Another Look at the Network Boundaries of American Markets[1]

Ronald S. Burt
Columbia University

Debbie S. Carlton
Apple Computer

Measuring transactions as proportional variables rather than as marginal variables produces important differences in our images of economic networks. Market boundaries defined by proportional transactions emphasize the differences among *specialized* markets (production markets with a single principal supplier or consumer market). Boundaries defined by marginal transactions emphasize the differences among *diversified* markets (production markets defined by unique transaction patterns with multiple supplier and consumer markets). The results reported here with marginal measures of transaction strength offer a substantively richer map of market boundaries than the results Burt reported with proportional measures. These findings promise to guide organizational research by offering clearer distinctions among the market environments in which organizations operate. Proportional transaction measures are well suited to their traditional use in economic input-output models tracing the flow of resources through a network. Marginal transactions are the more useful measure for sociological studies of market boundaries for organizational analysis, more clearly revealing variation in the resource-flow patterns that define structurally equivalent (substitutable) production activities as a market.

Measuring the structural equivalence of broadly defined production activities, Burt (1988*b*) described the stability of network boundaries be-

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tween aggregate American markets during the 1960s and 1970s. Before using the published results to guide practical advice to a corporate research and development group, we tried to replicate the results with various alternative measures of structural equivalence and transaction strength. We found an important difference between results generated by two apparently equally valid measures of transaction strength: proportional measures and marginal measures. Our purpose here is to communicate the nature and extent of the different results generated by the alternative transaction measures, and then, by fleshing out the substance of the revealed market boundaries, describe the distribution of key market characteristics within and across boundaries.

MARKET BOUNDARIES, STRUCTURAL EQUIVALENCE, AND PROPORTIONAL VERSUS MARGINAL TRANSACTIONS

Markets are bounded as network phenomena by differences between patterns of buying and selling imposed by production technologies. Two commodities are the products of different markets to the extent that the suppliers and consumers associated with producing and selling one commodity are different from the suppliers and consumers for the other. To the extent that producers of one commodity and producers of another have identical relations with the same supplier markets and identical relations to the same consumer markets, they are competitors in the same production market. Differences between them are a matter of product differentiation rather than market boundaries. Their identical patterns of transactions with suppliers and consumers make them structurally equivalent in the economy.

At issue here is the manner in which transactions are measured so that their patterns can be compared to determine the structural equivalence of production activities. Previously, Burt (1988*b*) operationalized structural equivalence as a Euclidean distance:

$$d_{ij} = \left[\sum_k (z_{ik}/R_i - z_{jk}/R_j)^2 + \sum_k (z_{ki}/C_i - z_{kj}/C_j)^2\right]^{.5}, \quad i \neq k \neq j,$$

where z_{ik} is the amount in dollars of sales from input-output sector i to sector k, R_i is the sum of those sales across sectors in row i of the input-output table (see Appendix), and C_i is the sum of sales to sector i in column i of that table. In other words, production activities in sectors i and j are structurally equivalent—and so production within the same market—to the extent that they involve identical transactions with other sectors as supplier markets and identical transactions with other sectors as consumer markets.

This structural equivalence measure is similar to traditional measures in input-output analysis of sector substitutability defined by input coefficients. In such studies, input coefficient a_{ki} equals z_{ki} divided by the total output of sector i. The coefficient is the proportional input from sector k required to produce a unit of output from sector i (Miernyk [1965, pp. 16 ff.] provides a helpful introduction). Two sectors that have similar patterns of input coefficients, that is, similar proportional purchases from each other sector as a supplier market, are treated as substitutable production activities; the production facilities in the one sector could be used to produce commodities in the other sector (see, e.g., Blin and Cohen 1977; Burt 1983, pp. 60–63). Cane sugar and beet sugar, to use a well-known example, involve similar production facilities with massive proportional purchases from the "other agriculture" sector and massive proportional sales to the food sector. The two kinds of sugar production are substitutable (i.e., structurally equivalent) production activities.

A different measure is typical in social network analysis. Relations are measured as ratios of strengths, a criterion relationship defining the marginal strength of others. Typically, the criterion is a maximum strength relation. With sociometric data, for example, individuals are asked to name their strongest relationships. These are set at a value of 1.0, and other relations are scaled to vary from 0.0 to 1.0 as fractions of the maximum strength relations. Complete or limited path distances are used to guide this measurement, with closely connected individuals having stronger relationships than persons separated by many intermediaries.

Markets structurally equivalent with respect to marginal measures of transaction strength would be defined by the same distance equation used to define equivalence with respect to proportional measures, but the terms R_i and C_i would be different. To define proportional strength transactions, R_i is the sum of z_{ik} in row i and C_i is the sum of z_{ki} in column i. To define marginal strength transactions, R_i would be the maximum z_{ik} in row i and C_i would be the maximum z_{ki} in column i.

The choice between proportional and marginal measures of relation strength has little intellectual glamour and crosses disciplinary borders. It is a choice rarely discussed. However, it is a choice highlighted by network analysis and turns out to be more substantial than the reigning indifference to it would imply.

Proportional measures of relation strength are used when actors are expected to take the social system as a frame of reference and calculate an allocation of resources to each other actor in the system. Such measures are typical of macroeconomic models and of sociological models adopting a market metaphor. In input-output models, input coefficients are used to trace through the economy the extent to which change in one sector's production would change demand for goods produced in every other sector (again, see Miernyk 1965). Correctly defining the boundaries of sectors is a secondary concern (cf. Leontief [1951] 1966, p. 15) that developed with the general use of input-output models as a way of keeping accounts of an economy (see, e.g., Blin and Cohen 1977). The same priorities and use of proportional measures can be found in social network models where actors are expected to calculate their allocation of resources across all options in a system and tracing the distribution of resources is a primary concern. Examples are Hubbell's (1965) use of input-output models to describe power and Coleman's (1966, 1971) collective-action model in which control over events is exchanged in a market system (see Burt 1982, pp. 36–37, for review).

Marginal measures of relation strength are used when the primary goal is to describe the strength of dyadic relationships. Such measures are typical of sociopsychological models, models that often use sociometric data, as described above. It is not presumed that individuals calculate relation strength with respect to the sum of their relations but merely that comparisons are made between pairs of relations. A relationship is strong to the extent that it is as strong as some other relation familiar to the individual, usually a maximum strength relation. The frame of reference for evaluating relation strength is another relationship, rather than a system total. The analogy to marginal measures in economics is obvious and is similarly adopted from psychophysics. Note that the accounting use provided by proportional relations is lost. Relations do not sum to total output. Marginal relations can be converted to proportional ones by summing them and dividing by the sum, but, until they are converted to proportional measures, marginal measures are not as useful an accounting mechanism for tracking the system distribution of resources expected to flow through relations.

As the alternative measures of transaction strength have different analytical virtues, they emphasize different aspects of market boundaries. This results in their generating different structural images, and that is the central point here. Their differences are especially pronounced in networks containing many densely connected elements—as is typical of the U.S. Department of Commerce input-output tables. Because the total output of a market tends to be much larger than any one of its transactions with a specific supplier or consumer market, proportional transaction data homogenize patterns. Proportional transactions between markets are very small fractions. Specialized markets, those with one principal supplier or consumer, are most easily distinguished when market boundaries are defined by proportional transactions because their principal trade relationship stands out as a large proportion of all their transactions. In contrast, marginal transaction data highlight differences in transaction patterns because each transaction is measured relative to the largest of a market's transactions rather than to the sum of all its transactions. Nonzero marginal transactions between two markets are much larger fractions than the corresponding proportional transactions. With individual transactions more pronounced, market boundaries between transaction patterns are more pronounced.

DISTINGUISHING MARKETS

Figure 1 presents a social topology of markets in the American economy based on marginal transaction patterns. As Burt (1982) described in the early empirical work with structural equivalence, the figure is a social topology in that it is a spatial representation of equivalencies between network elements in a social structure. Figure 1 is a representation of equivalencies between markets defined by transaction patterns in the social structure of the American economy. To lessen the torpid style assured by our continual reference to figure 1 as the social topology of American markets, we will refer to it simply as the market topology map or market topology, or, best of all, we will just refer to it and its corresponding topology map in the earlier (Burt 1988*b*) article as maps.

