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Partitioning the American Economy for Organization Research

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Note — A copy of this paper and the structure-performance data in Table 3 on the proposed industries can be downloaded from the following webpage: http://gsbwww.uchicago.edu/fac/ronald.burt/research. I am grateful to Holly Raider for comments on the draft manuscript.

Partitioning the American Economy for Organization Research

My goal in this paper is to use the sociology of markets to better define industries for organization research. How an organization operates, and how well it operates, depends in large part on its fit to the market environment, the industry, in which it operates. Valid distinctions between industries are therefore a critical exogenous factor affecting the quality of organization research. The market boundaries around an industry are defined in theory by the network concept of structural equivalence: products are in the same market to the extent that their production involves purchases from the same supplier markets and sales to the same customer markets. I apply the structural equivalence criterion to detailed transaction data from the U.S. Department of Commerce and get three results: (1) The analysis yields a partition of the American economy into 123 industries (versus the 77 distinguished by Commerce before 1987, and the 88 thereafter), showing where product distinctions are negligible, and where distinctions between structurally nonequivalent kinds of products are needed. (2) Market boundaries are defined less by the homogeneity of transaction patterns within industries, than by differences between industries. Many industries contain products that are structurally nonequivalent with respect to an important supplier or customer transaction. (3) Nevertheless, the proposed partition into 123 industries promises stronger results for organization research because transaction patterns are more equivalent within the proposed industries (more reliable market boundaries), and performance differences are more between than within the proposed industries (market boundaries with higher construct validity). Structure-performance scores on several variables for the proposed industries are presented and can be downloaded from the internet (see acknowledgment note).

People accustomed to the authoritative inferences possible with probability samples of data such as provided by the General Social Survey or the Panel Study of Income Dynamics are quite rightly appalled at the convenience samples characteristic of organization research. There have been occasional efforts in organization research to match the sampling rigor in survey research (for an exemplar, and references to other efforts, see Kalleberg, Marsden, Aldrich, and Cassell, 1990; Kalleberg, Knoke, Marsden, and Spaeth, 1996), but the standard has been to study one or a few firms to which a principal investigator has convenient access. For various reasons (including the honorable ones of research budget and the close study needed to understand how an organization works), convenience samples are likely to continue to characterize organization research. To the extent that this prediction is correct, future organization research will not benefit as it should from improved methods of drawing probability samples. Generalizeable research is more likely to result from establishing

criteria that link study organizations or study industries, selected in a nonprobabilistic way, back to broader populations of organizations.

There are two ways to proceed, both of which have been popular in organization research. The simpler is to say that a study organization is a kind of organization, and claim that research results on the study organization generalize to other organizations of the same kind (e.g., other large organizations, other multi-divisional organizations, multi-nationals, matrix organizations, network organizations, etc.). This is a poor criterion for inference. Whatever the clarity and significance of distinctions between kinds of organizations, generalization by kind of organization ignores environment.

If the diverse views in organization theory agree on anything, it is that the value and operation of an organizational form is contingent on the market environment, the industry, in which it operates (recent overviews of the literature include Hall, 1998; Pfeffer, 1997; Scott, 1998). To cite a classic example, loose-coupling between functions is an advantage for an organization operating in a complex, changing market, while the opposite is true in a stable market with strong customers (the contrast between plastics and cans in Lawrence and Lorch, 1967). Further, kinds of organizations in an industry can be expected to adapt to their industry's resource flows such that organizations in the same industry come to resemble one another (resource dependence, e.g., Pfeffer and Salancik, 1978), or they can be expected to be sorted for their fit such that organizations in the same industry come to resemble one another (population ecology, e.g., Hannan and Freeman, 1989) or they can be expected to imitate the same successful organizations such that organizations in the same industry come to resemble one another (the institutional perspective, e.g., Powell and DiMaggio, 1991). The inferential power of organization research is ultimately a function of clear distinctions between industries.

Industries are the second criterion for generalizing research: The study organization operates in a specific industry, so research results on the study organization generalize to other organizations in the same industry or same kind of industry. This second inferential criterion is implicit in data descriptions that identify research by the industry in which the study firm or firms operate (e.g., "I study a leading firm in the textiles industry." or "Our data describe airlines over a ten-year period."), and in research designs that sample organizations by industry (by broad categories in the Standard Industrial Classification, e.g., Warner, Unwalla, and Trimm, 1967; Burt, 1983; or even broader categories in business magazines such as Fortune, e.g., Kotter and Heskett, 1992).

However, industries are a useful criterion for generalizing research only up to the limit of the clarity with which market boundaries around the industries can be defined. The network concept of structural equivalence is a fundamental element in the sociology of markets (cf., Swedberg, 1994; Lie, 1997) in providing a clear theoretical definition of market boundaries: two products are in the same market to the extent their production involves purchases from the same supplier markets and sales to the same customer markets. The equivalence definition of market boundary is consistent with the substitutability definition in input-output analysis (argument and references in Burt, 1983: 60-63; 1992: 41-42; Burt and Carlton, 1989), and the Lotka-Volterra definition of niche in population ecology (argument and references in Burt, 1992: 208-225; Burt and Talmud, 1993). The empirical task is to use the equivalence criterion to define the market boundaries around industries for organization research.

That is the task reported in this paper. The authoritative data with which to define boundaries in the American economy are the transaction data published by the U. S. Department of Commerce on detailed sectors of the American economy. In intervals of every five years over recent decades, the Bureau of Economic Analysis at the U. S. Department of Commerce has published a benchmark input-output table of the American economy reporting, from a census of establishments, the dollar value of goods exchanged between categories of economic activity. The most recent benchmark table, released in 1997, described the economy in 1992. The detailed transaction data are published for about five hundred product categories (485 in 1992, 469 in 1987, 528 in 1982) that are assigned to just under one hundred aggregate industry categories (88 in the 1987 and 1992 benchmark tables, 77 before 1987).

The aggregate categories are a useful framework for case and comparative analyses of organizations. The categories are narrow enough to span a rich diversity of market conditions in which firms operate, yet broad enough to contain the primary production activities of large firms. More, the census data available on the aggregate categories make it possible to measure the intensity of market competition, demonstrate market stability from the 1960s into the 1990s, and draw rigorous comparisons between market environments in which case-study firms have been analyzed. Argument, evidence, and literature review for these statements is available elsewhere. See Burt (1988), Burt and Carlton (1989), Burt, Guilarte, Raider, and Yasuda (1997) on stability. See Burt (1992, Chap. 3) and Burt et al. (1997) on the relative intensity of market competition. See Burt, Gabbay, Holt, and Moran (1994) and Burt et al. (1997) on using Commerce categories as a

framework for sampling organizations and generalizing from case-studies to the population of American firms.

Aggregation remains an issue. The aggregation in some Commerce categories seems appropriate for organization research. For example, the Metal Container category combines metal cans with metal drums. Few organization studies require a market distinction between metal cans and drums. On the other hand, meat companies and beverage companies are usually treated in research as operating in separate markets, but meat and beverages are only two of many products combined in Commerce's Food industry.

In truth, aggregation will always be an issue. Few producers have such similar relations with suppliers and customers that they can be said to operate in identical markets. Aggregation in empirical research is a decision about how similar two producers are relative to other producers. The aggregation suitable for one research project, is too detailed for another project, and excessive for some other project. There is something interestingly different between the market environments of any two organizations; something obscured when the organizations are combined with competitors to characterize their shared market.

Nevertheless, what can be done in an authoritative way is to determine how much transactional information is obscured by alternative aggregations, such that research can be based on the most accurate of alternatives when research calls for accurate inference across industries. Thus this paper.

DATA

I will refer to the Bureau of Economic Analysis at the U. S. Department of Commerce as "Commerce," the detailed sectors as "products," and the aggregate sectors as "industries." To further distinguish the two classes of categories, I will capitalize industry names and leave product names in lower case. I analyze the two most recent benchmark tables, 1987 and 1992. Product categories are more often than not comparable in the two tables, and the detailed transaction data are readily available on diskette for organization research.

