as the net effects of being in a given block relative to location in the omitted category or "core" block.[29] The results presented in equation (2) are noteworthy in

[27] Data for this portion of the analysis are based on a merged file of information from Taylor and Hudson (1972) and the International Bank for Reconstruction and Development (1971, 1973). The GNP and other measures taken from the latter source are identical to those employed by Chase-Dunn (1975) and Delacroix (1977). Delacroix (1977, p. 800n) provides more detailed information and proper cautions regarding the GNP data. We also recognize that correlated error in the 1955 and 1970 GNP indicators will upwardly bias the slope of initial GNP/capita. But we are not overly concerned with that bias because coefficients of the variables of substantive interest will therefore be conservative estimates.

[28] If dependency arguments are largely correct, then location of course affects initial GNP/capita. Moreover, the persisting influence over time of world-system position is at least partially embedded in the estimated autoregression coefficient. Therefore, assessments of the importance of exogenetic factors suggested by our analyses are almost certainly very conservative. We also want to acknowledge that the longer-run relationship between position and economic growth is reciprocal. Greater or lesser economic growth determines a nation's ability to change or maintain position in the system. However, the substantive questions at issue here and the logic of our research design limit our inquiry to the short-run influence of position on economic growth.

[29] We could of course calculate the effect of the omitted category (minus the weighted average of the coefficients of the included ones) and then estimate deviations from the grand mean rather than from block C. However, that procedure is not important for our current purposes.

TABLE 4

ESTIMATES OF CHANGES IN GNP/CAPITA (1955–70) REGRESSED ON CONTROL VARIABLES AND DUMMY VARIABLES REPRESENTING "STRUCTURAL POSITION" (Location in 10-Block Model)

INDEPENDENT VARIABLES[a]	PARTIAL REGRESSION COEFFICIENTS (Standard Errors)			
	Eq. (1)	Eq. (2)	Eq. (3)	Eq. (4)
GNP/capita (1955)	.292 (.080)**	.274 (.081)**	.266 (.082)**	.294 (.082)**
Secondary school enrollment ratio (1955)	20.99 (2.37)**	13.62 (2.95)**	16.98 (2.76)**	11.18 (3.15)**
Block A	...	−468.0 (170.4)**	...	−329.0 (163.1)*
Block B	...	−507.4 (184.7)**	...	−449.6 (182.1)*
Block C′	...	−645.4 (186.0)**	...	−626.2 (184.1)**
Block D	...	−422.7 (139.7)**	...	−386.6 (146.3)**
Block D′	...	−510.0 (180.1)**	...	−490.5 (179.9)**
Block E	...	−542.8 (202.6)**	..	−504.3 (197.9)*
Block E′	...	−582.3 (177.5)**	...	−546.5 (175.9)**
Block F	...	−310.0 (153.4)*	..	−257.3 (158.9)
Block F′	...	−789.5 (204.3)**	..	−758.3 (204.7)**
Diplomats sent (1963–64)	...	...	.142 (.297)	.433 (.309)
Interventions into (1960–67)	...	...	−1.03 (3.54)	−3.44 (3.59)
Interventions by (1960–67)	...	...	−11.47 (4.42)*	−12.68 (4.49)**
Value of exports (1965; millions of U.S. $)	...	...	.036 (.018)*	.010 (.019)
Regression constant	20.33	562.2	51.1	507.6
R^2	68.1%	75.9%	72.7%	79.1%

NOTE.—N = 90 nations.
[a] Dependent variable is change in GNP/capita, 1955–70.
* Significant at .05.
** Significant at .01.

several respects. The coefficients of the block dummy variables are all in the negative direction expected from a core-periphery model.[30] Moreover, they are enormous: the "cost" of location in a peripheral or semiperipheral block (relative to the core) is roughly $500 per capita over this 15-year span.[31] To be sure, block location is correlated with a country's initial wealth, but these estimates are net of GNP/capita in 1955. It should be stressed that there is no necessary connection between the image and density matrices in the blockmodel analysis and the magnitudes or signs of the effects of the block dummy variables in the regression model. The convergent evidence from these two analyses therefore provides strong support for world-system/dependency theory of system structure and of the most widely investigated consequence of that structure (nations' differential economic growth). We also note that the inclusion of the block variables substantially attenuates the effects of the secondary school enrollment indicator in the "endogenous" model of economic growth. Finally, the series of dummy variables modestly increments the R^2 over the baseline model's explanatory power. This increment is perhaps more compelling in light of Delacroix's (1977, p. 805) conclusion that "in the short run, wealth leads to wealth. It is difficult to show the effect of anything on national wealth."