The map is multidimensional scaling of distances between the 77 broadly defined nongovernment production activities distinguished in the Department of Commerce's aggregate input-output tables for 1981 and 1982, the most recent data available. Two production activities are close together in the map to the extent that they involve identical purchase relations from each other sector as a supplier market and identical sales relations to each other sector as a consumer market. Details on the data and scaling used to create the market topology are given in the Appendix. We have shaded areas of related markets to facilitate interpretation of the map. These areas are not proposed as structurally equivalent sets of markets. For example, there is obvious differentiation in the area of mechanical machines between the internal combustion machines to the north of the area and the machines to the south that involve more electronic components. The shaded areas merely highlight often-combined classes of markets.

Comparing the map in figure 1 with the corresponding map presented in Burt (1986*b*, fig. 1) reveals the different images of market boundaries provided by marginal and proportional measures of transaction strength. Given comparable data, descriptive methods, and structural equivalence distance functions, the two maps could be presented by independent research efforts as descriptions of the same phenomenon. But even the most casual comparison is sufficient to demonstrate that they are quite different. More to the point, the market topology map in figure 1 provides

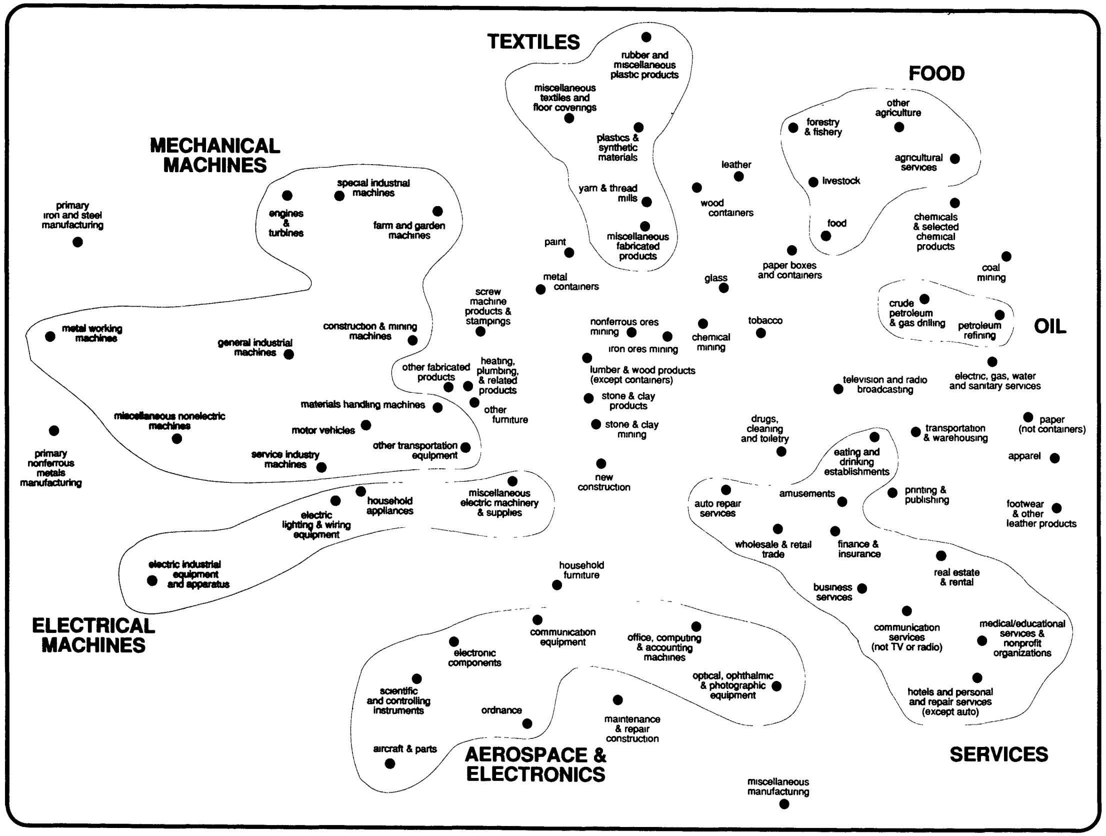


FIG. 1.—Market topology map of the American economy in the 1980s

a substantively more informative image of the economy. This shows up in two ways, both a result of the finer substantive differentiation between markets defined by marginal transaction data.

Market Specialization and Centrality

First, there is the expected change in the link between specialization and centrality in the market topology. The use of marginal transaction data has in several places turned the map inside out.

In a map of structurally equivalent markets defined by proportional transactions, such as the one presented in Burt (1988*b*), specialized markets appear around the periphery of the map, with diversified markets in the center. Specialized markets, with their strong proportional transactions with a single supplier or consumer, are most easily differentiated from other markets and so are pushed out to the periphery of the map.

Looking back to the map in Burt (1988*b*), one can see the specialized markets distributed around the periphery: crude petroleum and natural gas (70% of its extramarket transactions with petroleum refining); heating, plumbing, and related products (38% with new construction); iron ores mining (69% with iron and steel manufacturing); nonferrous ores mining (53% with nonferrous metals manufacturing); metal containers (47% with food); livestock (63% with food); and television and radio broadcasting (50% with amusements). These are specialized markets in the sense that they depend heavily on consumption or supplies from a single other market.

Diversified markets appear in the middle and central areas of the map. Burt cited the lack of clustering among these markets as a reason for not discussing the markets in any broader substantive categories (1988*b*, p. 4). In general, differences between production markets with many supplier and consumer markets will be difficult to distinguish in the muddle of minuscule proportional transactions that define them. They end up jumbled together in the center of the map.

The market topology in figure 1 when we use marginal transaction data is quite different. In a map of structurally equivalent markets defined by marginal transactions, diversified markets are pushed out to the periphery. Specialized markets appear in various places in figure 1, but especially in the center of the map as distant from all markets. Many of the specialized markets on the periphery of the map in Burt (1988*b*) now appear in the center of figure 1 (heating and plumbing and related products, iron ores mining, nonferrous ores mining, metal containers, television and radio broadcasting). Markets previously jumbled together in the center of the map are now clustered into substantive groups on the periphery (aerospace, services, textiles). Livestock, a specialized market previously isolated on the periphery of the market topology, is now clustered on the periphery with other food-production activities. We will return to the substantive clustering in a moment.

The graphs in figure 2 summarize the reversal between marginal and proportional transaction data. Third-order polynomial regression lines are drawn to highlight the different associations between market specialization and positions in the market topology. The top graph in figure 2 shows how market specialization—measured by the largest percentage of extramarket transactions conducted with a single supplier or consumer market—increases with a market's distance from the center of the map in Burt (1988*b*), where structural equivalence was defined by proportional transactions.[2] There is a .61 zero-order correlation between market specialization and centrality in that map. Just the opposite is true of the market topology in figure 1, where structural equivalence is defined by marginal transactions. Specialized markets are distributed through the center of the map, and diversified markets dominate the periphery. The six outermost markets in the map (aircraft, miscellaneous manufacturing, electrical industrial equipment, primary nonferrous metals manufacturing, primary iron and steel manufacturing, and metalworking machines) conduct no more than 14% of their extramarket buying and selling with any one other market.

Kinds of Markets

Second, by highlighting distinctions between transaction patterns, marginal transaction data better reveal substantive distinctions between markets. This shows up in the distribution of kinds of markets around the periphery of the map in figure 1. Of course, figure 1 is an imperfect fit to the full-dimension distances between markets, and some inconsistencies occur (see Appendix).

Still, there is a great deal of substantive sense to the distribution of markets in the map. Shaded areas connect contiguous markets often grouped together for their production similarities. Moreover, adjacent markets make substantive sense. For example, the markets immediately adjacent to the food area in figure 1 are related to processing and distrib-

[2] The multidimensional scaling procedure reports a market's position on each dimension as a positive or negative deviation from the center of the multidimensional space. In fig. 2, a market's relative distance from the center of the map is the square root of the sum of its squared values on each dimension of the map, quantity divided by the largest distance of any market from the center (to facilitate comparisons between the two graphs in fig. 2). Deviations on each dimension sum to zero, making the center the point closest to all markets (as opposed, e.g., to a point midway between the two most extreme markets on a dimension).