PRODUCT CATEGORIES WITHIN INDUSTRIES

The Commerce industries are 77 before 1987, then 88 in the 1987 and 1992 tables. Patterns of buying and selling between the industries are dramatically stable across the 1963, 1967, 1972, 1977, 1982, 1987, and 1992 benchmark tables (Burt, 1988; Burt et al., 1997). The 88

industries in the current aggregation are listed in Table 1. The column labeled "Commerce ID" shows how the 77 prior industries were re-arranged in 1987 to define the 88 current industries. Double numbers denote aggregations. In the fifth row, for example, Metallic Ores Mining (sector 5-6) is a combination of what was Ferrous Ores Mining (sector 5) and Nonferrous Ores Mining (sector 6). Lettered numbers denote disaggregations. For example, Printing and Publishing (sector 26 in tables before 1987) was subdivided in 1987 into Newspapers and Periodicals (sector 26A) versus Other Printing and Publishing (sector 26B). Also, because they are so often used in organization research, I have listed in Table 1 the two-digit Standard Industrial Classification (SIC) categories associated with each industry.

The gist of the change to the current Commerce aggregation is fewer supplier distinctions (industries listed above the box in Table 1, from 12 categories down to 9), slightly different manufacturing industries (in the box; was and still is 52 categories), and many more distinctions between distribution and service industries (below the box in the table, from 13 categories up to 27). Commerce publications offer a brief explanation of the change to the new categories in 1987 (U. S. Department of Commerce, 1994: 76): "With one exception, the aggregations involved small, declining industries; new construction and maintenance and repair construction were aggregated because of the abbreviated procedures used for the 1987 benchmark. The disaggregations involved large, growing industries."

——— Table 1 About Here ———

The detailed transaction data are dollars of buying and selling between product categories within the industries. The benchmark input-output tables are published with a list of detailed product categories in each aggregate category, and the four-digit SIC codes corresponding to each product category (U. S. Department of Commerce, 1991: 42-49; 1994: 68-71; 1997: 58-62). Product categories are not consistent across recent benchmark tables. The first three columns in Table 1 show 528 product categories in the 1982 data, 469 categories in the 1987 data, and 485 categories in the 1992 data (1982 is listed to show how much categories changed in 1987). Each row shows the number of product categories within an industry. For example, Tobacco contains the same four product categories each year; cigarettes (SIC 211), cigars (SIC 212), chewing and smoking tobacco (SIC 213), and tobacco stemming and redrying (SIC 214). In contrast, the seven 1982 product categories within Scientific and Controlling Instruments were expanded to 12 categories in 1987 and 1992 (e.g., engineering and scientific instruments, category 62.0100, is divided into search

and navigation equipment, category 62.0101, versus laboratory apparatus and furniture, category 62.0102).

PRODUCT TRANSACTION PROFILE

I constructed a "transaction profile" for each product category in each input-output table. For a table distinguishing N product categories, each transaction profile contains 2N+5 elements. Elements 1 to N are purchases from each of the N product categories. This is a column in the input-output table (e.g., the 1987 sector 27.0100 to 29.0100 transaction is drug producers buying $513.5 million from industrial inorganic and organic chemicals companies). The next N elements are sales to each of the N product categories. This is the corresponding row in the input-output table (e.g., the 1987 sector 29.0100 to 14.1402 transaction is drug producers selling $8.5 million to cereal breakfast foods companies). For the purposes of this paper, I aggregated purchases from the nine supplier markets at the top of Table 1 (agriculture, mining, and construction). Finally, the last five elements in each transaction profile are sales to final demand (household sector, exports, imports, federal government, and state-local government). I cannot construct a single transaction profile across the 1987 and 1992 benchmark tables because product categories are not identical in the two tables. Profiles for products in the 1987 table contain 871 transactions (433 + 433 + 5). Profiles for products in the 1992 table contain 883 transactions.

I want to compare products for the relative strength of their supplier and customer transactions so I remove volume differences from the transaction profiles. Input-output analysts use proportional input coefficients to compare production functions, but market boundaries are more apparent from marginal strength relations (Burt and Carlton, 1989). I divided dollar transactions by maximum transactions. Purchases from suppliers are divided by the maximum purchase from any product category: the first N scores in each profile vary from 0.0 (producers buy nothing from the category) to 1.0 (producer purchases from the category are their maximum purchase from any category). Most transactions are zero because the typical product involves few supplier industries. Sales to customers are divided by maximum sales to any product category: the second N scores in each profile vary from 0.0 (producers sell nothing to the category) to 1.0 (producer sales to the category are their maximum dollars of sales to any category). Again most transactions are zero because the typical product is sold to a few customer industries. The final five transactions in each profile are divided by the maximum final demand transaction for each product category. Marginal strength of sales to final demand in 1992 varies from .002 to 1.000 for households

(.500 mean), from .001 to 1.000 for exports (.348 mean), from .001 to 1.000 for imports (.369 mean), from -.206 to 1.000 for the federal government (.086 mean, negative in the input-output table when sales to federal government are less than the federal subsidy to producers, most notably in agriculture), and from -.565 to 1.000 for state and local government (.265 mean, again negative when sales to the state and local government are less than the state and local subsidies to producers, here most notably in health and education services).[1]

DETECTING MARKET BOUNDARIES

The product transaction profiles can be compared to detect market boundaries. Two products are structurally equivalent within the same market to the extent that they involve the same proportions of buying and selling with the same supplier and customer markets. The structural equivalence between product categories i and j is measured by the Euclidean distance between their transaction profiles: $d_{ij} = [\sum_k (b_{ik} - b_{jk})^2]^{.5}$, where d_{ij} is the Euclidean distance summarizing differences between the two profiles, b_{ik} is the kth element in the product i transaction profile, b_{jk} is the same transaction in the product j profile, and buying and selling within product categories is excluded ($k \neq i, j$, else distances would be greatly determined by business between products i and j so distance would measure cohesion, or resource dependence, instead of the structural equivalence between products). Distance between products is zero for structurally equivalent products, and increases with the extent to which the product categories involve buying and selling with different supplier and customer markets. Distances were subjected to hierarchical cluster analysis (Ward's, 1963, variance criterion to represent structural equivalence) and multidimensional scaling to detect boundaries between nonequivalent products (Kruskal, 1964). Further detail was obtained from correlations between transaction profiles and comparing nonzero elements in the transaction profiles for specific product categories.

[1]Imports are typically negative entries in the published input-output tables because imports substitute for domestic production. An exception is goods imported by the wholesale sector, which are reported as positive income from trade. For the purposes in this paper of measuring the marginal strength of business with final demand sectors it is the volume of imports that is significant, not the direction in which they are reported. To make imports comparable across product categories, I coded all imports as positive dollars of trade.

PRINTING AND PUBLISHING

The process of detecting market boundaries can be illustrated using the relatively simple example of printing and publishing (Figure 1 and Table 2). There were 12 printing and publishing products in the 1992 and 1987 benchmark tables. The current aggregation (at the bottom left of Figure 1) combines newspapers and periodicals into one industry (26A) and all other products in a second industry (26B). Aggregation prior to 1987 combined all products into a single industry (sector 26). The proposed aggregation (at the bottom right of Figure 1) is to separate a Publishing industry ($87.8 billion in 1992) from Printing ($79.4 billion). The products had a combined output of $167.2 billion in 1992.[2]

Figure 1 is a spatial map based on a multidimensional scaling of distances between transaction patterns for the 12 product categories in 1992. Products close in the map have similar transaction profiles. The Commerce decision to combine newspapers (category 26.0100) with periodicals (category 26.0200) makes sense because the two categories are close in the map and separate from other products. The other products are not similarly clustered.[3] I circled four product categories to the right in the map that cluster together as printing products clearly distinct from newspapers and periodicals: book printing (26.0302), bookbinding (26.0802), typesetting (26.0803), platemaking (26.0806).

——— Figure 1 and Table 2 About Here ———

The two circled sets of products are a frame of reference for aggregating the other products. I computed an average transaction profile for Publishing by averaging each transaction in the newspaper profile (26.0100) with the corresponding transaction in the periodicals profile (26.0200). I averaged transaction profiles for the four printing products to get a Printing profile. Table 2 lists the 15 transactions beyond printing and publishing that have a marginal strength greater than .3 in either average profile. The first column lists transactions for Publishing, and the second column lists Printing transactions.

Paper is the primary input for both Printing and Publishing (fourth row of Table 2), with wholesale trade second. Printing is distinct from Publishing in its purchase of printing machinery and photography.