Despite the strength of the results presented in equation (2), they might still be artifactual. For example, core nations initiate more interventions, diplomatic missions, and trade flows and experience no military incursions. Other countries also vary along these dimensions. Therefore, it is plausible that the effects of block membership and its substantive analogue (structural position in the world system) simply reflect countries' differential values on these dimensions of international interaction. To investigate that possibility, equation (3) temporarily deletes the block dummy variables and adds the total number of interventions initiated and received by each nation (1960–67), diplomats sent (1963 or 1964), and dollar value (in millions) of exports in 1965. We are essentially (but not precisely) including the row and column marginals of the raw data matrices initially used to define the partitioning of nations into blocks. The results indicate that nations which

[30] However, expected differences in the economic costs experienced by nations in semiperipheral versus peripheral locations are not supported by these results. While block D (the clearly semiperipheral block) has the second lowest decrement, the general pattern of effects does not sustain that interpretation.

[31] Since our data pertain to the quasi universe of nations, standard errors and significance tests are reported solely for reasons of convention and convenience. We are quite willing to rest our conclusions on the magnitudes of the partial regression coefficients. One reader suggested that heteroscedasticity of the disturbances, which is plausible with a skewed dependent variable such as GNP/capita, might in any case bias the reported significance estimates. The regression coefficients that are of primary interest would be unbiased even if the disturbances were not homoscedastic. However, we employed a test for heteroscedasticity developed by Goldfeld and Quandt (1965; see Dutta [1975, pp. 132–36] for details on procedures) and found no evidence of it.

initiate more trade and diplomat flows experience positive economic returns (though small ones for diplomats) on those activities.[32] But the findings for interventions are surprising. The effect of receiving interventions is negligible. Conversely, the impact of interventions by a country is both substantial and negative. Moreover, this effect is "real." Other analyses (not reported in tabular form) indicate that it persists through a variety of estimating equations and is not masking different slopes across blocks (e.g., positive effects of interventions by core nations). Although we are primarily interested in the measures in equation (3) as control variables, this finding warrants brief discussion. We still maintain that nations' bonds in the intervention matrix (e.g., the dominance of block C) contribute to the effects of the block dummy variables in equation (2). However, we believe that the negative effect of the number of interventions by a country in equation (3) could reflect either of two (not necessarily exclusive) phenomena. Interventions may be initiated precisely because the target country is not under firm control, that is, as a response to declines in economic returns extracted from that country. It is also possible that this result indicates a "free rider" problem (e.g., Olson 1965). For example, while the core block may derive collective economic benefits from military imperialism, the particular nations that initiate interventions bear the direct costs of providing or ensuring that collective good.

Finally, equation (4) in table 4 adds the block dummy variables to the controls included in equation (3). Although the effects of block location are slightly attenuated in this expanded model, the absolute and relative magnitudes of the coefficients are similar enough to those of equation (2) that our substantive conclusions need not be materially altered. The effects we attribute to structural position in the system are clearly not due simply to the gross outflow and inflow (i.e., marginal) characteristics of nations' interactions in that system. Therefore, the contention that such effects must be due to the networks of interaction that define the system and position in it becomes even more plausible.

FURTHER ANALYSIS

In order to investigate as exhaustively as possible with available data whether the effects of block location are spurious, we undertook several fur-

[32] Total value of imports is correlated over .99 with exports, so we dropped it from the analysis. Therefore, the exports measure more properly reflects total trade volume. We also originally included the numbers of diplomats received and treaty ties for each nation. However, there was no clear substantive rationale for expecting effects on economic growth, and the estimated coefficients were trivial in magnitude. Inclusion of these two variables changes the reported coefficients only in minor ways. We also note that exports and diplomats sent are highly correlated ($r = .88$), and that entering either alone in the equations results in much larger slopes than does including both together.

ther analyses. We first added the block dummy variables to a lagged dependent variable model that included investment dependence per capita (1961–65) and domestic capital formation in 1960 as a percentage of gross domestic product (see Chase-Dunn 1975). We further incorporated all the control variables of equation (4) in table 4, as well as a measure of each country's degree of export concentration in 1965. The latter reflects the concentration of exports (the row entries in our original trade matrix) but not the origin-destination combination captured in the blockmodel partitions. Although the sample size is substantially reduced in this analysis, the effects of block location remain roughly as strong as those reported in table 4. In addition, some treatments (e.g., Chase-Dunn 1975) log transform the dependent variable in order to normalize the skewed distribution of GNP/capita or changes therein. That procedure substantially reduces the fit of the model as a whole (because the autoregression effect diminishes considerably), but the substantive conclusions based on the block-location coefficients are again unaltered by such transformations. We prefer the untransformed GNP/capita estimates (particularly given the absence of heteroscedasticity) because the metrics are so easily interpretable.