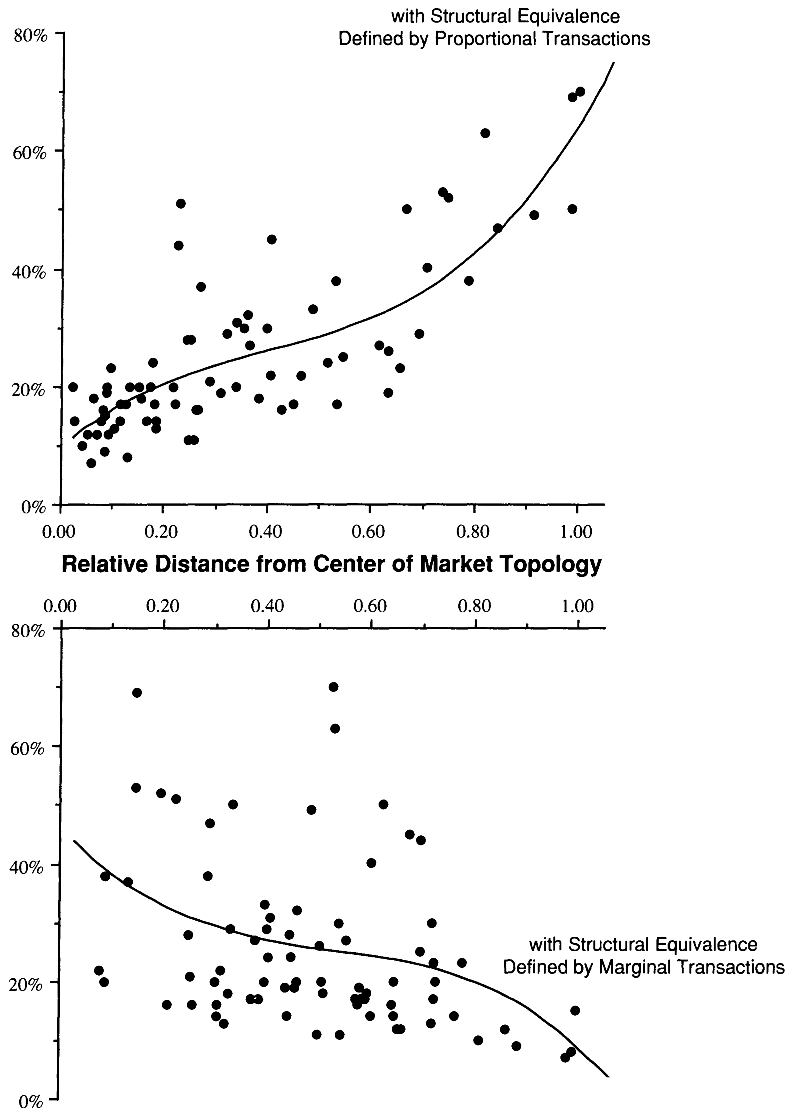


FIG. 2.—Market specialization by centrality in the market topology (market specialization is indicated on the vertical axis by the maximum percentage of extramarket buying and selling transacted with a single supplier/consumer market).

uting food, chemicals, containers, leather, and glass. Oil and gas markets are next to the utilities and transportation markets. The markets just north of the aerospace markets are the related markets for electronic components and communication equipment. Primary metals-manufacturing markets lie to the west of the markets for mechanical machines. Textile mills lie between agriculture and mechanical machines. Computers lie between professional services and electronics.

When we stand back from the map, more abstract similarities become apparent. The east-west axis is a distinction between inorganic and organic products. To the east are the markets for food, fossil fuels, clothing, and services. To the west are the markets for machines. The north-south axis is a distinction between old and new technologies. To the north are the markets for mechanical machines, textile mills, and agriculture. To the south are the aerospace, computer, and professional services markets. Cutting the map in another way, we find substantively interesting contrasts among the four corners. When we move clockwise around the map, plant and animal markets appear in the northeast, human services appear in the southeast, electric products appear in the southwest, and mechanical products appear in the northwest. Cutting the map in still another way, we can see the resource-grain contrasts that Freeman and Hannan (1983) use in their population ecology studies of organizations. Resources in the markets in the west of the map in figure 1 are coarse-grained in the sense that their products are sold in large purchases scheduled well in advance of delivery. One does not buy $500 worth of steel or $100 of space vehicle, and one typically contracts well in advance of delivery. Resources in the markets in the east of the map are fine-grained in the sense that products are sold in small units, with their volumes volatile over time.

There are a great many alternative contrasts to be drawn from the map. The above are not advanced as definitive. They merely highlight interesting dimensions of substantive differentiation across the market topology in figure 1 and so highlight the value of defining market boundaries by marginal transaction data. They also highlight the need to know how key market characteristics are distributed across the map so that definitive interpretations can be developed. If we have only the map, interpretations are limited to generalizations from the verbal labels from the Department of Commerce production categories printed in figure 1.

MORE PRECISE DISTINCTIONS BETWEEN MARKETS

The next analytical task is to enrich the distinctions between markets in figure 1 with precise data on market characteristics often used in market and organization research. The following is a summary description of three classes of variables: market performance, structure, and stability.

Market Performance

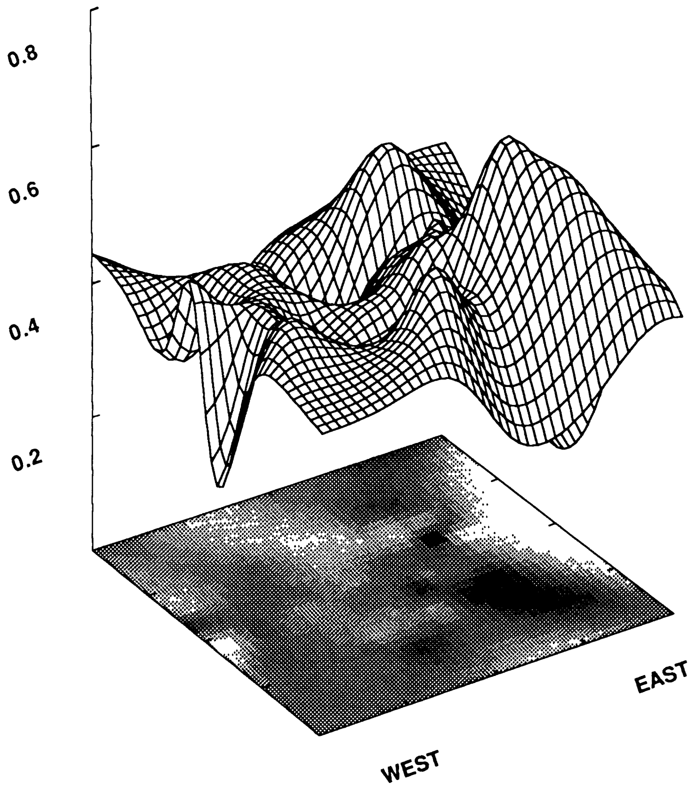
Three market performance variables are presented in figure 3: sales (in millions of dollars), the portion of those sales that is value added (sales minus taxes, labor, and profit, quantity divided by sales), and the portion of those sales that is profit. The sales and value-added variables are taken from the 1982 annual input-output table. Value added is a useful measure of performance broadly defined. It measures the extent to which sales exceed production costs, the difference to be allocated at a firm's discretion (within obvious limits) to expansion, employee compensation, stockholder profits, and taxes. The profit variable is taken from the 1977 benchmark input-output table (the most recent table in which profit is distinguished within value added; see the Appendix). The average market returned 44¢ value added on a dollar of sales, of which 18¢ was profit beyond labor and tax costs. In addition to the means presented in figure 3, three kinds of information are presented in the figure.