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[2]Output is the column sum for a product of purchases plus value added. Value of shipments is the row sum of sales for the product, which includes negative adjustments for inventory change, imports, and government subsidies. Output better reflects the volume of business passing through organizations that make the product and will be the number used in the text to indicate volume of business.

[3]Using the structural equivalence measure introduced below in the Reliability section, a single principal component describes 46.9% of variance in their transaction profiles.

The two sectors are more distinct with respect to their customer industries. Printing is an insider business in that printers sell primarily to Publishing (not listed in Table 2) and to government organizations, especially state and local government. Publishing is an outsider business in that a high volume of sales are to sectors outside Printing and Publishing, especially to households. Households are to Publishing what government organizations are to Printing.

Compare the first and second columns to book publishing, the third column of Table 2. Like newspapers and periodicals, book publishing involves extensive sales to households, little demand from the federal government, and extensive sales to educational institutions. In other words, organizations involved in book publishing can be expected to have the resource-dependence concerns of newspapers and periodicals (as opposed to the resource-dependence concerns of printers). Organizations that produce greeting cards (fourth column in Table 2) do not have the same widespread demand for their product, but they share with newspapers and periodicals their dependence on sales to households. In contrast, organizations that produce business forms (fifth column in Table 2) have a transaction profile in some ways similar to printers — low sales to the household sector and high sales to state and local government, and in other ways similar to publishers — high sales to retail, wholesale, and hospitals. The mixture of Printing and Publishing in the transaction profile explains why the product category of business forms is apart from both Printing and Publishing in Figure 1 (sector 26.0601 at the top of the spatial map). On balance, however, the business-form transaction profile is more similar to Printing than to Publishing (correlations of .61 and .32 respectively across the 949 transactions in the profile). Two product categories in Figure 1 are similarly closer to Printing; commercial printing (26.0501), and blankbooks and binders (26.0602). One product category in Figure 1 is in the same way more similar to Publishing; miscellaneous publishing (26.0400; profile correlation of .57 with publishing versus .27 with printing).

THE PROPOSED INDUSTRIES

I grouped the products beyond Printing and Publishing into ten broad classes for analysis. Results are reported in the Appendix for each class. Classes are broad enough so products are unlikely to be equivalent across classes, which reduces the network analysis to a manageable task of studying equivalence within each class separately. At the same time, classes contain related industries, so products in adjacent markets can be tested for equivalence. My default was to stay with the current Commerce aggregation unless the

network analysis reveals a compelling alternative (as in Printing and Publishing). Even where the analysis reveals no change, however, the result of this exercise is to know the extent to which the boundaries around each industry are based on products substitutable in a structural equivalence sense.

The end result of the network analyses is a proposed aggregation of products into the 123 industries in Table 3. The first nine rows are supplier markets taken unanalyzed from the current Commerce aggregation in Table 1. Also, I followed the Commerce convention of using industry codes to indicate where industries in the prior Commerce aggregation were combined (e.g., 33-34 for Leather combined with Leather Products) or subdivided (e.g., 36B distinguishing Concrete within the broader Commerce industry 36 — Stone and Clay Products). To facilitate the research task of mapping study organizations into the industries, each industry is listed with the SIC categories it contains (taken from U. S. Department of Commerce, 1994: 68-71; 1997: 58-62).

———Table 3 About Here ———

Structure-performance scores on several variables are reported in Table 3 for the proposed industries in 1987 and 1992. These are the data available for downloading from the internet (see acknowledgment note). The first column is the year of the data in the row, and the second column is industry output for the year in millions of dollars. Column "PCM" lists price-cost margins for each industry, a performance measure of the profit margin for year's output (defined below in the discussion of construct validity). Column "N" lists the number of product categories aggregated within the industry that year, and "SE" is the structural equivalence score across aggregated products (defined below in the discussion of reliability). Column "SD PCM" lists the standard deviation of price-cost margins across product categories in the industry (another measure of product heterogeneity within the industry). Finally, columns "EO" and "EC" list the effective organization (EO) of producers within the industry, and the effective buyer-supplier constraint (EC) on producers (defined in Burt et al., 1997). The effective organization of producers varies from 0 to 1 measuring the lack of market competition within their industry (1 minus EO measures the effective intensity of market competition). Industry EO scores are obtained numerically by adjusting producer concentration to align the observed performance of producers (PCM) with the level of constraint they face from suppliers and customers (EC). Where producers enjoy a profit margin higher than expected from the observed internal and external structure of their market, they are "effectively" more organized than they appear to be. Typical factors associated with producers being more effectively organized than they appear to be

are regional markets (versus national), government regulation of a market, and entry barriers created by reputation effects defined by social networks among producers. Where margins are lower than expected from observed industry structure, producers are "effectively" less organized than they appear to be (strongly correlated with the market share of imports). Effective organization is a useful variable for selecting study firms and generalizing research findings from convenience samples of firms because the competitive advantage of tighter coordination within a firm increases with the extent to which producers in the firm's industry are in effect disorganized (Burt et al., 1994; Burt et al., 1997).

RELIABILITY OF THE BOUNDARIES

Market boundaries are defined unambiguously in theory by structural equivalence, but what is clear in theory is not equally clear for all industries. Where structurally equivalent products are combined in an industry, the market boundary around the industry is reliable in the sense that the industry is easy to detect in a spatial map of equivalence distances. It is not surprising to see that market boundaries vary in their reliability. Industries vary in their complexity and similarity to related industries, so it is to be expected that the market boundaries between certain industries will be difficult to define with any certainty. There are industries that contain a heterogeneous mix of products (e.g., the apparel and textiles industries in Figure A2 in the Appendix), and industries that contain related, but nonequivalent, products from adjacent steps in a production chain (e.g., the primary metals industries in Appendix Figure A3). The question for this section of the paper is whether boundaries in the proposed aggregation are on average any more reliable that boundaries in the prior or current Commerce aggregations.

Boundary reliability can be measured with principal component models. A summary equivalence score for an industry measures the extent to which product categories assigned to the industry have structurally equivalent transaction profiles. I use the equivalence scores frequently in the Appendix to decide between alternative market boundaries. The logic of the measurement is as follows (e.g., Burt, 1983: 60-63; Burt and Carleton, 1989): There is a 1.0 correlation between the transaction profiles for two products when the products have identical profiles of buying and selling with supplier and customer markets. In other words, the correlation between transaction profiles is 1.0 for structurally equivalent products, so the principal component extracted from transaction profiles for structurally equivalent products describes 100% of variance in the profiles. Thus the equivalence measure: the proportion of transaction variance described by the first principal component

for a set of products combined in an industry measures the extent to which the products involve equivalent patterns of buying and selling.

RESULTS ON PRINTING AND PUBLISHING

The results in Table 4 describe structural equivalence within Printing and Publishing. The first row measures equivalence for the prior Commerce aggregation — all products were combined in a single Printing and Publishing industry. The products are not equivalent. The first principal component describes 46.2% of transaction variance in 1992 and 50.2% in 1987. The second principal components are also substantial (17.9% for 1992).

Equivalence is not much better for the aggregation currently used by Commerce. The percentages are acceptable for newspapers and periodicals, but that is not too surprising since there are only two products aggregated. Figure 1 shows several pairs of products that are as close together as newspapers and periodicals. Equivalence in the Other Printing and Publishing industry is about the same as it was when all of the printing and publishing products were combined in a single industry; 46.9% of variance is described in 1992 and 50.4% in 1987.

Equivalence is only slightly better for the proposed aggregation. The percentages are all higher than for the single-industry aggregation, but they are still low, between 54% and 62%.

RESULTS ACROSS INDUSTRIES

The Printing and Publishing industries illustrate two points. First, these are examples of industries composed of structurally nonequivalent products. The proposed industries are a reasonable aggregation of product transaction profiles in the sense that product categories are assigned to industries on the basis of their patterns of buying and selling (Figure 1, Table 2). However, the products involve such diverse patterns of buying and selling that the products are scattered across a broad area in the spatial map of equivalence distances (Figure 1) and equivalence scores are low for the industries (Table 4). Other examples of such industries can be found in apparel and textiles (Figure A2), primary metals (Figure A3), chemicals and synthetics (Figure A6), and other product classes. The market boundaries around such industries are unreliable in the sense that a product in one industry can be treated as a product in an adjacent industry. Organizations have to be sampled more carefully to represent such industries, and statements that characterize the whole or average of such industries should be taken with a grain of salt (so equivalence scores are reported in

Table 3 for each of the proposed industries; a low equivalence score means a more heterogeneous industry).