In summary, our extensive examination of other important determinants of economic growth identified in recent analyses indicates that the empirical effects of block location are in no way spurious. In our view, substantive interpretation of those effects as the accumulative structural advantage of the core over the periphery (and semiperiphery) of the world system is therefore warranted. As a final test of that interpretation, we estimate equation (2) in table 4 separately for changes in GNP/capita during the periods 1960–70 and 1965–70.[33] Table 5 presents results of those estimates, which may be compared with equation (2) in table 4. The effects of block location remain substantial (particularly for 1960–70). However, the absolute magnitudes of the coefficients of block location decline monotonically as the interval of observation decreases from 15 to five years.[34] These findings suggest that the advantages or costs of particular structural positions operate even in the very short run. But, while they are of modest size over a five-year period, these effects also persist through time and therefore result in

[33] These analyses also address a potential concern with time ordering of the measures. Since the network data and block location variables pertain to the early 1960s, they are observed after some of the economic changes in the 15-year interval (1955–70) have already occurred. However, the findings reported below eliminate that as a plausible explanation for the results presented in table 4.

[34] We also estimated expanded models of the form of equation (4) for changes from 1960 to 1970 and from 1965 to 1970. In these models, the coefficients of the block dummy variables are reduced by amounts roughly proportional to those shown in table 4. In the 1965–70 estimates, the effects for a few blocks (A, B, and F) become almost trivial in magnitude, but the general pattern of results supports conclusions identical to those based on table 4.

TABLE 5

ESTIMATES OF CHANGES IN GNP/CAPITA (1960–70 and 1965–70) REGRESSED ON CONTROL VARIABLES AND DUMMY VARIABLES REPRESENTING "STRUCTURAL POSITION" (Location in 10-Block Model)

INDEPENDENT VARIABLES	PARTIAL REGRESSION COEFFICIENTS (Standard Errors)	
	Change in GNP/Capita (1960–70) Eq. (5)	Change in GNP/Capita (1965–70) Eq. (6)
Initial GNP/capita (1960 or 1965)	.126 (.073)	.338 (.052)**
Secondary school enrollment ratio (1960)	14.90 (2.58)**	7.68 (1.84)**
Block A	−296.5 (143.7)*	−127.8 (96.6)
Block B	−317.7 (149.4)*	−136.8 (99.3)
Block C′	−482.0 (162.1)**	−262.5 (109.1)*
Block D	−425.3 (116.1)**	−210.5 (79.4)**
Block D′	−473.5 (143.2)**	−253.9 (97.1)**
Block E	−380.4 (159.9)*	−201.6 (107.3)
Block E′	−428.7 (153.4)**	−207.1 (103.6)*
Block F	−256.8 (124.0)*	−90.4 (90.1)
Block F′	−684.1 (174.8)**	−361.7 (114.7)**
Regression Constant	351.6	151.1
R^2	75.6%	83.2%

NOTE.—N = 105 nations for 1960–70; 106 nations for 1965–70.
* Significant at .05.
** Significant at .01.

large cumulative differentials in economic growth among nations even over a 15-year period.

CONCLUSIONS AND IMPLICATIONS

Taken together, the analyses reported here provide strong support for world-system/dependency theories of structure in the post–World War II period and of the sources of differential economic growth of nations. The blockmodel results indicate a core-semiperiphery-periphery structure in the world system. Moreover, the effects of structural position on the economic growth of nations from 1955 to 1970 are highly consistent with world-system/dependency formulations, although they do not differentiate between the economic costs of peripheral versus semiperipheral location. Substantively, these findings suggest that exogenetic theories of economic growth may be even more powerful than previous analyses have indicated. This is not to claim that world-system position alone determines the differential economic growth of nations. Both endogenous factors (education) and the magnitudes of some transnational flows (e.g., trade, interventions) have important effects and must also be included in models of economic growth.

More generally, this paper demonstrates a natural wedding of an empirically grounded theoretical approach to social structure (blockmodel

analysis) and a conceptual framework (the world system) that can be fruitfully applied to domestic conflict, inequality, and other substantive issues addressed by world-system treatments (e.g., Chirot 1977). In addition, we have begun designing blockmodel analyses of networks at several points in time which promise to answer questions concerning structural changes in the world system. For example, issues of obvious interest include the structural consequences of the incorporation of many African nations in the system circa 1960 and possible shifts in the location of OPEC countries in the 1970s. We do not mean to imply that such investigations are a substitute for the historical analyses and case studies that are necessary to understand national variations within structural positions and the mechanisms through which system position influences domestic processes. While we have not addressed such lines of inquiry here, our acknowledgment of their importance is more than token. Moreover, data availability will almost certaintly limit analyses of the form reported here to the post–World War II period and will therefore preclude examination of long-run historical developments with our procedures. Despite this limitation, the approach employed here should inform research problems concerning the world political economy that we have not yet even considered.

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