First, summarizing the extent to which adjacent markets have the same values on a variable, a standardized contagion effect is presented (with a t-statistic in parentheses). Each contagion effect and its test statistic is a jackknife estimate of the network autocorrelation between markets.[3] The strong contagion effects in figure 3 show that sales, value added, and profits are strongly connected to the pattern of a market's

[3] Statistical models for estimating such effects were developed to determine the effects of geographic proximity between units of analysis (e.g., factories' being located in similar geographic locations and therefore similarly positioned with respect to labor markets and transportation). The models were brought into sociology by network analysts, in particular Doreian (e.g., 1981), and have the following form:

$$y_j = a + b[\Sigma_i w_{ji} y_i] + e,$$

where y_j is market j's score on a criterion variable being tested for contagion, b is a regression coefficient measuring the contagion effect between markets, and w_{ji} is a row stochastic weight defining the extent to which market i's score on the criterion variable is contagious for market j ($0 \leq w_{ji} \leq 1$, $w_{jj} = 0$, and $\Sigma_i w_{ji} = 1$). The standardized contagion effect will be close to 1.0 to the extent that the score in market j (y_j) resembles scores in proximate markets (y_i for which w_{ji} is high). Here, w_{ji} is high to the extent that markets j and i are structurally equivalent (i.e., d_{ij} is low; see Burt 1987, p. 1331). The estimation of contagion effects here follows the models of contagion by structural equivalence discussed in Burt (1987, pp. 1328 ff.), using the jackknife statistics provided by the network analysis program STRUCTURE (see n. 1). The jackknife test statistics are especially appropriate to this analysis, in which the data are a population census. The program was allowed to iterate across values of the power function exponent v to maximize contagion effects, and settled on a value of 4.



	MEAN	CONTAGION	GOING EAST	GOING NORTH
Sales ($M)	71,151.455	.60 (4.4)	.30	-.14
Value Added Margin	.443	.77 (5.8)	.11	-.30
Profit Margin	.182	.61 (3.4)	.32	.01

FIG. 3.—Market performance with a detailed display of value added

transactions with its suppliers and consumers—precisely the point articulated in network models of the structural autonomy that producers have for determining prices in the market (Burt 1983, 1988*b*). Markets defined by similar transaction patterns, which is to say structurally equivalent markets close together in the map, generate similar levels of sales, value added, and profits. Contagion effects have been estimated with the original structural equivalence distances between markets, not the approximate distances in figure 1 generated by the multidimensional scaling of the original distances.

Next, correlations for each variable with the horizontal axis (going from west to east in the market topology map) and the vertical axis (going from south to north in the map) are presented. The correlations in figure 3 show that sales and profits generally increase from west to east in the map.

Third, a more detailed representation is presented for a key variable. Of the three performance variables, contagion between markets is strongest for value added. The three-dimensional display at the top of figure 3 provides a detailed picture of how value added is distributed across the map in figure 1.[4] From the uneven distribution of the data in figure 3 one can see how crude a description is provided by the linear correlations with the axes of the map. The floor of the display in figure 3 indicates by darkness where value added is greatest. Black areas indicate markets where sales income greatly exceeds costs, and light areas indicate markets where firms live on very little income beyond production costs. The ceiling surface of the three-dimensional display indicates by height where value added is greatest, with high points in the surface indicating markets where sales most exceed production costs to generate value added.

High levels of value added appear in clusters of markets along the southeastern borders of the map. The dominant concentration is in the human-services markets. This is represented by the large dark area and large bump in the southeast corner of figure 3 and the shaded area in the southeast corner of figure 1, excluding auto repair, amusements, and eating and drinking places. For these markets, on average, each dollar of income contains a very lucrative 69¢ of value added (average for seven markets, weighted by sales from each market). There is a smaller area of profitable activities to the north in petroleum drilling (80¢ value added), mass-media broadcasting (56¢), nonlivestock agriculture (an average of

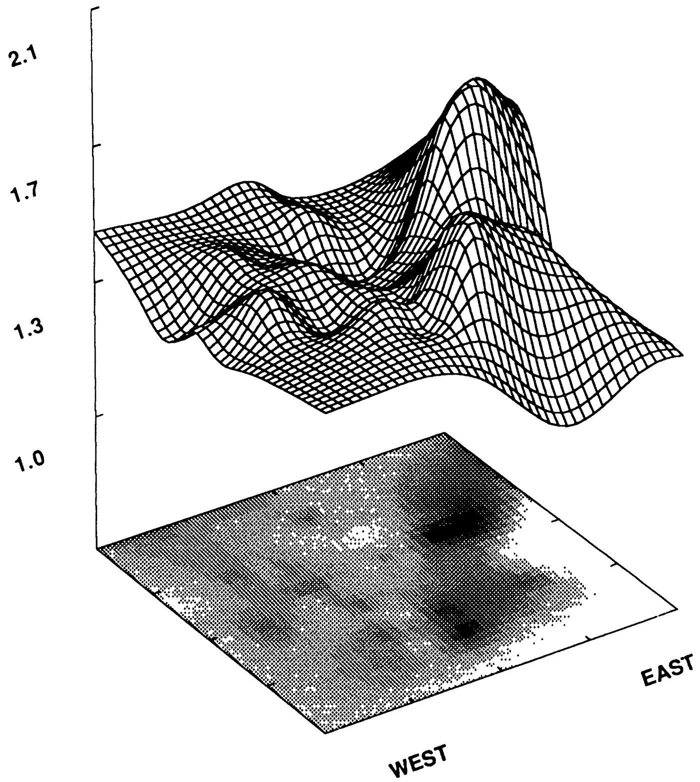
[4] Distributions of criterion variables across the two-dimensional market map were obtained with the distance-weighted least-squares smoothing algorithm in SYSTAT, allowing the surface to be highly flexible (.01 tension), and tying down the surface corners with the criterion variable value closest to each corner.

53¢ value added across three markets, weighted by sales), and coal mining (52¢). There is also a smaller area of profitable activities to the west of services in the markets for ordnance (60¢ value added), optical equipment (50¢), and scientific instruments (51¢). Firms in the markets in the northwest of the map live on the thinnest margins. On average, each dollar of income in the primary metals and mechanical machines markets (excluding metalworking machines) contains 37¢ of value added to distribute across taxes, labor, and profits (this is an average across 12 markets, weighted by sales).

We can use earlier input-output tables to look for correlated trends in market performance. Corroborating the evidence of market stability reported in Burt (1988*b*), performance margins were stable through the preceding two decades. Figure 4 presents data on market growth from the early 1960s through the early 1980s.[5] Note that the average value-added margin in any one period is almost identical to its value five years earlier (more precisely, 1.01 times its earlier value). Similarly, profit margins are very similar over time. More important, note that there is no tendency for increasing or decreasing profit margins to be concentrated in adjacent markets. The contagion effect for profit-margin growth is completely negligible (.3 t-statistic) and the effect for value-added growth is not strong.

While margins are stable, volume is not. There is strong evidence of contagion in market growth, and the graph at the top of figure 4 shows that the redistribution of income across markets is concentrated in two areas of the economy. The largest concentration is in energy, represented by the high bump in the central-eastern region of the topology. In contrast to the average market, for which expansion and inflation increased the total dollars of sales 49% every five years, sales more than doubled every five years for crude petroleum and natural gas drilling (2.10 average growth rate), with a slightly lower 1.84 growth rate in related energy markets (petroleum refining, coal mining, and utilities). The other concentrated growth occurred in the office- and optical-equipment markets, with office-equipment sales increasing 83% every five years and optical-equipment sales increasing 71% every five years. Other than these two concentrations, market growth was randomly distributed through the

[5] Growth is measured as the average ratio of current to previous market performance in roughly five-year intervals corresponding to the release of input-output tables. For example, where VS77 is a market's total sales (value of shipments) in the 1977 input-output table, the market's growth in sales for fig. 4 equals the average of four ratios: [VS82/VS77 + VS77/VS72 + VS72/VS67 + VS67/VS63]/4. The growth variables in fig. 4 are based on 76 markets. The market for eating and drinking places is excluded because it is not a category in the 1963 and 1967 benchmark input-output tables.