——— Table 4 and Figure 2 About Here ———

Structural equivalence is on average higher in other industries than it is in the Printing and Publishing industries. The graph in Figure 2 shows that the average structural equivalence score is 65.7% for industries in the Commerce aggregation used before 1987. The average increases to 70.1% in the current Commerce aggregation. The average is highest at 78.4% for industries in the proposed aggregation. Equivalence is lower in manufacturing industries, but still shows a substantial increase for manufacturing industries in the proposed aggregation. In other words, the proposed aggregation defines industries in which structural equivalence on average is higher, which means that market boundaries around the industries are more reliable.

However, the high levels of structural equivalence could result from the large number of industries distinguished in the proposed aggregation. The second point illustrated by the results on Printing and Publishing is the trade-off between structural equivalence and the number of products distinguished in an industry. There are two issues here. Issue one is that equivalence varies with the number of products in an industry; more products means more opportunity for differences between product transactions profiles and so, ceteris paribus, lower levels of equivalence (evidence below in Table 5). A proposal that decreases the number of products within an industry can be expected to increase equivalence within the industry. The only aggregation that will yield high equivalence scores for the diverse products in the middle of Figure 1 is one that makes each product category its own industry. That leads to the second issue: There is no consistent meaning to the product categories. I can describe transactions in no finer detail than the several hundred product categories in the input-output table, and the product categories vary dramatically in the volume and heterogeneity of the business they contain. Some are large and heterogeneous (e.g., Retail Trade is all of the $522.5 billion retail industry combined in a single product category). Other product categories are small and homogeneous (e.g., $45 million in fine earthenware table and kitchenware). A product category aggregated across a large volume of business and diverse kinds of products can be its own industry, whereupon equivalence is high simply because there are no detailed transaction data on the industry. For example, equivalence is 100% in the $533.5 billion Retail Trade industry because it contains only one product category (Table 1). At the other extreme, equivalence can be low in an industry composed of many product categories because detailed transaction data are available on the

industry. For example, fine earthenware table and kitchenware is one of 22 product categories in the Commerce industry of Stone and Clay Products — for which equivalence is only 60.8% in 1992.

Since equivalence varies with the number of product categories in an industry, and the product categories have no consistent definition in business volume or structural equivalence, measures of product heterogeneity within an industry have to be interpreted with caution. Low scores indicate product heterogeneity. A low structural equivalence score for an industry indicates that transaction profiles vary significantly between products assigned to the industry (e.g., the 60.8% equivalence for the 22 products within the Stone and Clay industry). A high structural equivalence score, however, could indicate either homogeneous transaction profiles across products in the industry (e.g., the 78.2% for the four products in the Computer and Office Equipment industry, Table A6), or the lack of Commerce distinctions between products within the industry (e.g., the 100.0% for Retail Trade which is composed of diverse products not distinguished by Commerce).

Therefore, the best way to use the input-output data to compare the reliability of alternative aggregations is to compare reliability within industries that contain the same number of product categories. Table 5 shows how the average level of equivalence within industries in each of the three alternative aggregations (columns) varies with the number of product categories combined in an industry (rows). The 1987 and 1992 data are pooled (the first nine rows of Table 1 are again excluded). For example, the second row shows that there are 13 industries in the prior Commerce aggregation that contain two product categories (6 in 1987 and 7 in 1992). The average percent of transaction variance described by a principal component for each of the 13 industries is 75.4%.

——— Table 5 About Here ———

The number effect is apparent across the rows. Equivalence is trivially perfect in industries that contain one product category (first row of Table 5). Equivalence is high on average in industries that contain two product categories (second row of the table). It is low in industries that contain many product categories (bottom of the table). The current Commerce aggregation makes more industry distinctions than the prior, and the proposed aggregation makes still more distinctions. Equivalence on average is therefore higher in the current than the prior Commerce aggregation (65.7% at the bottom of Table 5 increases to 70.1%), and higher still in the proposed aggregation (70.1% increases to 78.4%).

Structural equivalence is still significantly higher in the proposed aggregation when number of products is held constant. Pool the 515 industries in Table 5 and regress the

equivalence score for each industry across number of products and alternative aggregations to get the following results (R^2 = .38):

$$SE = 82.9 - 1.4\ Products + 0.8\ Year - 10.4\ Manu + 1.3\ Current + 7.8\ Proposed,$$
$$\quad\ (-11.3)\qquad\ (0.6)\qquad\ (-7.3)\qquad\ (0.8)\qquad\ (4.9)$$

where SE is the structural equivalence score for an industry, Products is the number of product categories in the industry, Year is a dummy control variable distinguishing 1992 from 1987, Manu is a dummy control variable distinguishing manufacturing, Current is a dummy variable distinguishing industries defined in the current Commerce aggregation, and Proposed is a dummy variable distinguishing the proposed industries.

The expected equivalence score in an industry is predicted as follows: Beginning with an intercept equivalence score of 82.9%, subtract 1.4 points for each product category in the industry, subtract another 10.4 points if the industry is in manufacturing, and add 7.8 points if the industry is one of the proposed industries. These are the three statistically significant effects in the regression equation (t-tests in parentheses). The adjustment for slightly higher levels of equivalence in 1992 is negligible (0.6 t-test). Interestingly, the current Commerce aggregation offers negligible improvement over the prior aggregation (0.8 t-test).[4] Using the regression coefficients as a metric, the improvement in structural equivalence provided by the proposed aggregation is more than six times the improvement that the current Commerce aggregation provided over the prior aggregation. Market boundaries around industries in the proposed aggregation are significantly more reliable than the boundaries around industries in the prior and current Commerce aggregations.

CONSTRUCT VALIDITY OF THE BOUNDARIES

Performance is a construct-validity issue for the alternative aggregations. To the extent that market boundaries are correctly defined, products in the same industry should yield more

[4]The significant improvement associated with the proposed industries remains if I use the current Commerce aggregation as the reference category (4.4 t-test). Also, I get the same results with the log number of products held constant, and I get the same results if I exclude multiple counts of the 24 industries that do not change across the alternative aggregations. There are 24 industries in the prior Commerce aggregation that do not change in the current aggregation nor the proposed aggregation (e.g., the two primary metals industries in Figure A3). The 24 unchanged industries enter the estimation in the text three times, once for each alternative aggregation. If I re-estimate the regression equation excluding the 24 unchanged industries in the current and proposed aggregations (to more clearly see the extent to which changes wrought by the current and proposed aggregations improve reliability over the prior Commerce aggregation), I get the following estimates for the five slopes in the equation (N = 419 with a multiple correlation about the same as in the text, .612): -1.2, 0.6, -9.4, 1.3, 9.9 with an intercept of 81.1 and respective t-tests for the slopes of -9.4, 0.4, -5.9, 0.7, and 5.7.

similar returns than products in separate industries because products in the same industry are subject to more similar market forces (e.g., see Porter, 1985; Schmalensee, 1989; Caves, 1992, for textbook treatments of the structure-performance connection). The construct validity of the proposed industries can be assessed therefore, by studying the extent to which product profit margins can be predicted from industry profit margins. The question for this section of the paper is whether the proposed aggregation puts a higher proportion of performance variance between, rather than within, industries.[5]

RESULTS ON PRINTING AND PUBLISHING

Figure 3 shows price-cost margins in 1987 and 1992 for the 12 product categories in the Printing and Publishing industries. Price-cost margins are a profit measure of net income to sales introduced by Collins and Preston (1969) and now widely used in market structure research: PCM equals dollars of value added minus labor costs, quantity divided by sales (see Burt, 1988:371ff., on price-cost margins computed from input-output tables versus the Census of Manufactures). For example, the total output from all of Printing and Publishing in 1987 was $137,105 million, of which $74,182 million was value added, of which $42,895 million was labor and the remaining $31,287 million was taxable income. The ratio of taxable income to total output, .228 in this case, is the price-cost margin. Figure 3 plots the margins by product.