	MEAN	CONTAGION	GOING EAST	GOING NORTH
Sales	1.490	.56 (3.7)	.20	-.27
Value Added Margin	1.007	.37 (2.0)	-.17	.13
Profit Margin	0.909	.08 (0.3)	.02	.25

FIG. 4.—Market growth, with a detailed display of sales (growth is ratio of current to previous, averaged from the early 1960s through the early 1980s).

economy, with some markets doing well and adjacent markets doing less well.

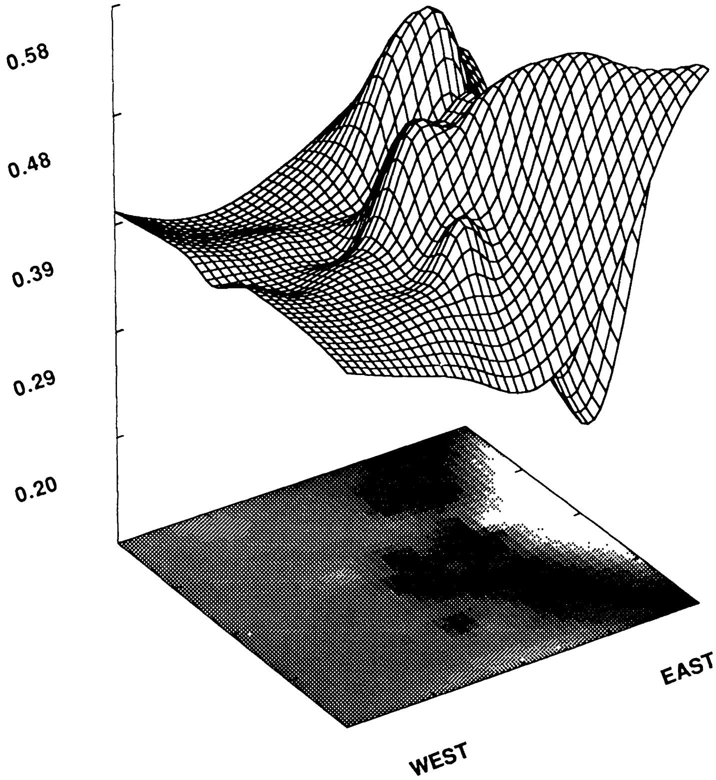
In sum, market performance increased from a low in the mechanical machines markets in the northeast of figure 1 to a high in the southeast quadrant of the map, especially in the services markets. This distribution was stable on average across the preceding two decades. In terms of gross income, there were two pockets of exceptional growth: energy markets growing with the explosion in oil prices associated with the formation of OPEC during the early 1970s and office- and optical-equipment markets growing with the continuing rapid diffusion of computers, copiers, and related office equipment.

Market Structure

Figure 5 presents information on the extent to which markets were structured to provide opportunities for firms to control prices so as to obtain high, stable profits. Three market-structure variables are presented from Burt (1988*b*), where they are discussed in detail. The variables describe the extent to which the structure of transactions defining a market in 1977 provided opportunities for market firms to negotiate advantageous prices reflected in a high value-added margin in 1982. Concentration is a weighted average of the market share (portion of sales) of the four largest firms in SIC subsectors of a market in 1977. Supplier/consumer constraint measures the extent to which producer transactions are concentrated in a small number of interconnected, oligopolistic supplier and consumer markets in 1977. Structural autonomy is a summary measure in the metric of 1982 value-added margins. It increases with the extent to which a market was highly concentrated and free from supplier/consumer constraint during the late 1970s.[6]

The three market-structure variables are not equally associated with market boundaries. There is no evidence of contagion in concentration, and the greatest evidence of contagion is in supplier/consumer constraint. The latter is no surprise since supplier/consumer constraint is defined in large part by the pattern of transactions defining a market, and markets are variably proximate in the social topology as a function of the similarity between the transaction patterns defining them. Structural autonomy,

[6] Specifically, structural autonomy in fig. 5 is the predicted score from a regression model in which value-added margins in the 1982 annual input-output table are regressed over four 1977 market structure variables: concentration, constraint, the interaction of concentration and constraint, and a dummy variable distinguishing manufacturing markets from nonmanufacturing markets (cf. Burt 1988*b*, table 2). The 1977 market structure variables are used because they are based on the most recent benchmark input-output table.



	MEAN	CONTAGION	GOING EAST	GOING NORTH
Structural Autonomy	.443	.61 (2.1)	.36	-.19
Concentration	.357	.45 (1.7)	-.14	-.02
Supplier/Consumer Constraint	.064	.68 (3.4)	.13	.20

FIG. 5.—Market structure, with a detailed display of structural autonomy

jointly defined by market concentration and supplier/consumer constraint, lies midway between its components, showing more evidence of contagion than concentration and less than supplier/consumer constraint.

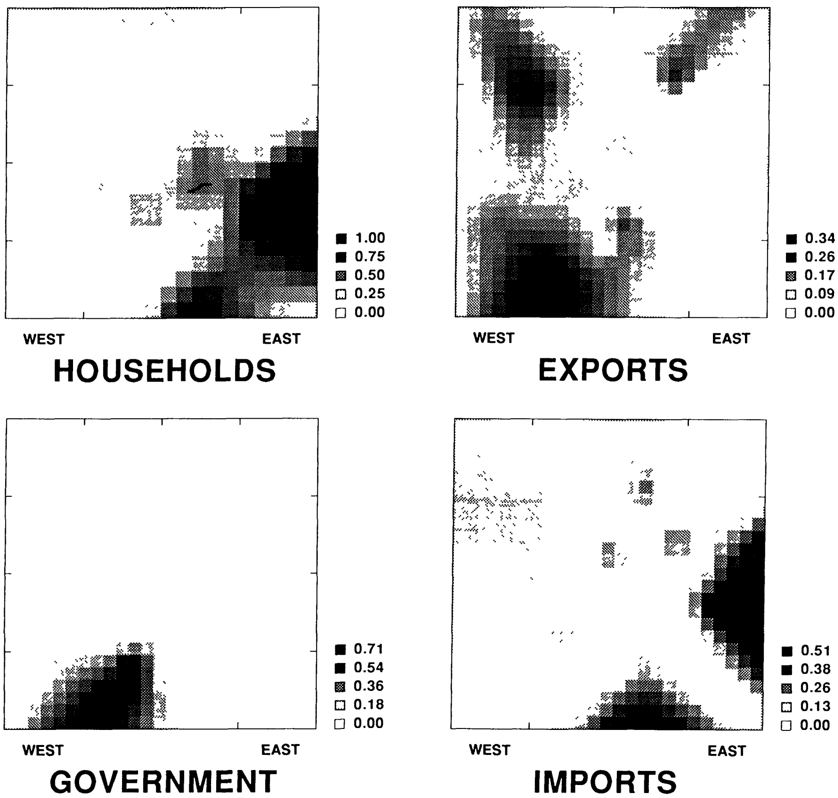
The graph at the top of figure 5 shows that the market structures providing the greatest structural autonomy are distributed along the eastern border of the market topology map. The dominant concentration is in the human-services markets shaded in the southeast corner of figure 1. The structure of these markets, on average, predicts 57¢ of value added in each dollar of income (average for 10 markets, weighted by 1982 sales from each market). Just to the north of the services markets, the structure of the broadcasting and utilities markets also predicts 57¢ of value added in each dollar of income. To the northwest of the services markets, the structure of the mining markets in the shaded area in the center of figure 1 predicts 54¢ of value added in each dollar of income (an average across four markets). Finally, the structure of the food markets in the shaded area in the northeast of figure 1 predicts 44¢ of value added in each dollar of income (the average across all markets).

In figure 6 we move beyond the transactions between producers to show how final-demand transactions are distributed across the map. The final-demand transactions are measured as ratios of final demand to total market output. According to figure 6, households purchased 18% of the average market's output, federal, state, and local governments purchased 5%, another 8% was exported to foreign markets, and imports were 9% of the average market's sales. All four final-demand transactions show evidence of contagion; that is, the pattern of final demand in one market is similar to patterns observed in adjacent markets.

Purchases by individual people, household final demand, is concentrated in the southeast corner of the map, around the markets for clothing, medical/educational services, and miscellaneous manufacturing (which includes commodities such as jewelry, toys, and sporting goods). Weaker concentrations of household consumption occur in textiles, human services, and the markets for furniture and electrical appliances.

Government purchases have the simplest distribution. Government final demand is concentrated in the southwest corner of the map—in the aerospace markets for planes, missiles, communication and controlling equipment, and ordnance.

When we turn to contacts with foreign markets, concentrations of exports can be seen in all four corners of the map—except in the southeast corner containing human services. In the southwest of the map, there are significant exports from the aerospace markets. In the northwest, there are significant exports from the mechanical markets for engines, turbines, construction equipment, and industrial machines. In the northeast, agricultural exports are prominent. Finally, note that imports are concen-



	MEAN	CONTAGION	GOING EAST	GOING NORTH
Household Consumption	.178	.73 (5.6)	.44	-.31
Government	.053	.84 (3.5)	-.11	-.40
Exports	.080	.61 (3.3)	-.34	.00
Imports	.085	.46 (2.8)	-.06	.00

FIG. 6.—Final demand across markets

trated where household consumption is most concentrated, in the markets for clothing and miscellaneous manufacturing. At the same time, it is worth noting that the only areas of the map from which foreign firms are notably absent are aerospace, food, and human services. Elsewhere, foreign firms are a visible presence in the general regions of markets producing electrical and mechanical machines, primary metals manufacturing, textiles, transportation, office equipment, and especially in mining and petroleum (although low imports in adjacent markets water down any visible concentrations in fig. 6 around the relatively extensive imports into certain mining and petroleum markets).

Market Stability

The shift to marginal transactions has implications for the evidence presented in Burt (1988*b*) on market boundary stability. Since marginal transactions better differentiate transaction patterns, they are more likely to reveal variations in those patterns over time. However, market structure growth variables—computed for the variables in figures 5 and 6 the same way the growth variables in figure 4 were computed for the performance variables in figure 3—show little or no contagion effect between markets in the social topology. Moving to a more aggregate level, we have computed the eigenvalue stability measure presented in Burt (1988*b*, pp. 362 ff.) to summarize the stability of each market's boundaries with other markets through the 1960s and 1970s.[7] Stability is measured as the extent to which a market's relative equivalence to each other market was constant over time. The distances between a market and each other market were computed for each year. A single principal component can describe the four-by-four covariance matrix among these distances to the extent that the market's relative equivalence to each other market was constant from 1963 to 1967 to 1972 to 1977. The ratio of variance described by the principal component divided by total variance for each market is graphed in figure 7. The results for structural equivalence distances defined by marginal transaction data are graphed with the same stability measure obtained with proportional transactions (cf. Burt 1988*b*, fig. 2).

As expected, when measured by marginal transactions, market boundaries appear to have been less stable in the aggregate and more variably so across markets than when they were measured by proportional trans-

[7] Again, stability is based on 76 markets. The market for eating and drinking places is excluded because it is not a category in the 1963 and 1967 benchmark input-output tables.

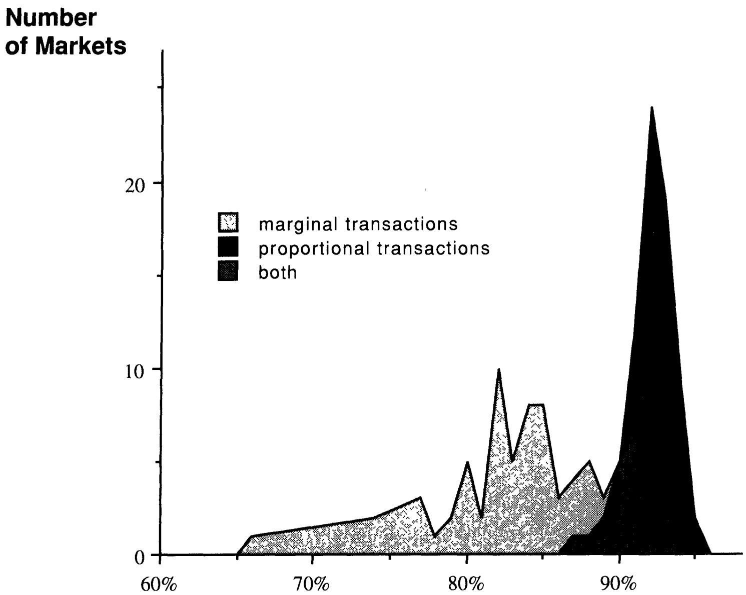


FIG. 7.—Percentage of distance variation within years described by a principal component across years.

actions. The stability measure has an average value of 92% for structural equivalence distances defined by proportional transactions, and this varies little across markets. This is represented by the dark area in figure 7. In contrast, the stability measure has an average value of 85% for structural equivalence distances defined by marginal transactions, and this varies widely across markets. This is shown by the light area in figure 7. In other words, the evidence of market boundary stability reported in Burt (1988*b*) was inflated by specialized markets' being consistently distinct from other markets. Specialized markets define stable points of reference for other markets in the economy. Changing transactions in diversified patterns were too small, when measured as proportional transactions, to shift market positions relative to the stable periphery of the economy.

To say that stability was exaggerated is not to say that markets were in truth unstable. The summary indicator of market boundary stability is lower when transactions are measured as marginal rather than proportional data; however, even then the indicator is quite high, with an average 85% of the distance variance to a market's position in the economy at each of the four benchmark years (1963, 1967, 1972, 1977) described by a single position across the 1960s and 1970s.

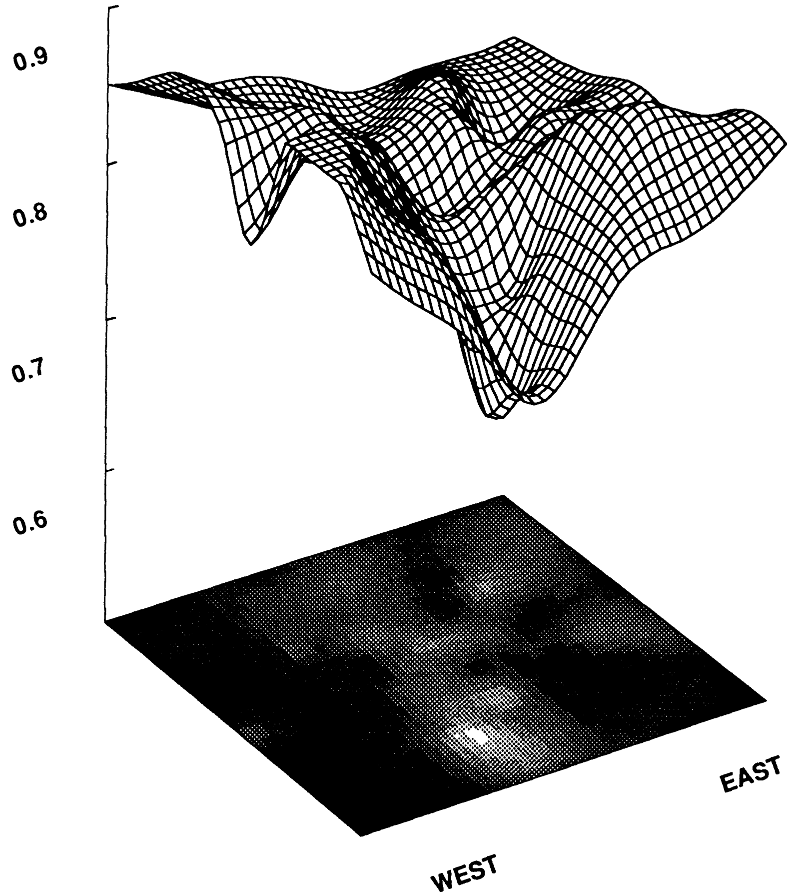


FIG. 8.—Market stability during the 1960s and 1970s (histogram given in fig. 7).