——— Figure 3 About Here ———

[5]This construct-validity question should not be confused with a related question more often discussed in organization research. The related question asks about the relative magnitude of two components in performance variance across firms; a component due to firm-specific factors, versus a component due to market forces in the firm's industry. For example, McGahan and Porter (1997:23) report that 45% of their return-to-asset measure of organization performance can be traced to the industry in which an organization operates (18.7% associated with four-digit SIC categories, plus 31.7% associated with business segments within the categories, minus a 5.5% firm-industry covariance adjustment; also see McGahan and Porter, 1997, for review of prior studies). Burt et al. (1997) report a similar 44% for Kotter and Heskett's (1992) sample of 180 firms in 19 broadly defined market categories akin to the categories in Fortune magazine. The presumption in such analyses is that there exists a population parameter measuring the industry-induced component to performance variance. The construct-validity question addressed in this paper differs in presuming that the market boundaries around industries are a data-coding decision (e.g., the proposed aggregation versus the current Commerce aggregation) subject to evaluation for the extent to which performance variance is between rather than within industries. Claims regarding the exact portion of performance variance associated with industry distinctions have little meaning under this second presumption since industries have no absolute boundaries. More narrowly defined industries, ceteris paribus, mean a higher portion of performance variance associated with industry distinctions. In the extreme, the portion of corporate performance variance associated with industry distinctions can be anything from 0% (assign all sample firms to one industry) to 100% (define industries narrowly such that each sample firm operates in its own industry).

There is a clear performance difference between Printing and Publishing. Products in the Publishing industry yield higher margins. When I regress the 24 margins in Figure 3 over a dummy variable for 1992, and a dummy variable distinguishing newspapers and periodicals — the current Commerce aggregation — I get no effect for 1992 (0.3 t-test), and no significant difference between the two industries (-0.8 t-test). When I run the regression with a dummy variable distinguishing the proposed Printing industry from Publishing, I get a significant performance difference (4.9 t-test for the higher margins in Publishing). In other words, the proposed distinction between the Printing and Publishing industries makes performance differences more visible between industries.

RESULTS ACROSS INDUSTRIES

The table at the bottom of Figure 3 contains two measures with which I can generalize the graphic display in Figure 3 across industries. The first is a ratio of industry variance to product variance. If product categories in the same industry had identical price-cost margins then all performance differences would be between industries — so industry differences in price-cost margins would be 100% of the differences between product categories. The industry-to-product variance ratio is 0.0% for the prior aggregation because all 12 products were combined in a single industry. The industry price-cost margin is the average across all 24 product margins so there is no industry variance across products. All performance differences are within the industry.[6] The variance ratio increases to 5.2% for the current Commerce aggregation. The ratio increases dramatically from 5.2% to 55.8% for the proposed aggregation because so much of the variation in product price-cost margins is now between rather than within industries (as illustrated in the Figure 3 graph).

The second indicator is the percentage of variance in product price-cost margins that can be predicted from industry margins.[7] This is the squared correlation between 24 the product price-cost margins and their corresponding industry margin. Again, if product

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[6]A portion of the variance in product margins is variance between industry margins in 1987 and 1992. I here treat that variance over time as product variance, which is a conservative estimate of how much product variance is between industries. I control for differences between years in the regression equations below. The differences are negligible. I ignore them here to simplify the introduction to the construct-validity measures.

[7]Industry margins here and below are weighted averages of product price-cost margins. Each industry margin is the sum of its product margins (PCM_k) weighted by product output ($OUTPUT_k$), quantity divided by industry output: PCM industry = (Σ_k PCM_k * $OUTPUT_k$) / (Σ_k $OUTPUT_k$). Unweighted averages of product margins within each industry have stronger correlations with individual product margins (so the bars in the graph at the bottom of Figure 4 would be higher), but do not correspond to industry margins computed from transaction data aggregated to the industry level.

categories in the same industry had identical price-cost margins then all performance differences would be between industries, and industry margins would predict 100% of the variance in product margins. There is only one Printing and Publishing industry margin in the prior Commerce aggregation, so industry margins are a constant, and predict 0.0% of the variance in the product margins. The distinction between Newspapers and Periodicals versus Other Printing and Publishing in the current Commerce aggregation predicts very little of the variance in product margins (2.2%, generates a negligible 0.7 t-test). Finally, the proposed distinction between a Printing industry and a Publishing industry predicts 72.1% of the variance in product margins (which generates a significant 7.5 t-test).

Figure 4 shows how the construct validity of the proposed aggregation generalizes to other industries. The ratio of industry performance variance to product variance (top graph) is 48.9% in the prior Commerce aggregation, increases slightly to 49.8% in the current Commerce aggregation, then increases dramatically to 71.1% in the proposed aggregation. Again, there is more variation within manufacturing industries (dark bars lower than white), but there is again a dramatic improvement for manufacturing industries in the proposed aggregation. The same pattern occurs in predicting product margins from industry margins (lower graph), except the current Commerce aggregation shows greater improvement over the prior aggregation. In fact, here are the results of regressing the 872 product price-costs across their corresponding industry price-cost margins (t-tests in parentheses, $R^2 = .42$):

$$\underset{}{PCM} = \underset{}{-.01} + \underset{(0.2)}{.00\ Year} + \underset{(0.2)}{.00\ Manu} + \underset{(1.8)}{.19\ PCM_{\text{prior industry}}} + \underset{(7.5)}{.74\ PCM_{\text{current industry}}},$$

where PCM is the price-cost margin for a product, Year is a dummy variable distinguishing the 1992 data from 1987, Manu is a dummy variable distinguishing manufacturing industries, “PCM prior industry” is the product’s industry price-cost margin in the prior Commerce aggregation, and “PCM current industry” is the product’s industry price-cost margin in the current Commerce aggregation. Price-cost margins do not differ significantly between the years, or between manufacturing and other industries. The current Commerce aggregation offers significantly better prediction of product margins. However, it is the proposed industries that dominate the prediction ($R^2 = .59$):

$$\underset{}{PCM} = \underset{}{-.04} + \underset{(0.5)}{.00\ Year} + \underset{(1.3)}{.01\ Manu}$$

$$+ \underset{(1.9)}{.16\ PCM_{\text{prior industry}}} - \underset{(-1.2)}{.11\ PCM_{\text{current industry}}} + \underset{(7.5)}{.90\ PCM_{\text{proposed industry}}},$$

In other words, market boundaries in the proposed aggregation have higher construct validity than boundaries in the prior and current Commerce aggregations in the sense that performance variance is more between, than within, industries.

I again want to check on the consequences of industries containing different numbers of product categories. Variance in product price-cost margins is reported in Table 3 for the proposed industries as another indicator of product heterogeneity. Where products are structurally equivalent (take an arbitrary cut-off of 75% equivalence), there is little variance between product price-cost margins (.025 average standard deviation within 194 industries). Variance in product price-cost margins is significantly higher within the other 321 industries (.085 average standard deviation, 11.9 t-test for the difference). Cautions in the previous section about inferring product heterogeneity from structural equivalence scores apply similarly to variance in product performance scores. High variance in price-cost margins across the product categories in an industry indicate performance heterogeneity (and so exposure to diverse market forces), but low variance in price-cost margins could indicate performance homogeneity across products or the lack of Commerce distinctions between products within the industry.

Performance variance is still significantly lower within the proposed industries when number of products is held constant. Pool the 515 industries, and regress the standard deviation of price-cost margins for products within each industry across number of products and alternative aggregations to get the following results (t-tests in parentheses, $R^2 = .10$):

$$\underset{}{SD = .053} + \underset{(6.2)}{.003\ Products} + \underset{(1.7)}{.010\ Year} - \underset{(-1.7)}{.008\ Manu} - \underset{(-0.2)}{.001\ Current} - \underset{(-2.0)}{.013\ Proposed},$$

where SD is the standard deviation of product price-cost margins within an industry, Products is the number of product categories in the industry, Year is a dummy variable distinguishing 1992 from 1987, Manu is a dummy variable distinguishing manufacturing, Current is a dummy variable distinguishing industries defined in the current Commerce aggregation, and Proposed is a dummy variable distinguishing the proposed industries. Again, the current Commerce aggregation offers negligible improvement over the prior aggregation (-0.2 t-test).