The distribution of the stability measure across the market topology map is displayed in figure 8. There is strong evidence of contagion in market stability (jackknife estimate of .67 network autocorrelation, with a 5.7 *t*-statistic), created by a single concentration of instability indicated in the central southern part of the map in figure 8 by a light area beneath the sharp dip in the ceiling surface. The markets creating this area of relative instability are ordnance, computers, and communication equipment. The markets for ordnance and computers lie to the extreme left in the histogram in figure 7. Elsewhere in figure 8, varying levels of stability in adjacent markets average across markets to a high level of stability.

BROAD DISTINCTIONS RECONSIDERED

To empower this article as a reference for designing research samples, we have offered a somewhat overwhelming number of data distributions in the preceding pages. For someone constructing a sampling frame, the facts alone are the new and needed information; the researcher's own agenda provides the interpretation. Before concluding the article, however, we wish to consolidate the descriptive passages above into some general distinctions between American markets. To facilitate the discussion, we present average *z*-score market characteristics in table 1 for each of the four quadrants of the market topology in figure 1, the northeast quadrant (positive scores on both dimensions of the multidimensional scaling), southeast quadrant, and so on. A positive quadrant average means that markets in the quadrant are above average relative to all markets in the economy. A small probability of no difference between quadrants (*P*) indicates that differences between markets in separate quadrants are typically larger than differences between markets in the same quadrant.

The most significant contrast seems to be between the mechanical machine markets to the northwest of the map and the human-services markets to the southeast. Drawing on the initial discussion of kinds of markets in figure 1, we see that the long-standing production technologies

TABLE 1

MEAN *z*-SCORES ON KEY MARKET CHARACTERISTICS BY QUADRANT OF FIGURE 1

	NE (22)	SE (19)	NW (19)	SW (17)	*P*
Market performance:					
Value added (fig. 3)	−.30	.59	−.25	.00	.02
Growth (fig. 4)	.07	.32	−.28	−.11	.31
Market structure:					
Autonomy (fig. 5)	−.02	.64	−.51	−.11	.01
Concentration (fig. 5)	.33	−.46	.04	.09	.09
Constraint (fig. 5)	.57	−.28	.00	−.37	.01
Household consumption (fig. 6)	−.20	1.02	−.58	−.23	.01
Government consumption (fig. 6)	−.33	−.11	−.26	.85	.01
Exports (fig. 6)	−.07	−.43	.30	.24	.09
Imports (fig. 6)	.02	−.11	.16	−.09	.85
Market stability (figs. 7, 8)	−.33	.20	.34	−.16	.12

NOTE.—The probability of no difference across quadrants is given to the far right under *P*, based on a one-way analysis of variance. A value of .01 indicates a probability of .01 or less. The number of markets in each quadrant is given in parentheses under each quadrant's compass heading. Scores have been standardized across all markets, so negative quadrant averages indicate markets below average and positive quadrant averages indicate markets above average.

in the mechanical machine markets characterizing the northwest quadrant of the map have stabilized over the years to yield below-average value added and below-average growth. The markets are average in their concentration and supplier/consumer constraint, yielding the lowest average structural autonomy in any quadrant.

The action is clearly in the southeast quadrant, in new technologies for human services. Here are the markets yielding the greatest average value added and the highest average growth. Moreover, the markets are structured to yield high profits, as can be seen from structural autonomy's reaching its highest average level in the southeast quadrant. Firms in these markets do not reap oligopoly profits (note the minimal average concentration in this quadrant). They make their profits by offering products that can be sold across almost any sector of the economy. Their high structural autonomy comes from their diversified supplier/consumer transactions, which are in turn the most significant components determining the structural autonomy of firms in a market to negotiate prices to their own advantage and so create value added. More specifically, there are two important classes of markets in the southeast quadrant, both in sharp contrast to markets in the northwest quadrant.

The office- and optical-equipment markets are characterized by high growth, high structural autonomy, and the least stable market boundaries in the economy. Successful firms in these markets have multiple competitors (as opposed to being oligopoly producers), sell to a shifting mix of consumer markets, and make a lot of money. Change and uncertainty are the rule.

The other important class of markets shown in the southeast quadrant is human services. These markets are characterized by high levels of value added, high structural autonomy created by the diversity of their consumer markets, high exposure to final demand from people as consumers, and low exposure to foreign firms. The homophily component in human-services markets shows up in the form of little exporting and the exceptional absence of foreign firms. Successful firms in these markets have special competence in negotiating interpersonal relations—a need created by their dependence on consumption by individuals and a characteristic of the people who choose to enter the human-services professional training required for practicing in these markets. The firms have multiple competitors, sell to a diverse, stable mix of consumer markets, and make a lot of money.

The most striking feature of the southwest quadrant of the market topology is the presence of aerospace and its related high-technology production processes, with the markets for electrical machines to the north on the border with mechanical machines and household commodities to the northeast. Government consumption reaches its maximum average level in this quadrant, and the bulk of that demand consists of defense purchases from the aerospace markets. The aerospace markets are above average in concentration, about average in supplier/consumer constraint, and yield a slightly higher-than-average level of value added. They export an above-average level of their output but import little. The net impression is that successful firms shown in the far southwest quadrant are large, with few competitors, possessed of special competence in doing business with American and foreign government customers, free from competition within the United States from foreign firms, and able to generate an above-average level of value added.

At the opposite corner, the markets shown in the northeast quadrant of the map produce plant and animal products. The northeast is a very heterogeneous quadrant. For example, fossil fuels and nonlivestock agriculture generate especially high levels of value added, yet the quadrant average for value added is below average. The most dramatic growth anywhere in the economy occurred in the fossil-fuel markets, yet overall growth in the northeast quadrant is merely the average for the economy. Some of the most concentrated markets in the economy appear in the northeast quadrant together with some of the least concentrated. At minimum, two classes of markets are distinct in the northeast quadrant (putting to one side the mining and textiles markets that spill over from the northwest quadrant).

These are, first, the food markets, especially the nonlivestock agriculture markets. These markets are highly competitive at the same time that they face intense supplier/consumer constraint because of their dependence on a small number of other sectors for supplies and purchases. For example, 40% of the extramarket transactions by establishments in the forestry and fishery market are with the lumber and wood-products market. Establishments in the "other agriculture" market transact 25% of their extramarket business in the food market and another 24% in the livestock market. Despite their disadvantageous structures, these markets produce above-average value added. They tend to be well organized through trade associations and able to protect themselves from imported agricultural products at the same time that they export a substantial portion of their production to foreign markets.

The fossil-fuels and utility markets are most distinct from the food markets in terms of concentration. Like the food markets, the market for fossil fuels and the markets for broadcasting, power, water, and sanitation suffer the disadvantage of dependence on a small number of other sectors for supplies and purchases. Establishments for drilling crude petroleum and natural gas transact 70% of their extramarket buying and selling in the petroleum-refining market. Coal-mining establishments transact 45% of their extramarket business with gas and electric utilities.

Unlike the food markets, however, the fossil-fuels and utilities markets are highly concentrated, dominated by regional monopolies closely regulated by government agencies. It is through this component that they have the structural autonomy to negotiate the advantageous pricing that yields their high value added. Successful firms in these markets operate in oligopolistic or near-monopolistic conditions and can focus on managing their stable dependence on a very small number of supplier and consumer markets to negotiate advantageous prices. Like human-services firms, these firms benefit from skills in managing people as consumers; however, their concern is with mass public opinion about their legitimacy as public-service companies as much as it is with individual consumption.

In sum, the preceding data displays, improving the precision of distinctions within the marklet topology, flesh out a sampling frame for organization research. They distinguish, and indicate the relative similarities between, kinds of market environments in the American economy. Firms and employees successful in different kinds of markets can be expected to have adapted to the conditions for survival in the different markets, taking those conditions for granted as a ubiquitous frame of reference for doing business.