The improved construct validity associated with the proposed industries can be traced to the improved reliability of the market boundaries around the proposed industries. If I add industry structural equivalence scores to the prediction, the predication is stronger, number of products no longer matters, and differences between the three aggregations are negligible ($R^2 = .28$):

$$SD = .053 + .000\ \underset{(0.1)}{\text{Products}} - .002\ \underset{(-11.6)}{\text{SE}} + .004\ \underset{(0.7)}{\text{Current}} + .002\ \underset{(0.3)}{\text{Proposed}},$$

where SE is the industry structural equivalence score. The direct effect of the proposed industries is gone, replaced by the direct effect of structural equivalence, which is in turn a function of the proposed aggregation in the earlier regression equations predicting SE.

In sum, a significant amount of performance variance within industries in the prior and current Commerce aggregations is between industries in the proposed aggregation. By shifting performance variance from within to between industries, market boundaries in the proposed aggregation have higher construct validity. Further, the improved construct validity is directly attributable to the improved reliability of market boundaries around the proposed industries as measured by higher structural equivalence within the industries.

SUMMARY

My goal in this paper has been to use the sociology of markets to better define industries for organization research. How an organization operates, and how well it operates, depends in large part on its fit to the market environment, the industry, in which it operates. Valid distinctions between industries are therefore a critical exogenous factor affecting the quality of organization research. Market boundaries are defined in theory by the network concept of structural equivalence: two products are in the same market to the extent that their production involves purchases from the same supplier markets and sales to the same customer markets.

I applied the structural equivalence criterion to detailed transaction data from the U.S. Department of Commerce and get three results: (1) Most obviously, the network analysis yields a partition of the American economy into 123 proposed industries (Table 4); versus the 77 distinguished by Commerce before 1987, and the 88 now distinguished (listed in Table 1). The network analysis shows where product distinctions were negligible, and where distinctions between structurally nonequivalent kinds of products were needed.

(2) It is clear from the analysis that industry boundaries are defined less by the homogeneity of transaction patterns within industries, than by differences between industries. Many industries contain products that are structurally nonequivalent with respect to an important supplier or customer transaction.

(3) Nevertheless, the proposed partition into 123 industries promises stronger results for organization research. Structural equivalence differences between industries show that market boundaries around industries in the proposed aggregation are significantly more

reliable than the boundaries around industries in the prior and current Commerce aggregations (Figure 2). Performance differences between products show that market boundaries in the proposed aggregation have higher construct validity than boundaries in the prior and current Commerce aggregations in the sense that performance variance is more between, than within, industries (Figure 4). Further, the improved construct validity is directly attributable to the improved reliability of market boundaries around the proposed industries as measured by higher structural equivalence within the industries. As an aid to organization scholars interested in the stronger research results, structure-performance scores on several variables for the proposed industries are presented in Table 3 and can be downloaded from the internet (see acknowledgment note).

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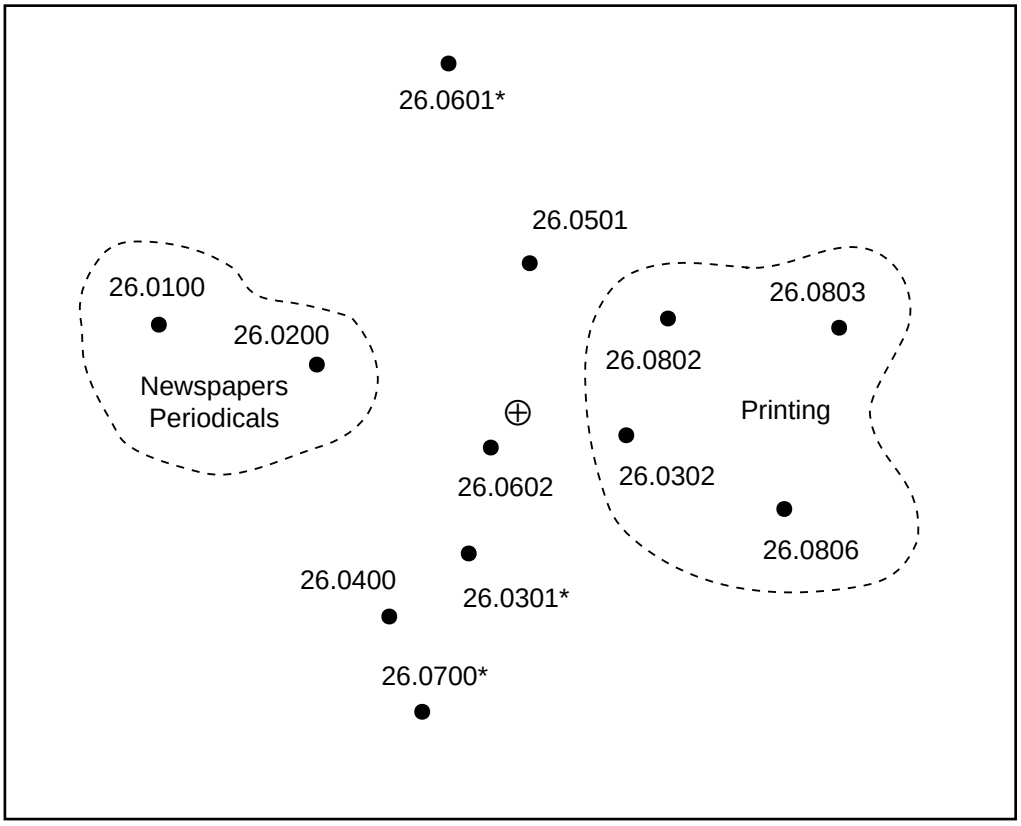
FIGURE 1. PRINTING AND PUBLISHING

(⊕ marks the center of the space, stress = .077, asterisk marks products in Table 2)



Current Aggregation:

26A. Newspapers and Periodicals

26.0100	newspapers
26.0200	periodicals

26B. Other Printing and Publishing

26.0301	book publishing
26.0302	book printing
26.0400	miscellaneous publishing
26.0501	commercial printing
26.0601	manifold business forms
26.0602	blankbooks, looseleaf binders, etc.
26.0700	greeting cards
26.0802	bookbinding and related work
26.0803	typesetting
26.0806	platemaking and related services

Proposed Aggregation (* marks revised category)**:**

*26A. Publishing

26.0100	newspapers
26.0200	periodicals
26.0301	book publishing
26.0400	miscellaneous publishing
26.0700	greeting cards

*26B. Printing

26.0302	book printing
26.0501	commercial printing
26.0601	manifold business forms
26.0602	blankbooks, looseleaf binders, etc.
26.0802	bookbinding and related work
26.0803	typesetting
26.0806	platemaking and related services