SUMMARY

Experienced network analysts know that differences between structural equivalence analyses can be attributed to seemingly innocuous differences between measures of relationship as much as or more than they can be attributed to differences between structural equivalence distance functions. This impression is based typically on whatever study populations have happened to come to an analyst's attention, although more systematic evidence can be obtained from Monte Carlo studies across kinds of populations (e.g., Burt 1988*a*).

The contrast drawn in this paper between alternative structural equivalence analyses of markets clearly illustrates the point. Proportional measures of transaction strength yield a very different image of the American economy from the image generated with marginal measures of transaction strength. Structural equivalence distances computed from proportional transactions highlight distinctions between specialized markets, markets with one principal supplier or consumer sector. The same distances computed from marginal transactions capture distinctions between the patterns of transactions defining markets and so better highlight substantive distinctions between kinds of markets.

Compared with the results obtained with proportional measures, marginal measures of transaction strength yield a substantively richer market topology to guide organization research by offering clearer distinctions between kinds of market environments in which organizations operate. At the same time, the results obtained with marginal transaction data corroborate the conclusion reached with proportional transaction data that market boundaries were, by and large, stable during the 1960s and 1970s. The implication is that the described market topology provides a stable sampling frame for organization research. We hasten to stress again, as before (Burt 1988*b,* pp. 388–90), that the stability corroborated here is stability across markets, not within markets. The social structure of the production relations defining markets and the shape of successful firms in the markets can be stable despite massive turnover in the population of the firms transacting those relations. This is the familiar tension between enduring social structures and changing populations, and it is the former that we have found to be stable in American markets.

In sum, the seemingly innocuous choice between proportional and marginal measures of market transaction data can be significant. Proportional transaction measures are well suited to their traditional use in economic input-output models tracing the flow of resources through a network. Marginal transaction measures are the more useful measure for sociological studies of market boundaries for organizational analysis because they more clearly reveal variation in the resource-flow patterns that define structurally equivalent (substitutable) production activities as a market.

APPENDIX

The raw transaction data measuring the amount in dollars of goods purchased by one sector from another are averages combining the 1981 and 1982 input-output tables published by the Department of Commerce (*1987 Survey of Current Business,* pp. 44–51; and *1988 Survey of Current Business,* pp. 32–39). These annual data are not the direct measures provided by the benchmark tables published every four or five years. (The 1982 benchmark table is to be released late in the *1989 Survey of Current Business.*) Rather, these annual tables are based on direct measures of the marginals for the annual table that are then used with the proportional cell measures from the previous benchmark table to estimate cell entries in the annual table. Further, the value-added components used to estimate sector profit margins are available only in the benchmark tables. In other words, the 1981 and 1982 annual tables are based on the structure of transactions in the 1977 benchmark table, and the profit data we present come directly from the 1977 table. I have used the 1981 and 1982 tables here because of the more recent marginal and final-demand data on which they are based, but they are not presented as benchmark results. In all the distances to be considered, the five final-demand transactions (sales to households, federal government, state and local government, exports, and imports) can be quite large and are measured as proportions of total market output.

The multidimensional scaling in figure 1 follows Kruskal (1964), as implemented in SYSTAT, using a linear prediction of observed distances between markets. There is not much difference if the less restrictive monotonic prediction is used, but the linear prediction spreads the markets out more widely in the space (at a cost of slightly higher stress coefficients). Across increasing dimensions, the stress coefficient (analogous to one minus the squared correlation) starts at .44 for one dimension, decreases to .27 for the two-dimensional solution in figure 1, and from there decreases to .19, .15, and .12 for three-, four-, and five-dimensional solutions, respectively.

The two-dimensional distances between markets in figure 1 are strongly correlated with observed differences between markets (.79), but substantive inconsistencies exist that are resolved in higher-dimension solutions. The most irritating were the appearance of coal mining and maintenance construction at the bottom of the map next to miscellaneous manufacturing in the general area of aerospace, computers, and instruments. In the three-dimensional solution, maintenance construction is next to new construction on the first two dimensions, and coal mining lies closer to the utilities market. Thinking that there might be a class of solutions in the same area as the initial one, we recomputed the scaling with the two-dimensional solution as an initial configuration—except that maintenance construction was given the coordinates of new construction and coal mining was given coordinates between utilities and the other mining markets in the center of the map. The solution is displayed in figure 1 and is identical to the initial solution in stress coefficient (to four decimal places), correlation between observed and predicted distances (to three decimal places), and the location of all markets but one. Maintenance construction again migrated toward the miscellaneous manufacturing market as it appears in figure 1. But coal mining moved to its location in figure 1, a more intuitively meaningful position, between the petroleum and chemicals markets. We tried various start values. If coal mining is given initial coordinates anywhere in the triangle bounded by tobacco, chemicals, and utilities, in the final solution it ends up where we see it in figure 1.

The three-dimensional solution seems optimal from the progression of stress coefficients, but the complexities of three dimensions erode the figure's heuristic value. The two-dimensional solution seems adequate and optimal for the purposes of figure 1, especially since full-dimension distances are used to test for contagion effects between markets.

There are ostensible differences between the market topology map in figure 1 and the corresponding map presented in Burt (1988*b*), differences that deserve more detailed discussion so that they do not divert attention from comparisons between the two maps. Figure 1 describes the American economy during the early 1980s, while the previous figure described the 1960s and 1970s. Figure 1 includes five final-demand transactions in the pattern defining a market's position in the economy (sales to households, federal government, state and local government, exports, and imports), while the previous figure was based only on intermediate demand (intermarket transactions). Figure 1 is a multidimensional scaling following Kruskal (1964), while the previous figure was a multidimensional scaling following Takane, Young, and de Leeuw (1977). None of these differences are important in this analysis. However, to prove this to the skeptical reader, the most direct method of controlling these ostensible differences would be to present two maps generated by the same scaling procedure from the same transaction data, one map based on proportional transaction strength and the other based on marginal strength. We have not presented two maps because the map obtained with proportional transaction data for the early 1980s using the Kruskal scaling algorithm looks just like the map obtained with earlier proportional transaction data using the Takane et al. algorithm and published in figure 1 of Burt (1988*b*). This should not be too surprising given the similarity of the scaling options selected, the stability of the transaction patterns during the 1960s and 1970s described in Burt (1988*b*), and the fact that the early 1980s data are strongly determined by the 1977 benchmark data as explained above. Nevertheless, to focus better on what was significantly different between the figures, we computed canonical correlations between market positions on the two dimensions in figure 1 with positions in two-dimensional maps generated by the same scaling procedure from the same transaction data—varying the measures used to define distances. Here are some of the key results, where the first row is for figure 1 and the last row is for the map in Burt (1988*b*) (with the stress coefficient for each multidimensional scaling in parentheses):

Marginal transaction strength:	
All extramarket transactions (.272)	1.000
Excluding final demand (.271)	0.991
Excluding final demand and including intramarket transactions (.274)	0.795
Proportional transaction strength:	
All extramarket transactions (.265)	0.580
Excluding final demand (.264)	0.567
Excluding final demand and including intramarket transactions (.242)	0.518

Figure 1 is based on all extramarket transactions including final-demand transactions, a total of 161 transactions for each production market (78 purchase transactions from supplier markets and government enterprises, and 83 sales transactions to consumer markets, government enterprises, and final demand). If we exclude final-demand transactions from the distance equation, positions in a two-dimensional map of the resulting distances are correlated .991 with market positions in figure 1. In other words, the solution is little affected by excluding final-demand relations. If we allow diagonal elements of the input-output table to be used as the maximum transaction in a row, then the correlation drops to .795. At this aggregate level, the volume of transactions in markets is much higher than the transactions with any one supplier or consumer market. Therefore, normalizing by intramarket transaction volume begins to show the homogenizing effects of proportional measures of transaction strength. The biggest variations from figure 1 occur with proportional transaction data. The canonical correlation drops to .580 for the all-extramarket-transactions definition of market position used in figure 1, .567 if final demand is excluded, and .518 if diagonal elements are included in total sector output. The last of these alternatives, the one most dissimilar to figure 1, was used to define structural equivalence in Burt (1988*b*).

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