FIGURE 2.
RELIABILITY INDICATED BY STRUCTURAL EQUIVALENCE

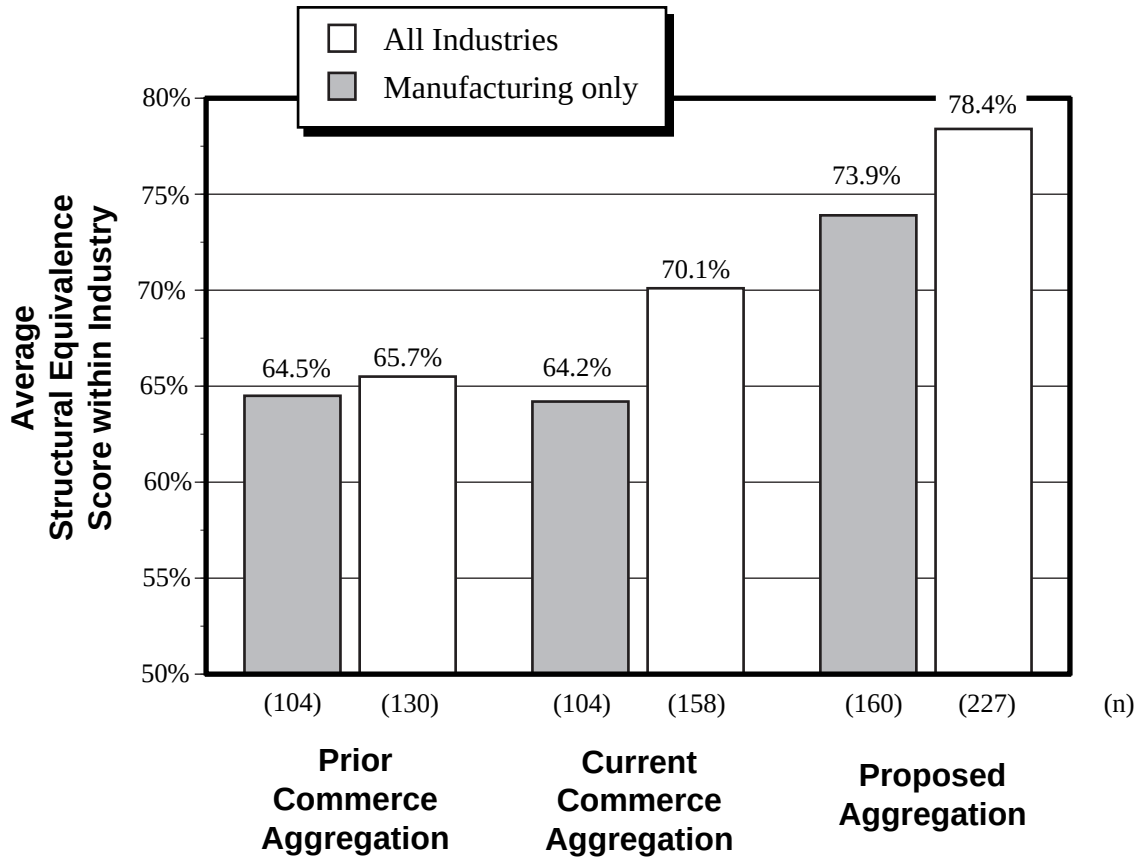
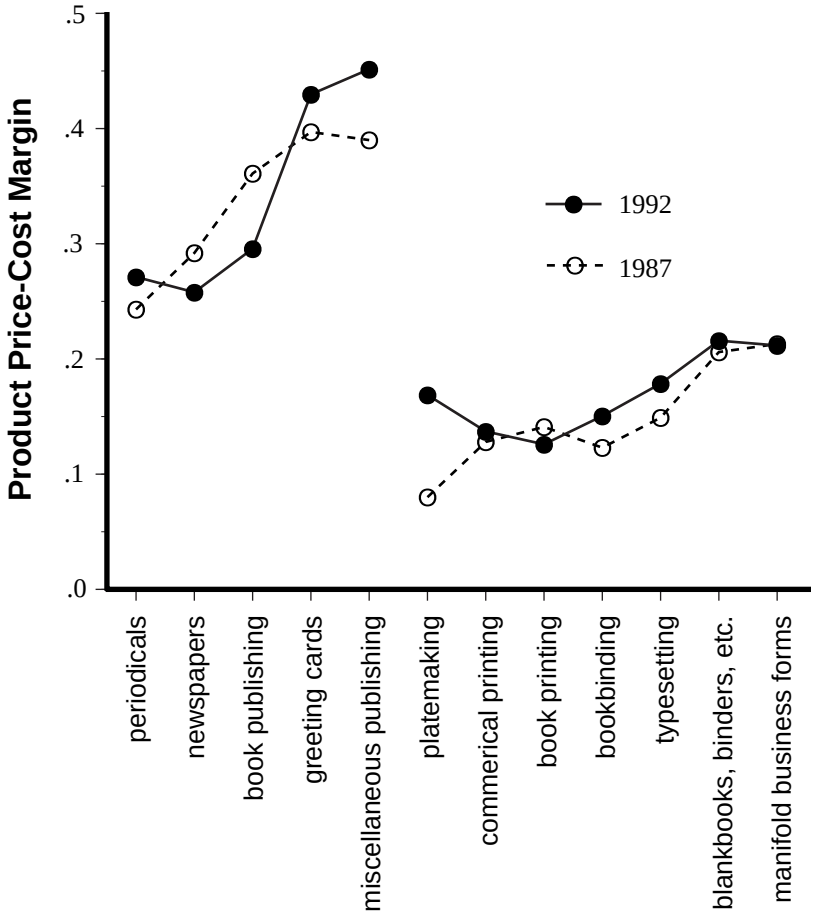


FIGURE 3.
PRICE-COST MARGINS
IN PRINTING AND PUBLISHING



	Ratio of Industry Variance in Price-Cost Margins to Product Variance	Percent Variance in Product Price-Cost Margins Predicted by Industry Margin
Prior Commerce Aggregation	0.0%	0.0%
Current Commerce Aggregation	5.2%	2.2%
Proposed Aggregation	55.8%	72.1%

FIGURE 4.
CONSTRUCT VALIDITY INDICATED BY PERFORMANCE VARIANCE

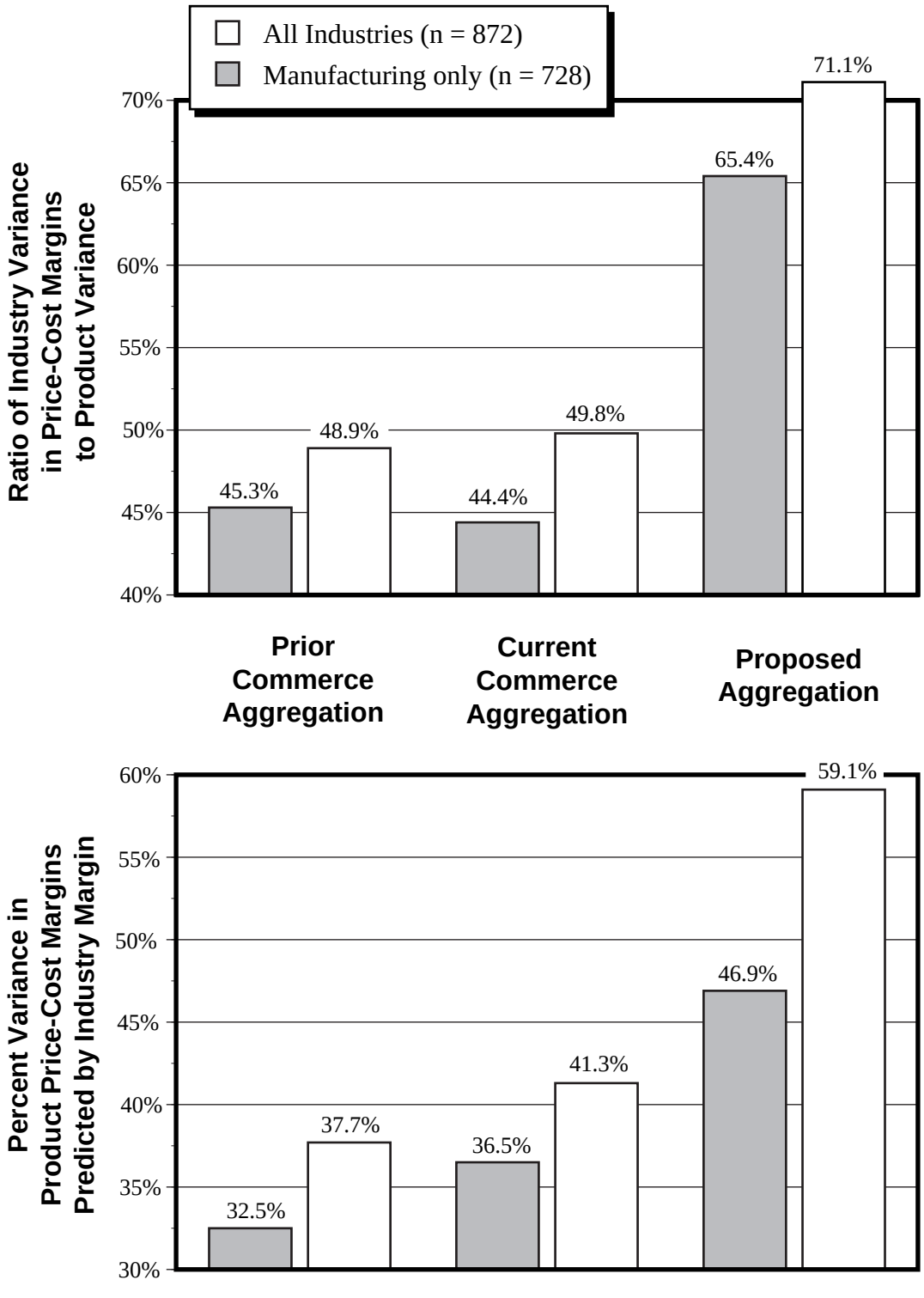


Table 1. Current Commerce Aggregation

Product Categories			1992 Commerce			
1982	1987	1992	SE	SIC	ID	Industry
4	4	4	——	1, 2	1	Livestock and livestock products
13	13	13	——	1, 2	2	Other agricultural products
2	2	2	——	8, 9	3	Forestry and fishery products
2	2	2	——	2, 7, 8, 9	4	Agricultural, forestry, and fishery services
3	3	3	——	10	5-6	Metallic ores mining (iron, copper, and other)
1	1	1	——	12	7	Coal mining
1	1	1	——	13	8	Crude petroleum and natural gas
5	5	5	——	14	9-10	Nonmetallic minerals mining
54	5	15	——	10, 13-17	11-12	Construction
6	6	6	51.4	34, 37	13	Ordnance and accessories
45	47	46	61.7	20	14	Food and kindred products
4	4	4	70.7	21	15	Tobacco products
4	4	4	82.4	22	16	Broad and narrow fabrics, yarn and thread mills
10	6	6	56.5	22	17	Miscellaneous textile goods and floor coverings
7	7	7	67.4	22, 23	18	Apparel
8	8	8	56.9	23	19	Miscellaneous fabricated textile products
14	15	15	64.2	24	20-21	Lumber and wood products
13	13	13	49.6	25	22-23	Furniture and fixtures
12	9	9	47.1	26	24	Paper and allied products, except containers
1	1	1	100	26	25	Paperboard containers and boxes
2	2	2	89.0	27	26A	Newspapers and periodicals
12	10	10	46.9	27	26B	Other printing and publishing
11	7	7	46.3	28	27A	Industrial and other chemicals
3	3	3	64.3	28	27B	Agricultural fertilizers and chemicals
4	4	4	73.2	28	28	Plastics and synthetic materials
1	1	1	100	28	29A	Drugs
4	4	4	59.9	28	29B	Cleaning and toilet preparations
1	1	1	100	28	30	Paints and allied products
5	5	5	47.7	29	31	Petroleum refining and related products
6	6	6	63.6	30	32	Rubber and miscellaneous plastics products
9	9	9	56.8	31	33-34	Footwear, leather, and leather products
2	2	2	75.4	32	35	Glass and glass products
23	22	22	60.8	32	36	Stone and clay products
9	9	9	48.6	33	37	Primary iron and steel manufacturing
14	12	12	43.2	33	38	Primary nonferrous metals manufacturing
2	2	2	74.7	34	39	Metal containers
10	10	10	71.5	34	40	Heating, plumbing, and fabricated structural metal products
4	4	4	59.0	34	41	Screw machine products and stampings
11	11	11	56.3	34	42	Other fabricated metal products
2	2	2	79.7	35	43	Engines and turbines
5	5	5	63.9	35	44-45	Farm, construction, and mining machinery
4	4	4	65.9	35	46	Materials handling machinery and equipment
6	8	8	60.7	35	47	Metalworking machinery and equipment
6	6	6	70.4	35	48	Special industry machinery and equipment
7	7	7	64.3	35	49	General industrial machinery and equipment
2	4	4	62.4	35	50	Miscellaneous machinery, except electrical
4	4	4	78.2	35	51	Computer and office equipment
5	5	5	71.7	35	52	Service industry machinery
8	6	6	50.4	36	53	Electrical industrial equipment and apparatus
7	6	6	72.8	36	54	Household appliances
3	3	3	77.4	36	55	Electric lighting and wiring equipment
4	4	4	49.9	36	56	Audio, video, and communication equipment
3	3	3	70.6	36	57	Electronic components and accessories
5	5	5	54.0	36	58	Miscellaneous electrical machinery and supplies
1	1	1	100	37	59A	Motor vehicles (passenger cars and trucks)
3	3	3	66.5	37	59B	Truck and bus bodies, trailers, and motor vehicles parts
3	3	3	73.7	37	60	Aircraft and parts
8	7	7	46.1	37	61	Other transportation equipment
7	12	12	56.4	38	62	Scientific and controlling instruments
3	2	2	60.3	38	63	Ophthalmic and photographic equipment
20	18	18	47.1	39	64	Miscellaneous manufacturing
2	2	2	70.8	40, 41, 47	65A	Railroads and related services; passenger ground transportation
1	1	2	74.3	42, 47	65B	Motor freight transportation and warehousing
1	1	1	100	44	65C	Water transportation
1	1	1	100	45	65D	Air transportation
3	3	3	61.4	46, 47	65E	Pipelines, freight forwarders, and related services
1	1	2	75.0	48	66	Communications, except radio and TV
1	1	1	100	48	67	Radio and TV broadcasting
1	1	1	100	49	68A	Electric services (utilities)
1	1	2	71.2	49	68B	Gas production and distribution (utilities)
2	2	2	83.6	49	68C	Water and sanitary services
1	1	1	100	50, 51	69A	Wholesale trade
1	1	1	100	52-57	69B	Retail trade
3	3	3	71.8	60-62, 67	70A	Finance
2	2	2	51.9	36, 64	70B	Insurance
1	1	1	100	—	71A	Owner-occupied dwellings
2	2	2	53.8	65	71B	Real estate and royalties
1	1	2	70.2	70	72A	Hotels and lodging places
6	6	6	56.5	72, 76	72B	Personal and repair services (except auto)
1	1	1	100	73	73A	Computer and data processing services
3	3	3	64.8	81, 87, 89	73B	Legal, engineering, accounting, and related services
8	8	9	62.8	73, 76, 87	73C	Other business and professional services, except medical
1	1	1	100	73	73D	Advertising
1	1	1	100	58	74	Eating and drinking places
3	3	3	68.2	75	75	Automotive repair and services
7	8	8	62.4	78, 79	76	Amusements
4	4	6	78.9	7, 80	77A	Health services
11	11	11	72.1	82-84, 86-87	77B	Educational and social services, and membership organizations
528	469	485	——	——	88	Total Number of Categories

TABLE 2. SUPPLIER-BUYER TRANSACTIONS DISTINGUISHING PUBLISHING FROM PRINTING

Publishing (26A)	Printing (part 26B)	Book Publishing (26.0301)	Greeting Cards (26.0700)	Business Forms (26.0601)	
					Suppliers in 1992
0.02	0.52	0.00	0.01	0.00	Photography
0.00	0.36	0.00	0.03	0.02	Printing Machinery
0.25	0.40	0.24	0.25	0.15	Wholesale Trade
0.82	0.69	0.22	0.42	1.00	Paper
					Customers in 1992
0.05	0.89	0.23	-0.01	1.00	State and Local Government
0.01	0.34	-0.00	0.00	0.28	Federal Government
0.36	0.00	0.01	0.00	0.79	Retail Trade
0.39	0.03	0.10	0.00	0.07	Other Membership Orgs.
0.44	0.00	0.73	0.00	0.19	Colleges, Universities, Prof. Schools
0.47	0.00	0.35	0.00	0.10	Banking
0.60	0.01	0.05	0.00	0.12	Social Services n.e.c.
0.61	0.02	0.12	0.00	0.04	Priv. Libraries, Voc. Schools, Ed. Serv. n.e.c.
0.78	0.00	0.14	0.00	0.86	Wholesale Trade
1.00	0.00	0.05	0.00	0.58	Hospitals
1.00	0.00	1.00	1.00	0.00	Households

Note — The two negative entries here indicate government subsidies.

Table 3. Proposed Aggregation

YR	Output (mil $)	PCM	N	SE	SD PCM	EO	EC	ID	Sequence, Name (SIC codes)
1987	87484	0.1348	4	——	——	0.7503	0.2592	1	1. Livestock and livestock products (*019, 0251-3, 0211-4, *0219, 024,
1992	91504	0.1210	4	——	——	0.8278	0.2884		*0259, 0271-3, *0279, *029)
1987	86742	0.4738	13	——	——	0.8917	0.1499	2	2. Other agricultural products (011, 013, 016, 017, 018, *019, *0219,
1992	108294	0.4605	13	——	——	0.8804	0.1148		*0259, *029)
1987	7456	0.3928	2	——	——	0.8730	0.1828	3	3. Forestry and fishery products (081, 083, 097, 091)
1992	9613	0.3282	2	——	——	0.8817	0.1975		
1987	22200	0.0003	2	——	——	0.5140	0.1846	4	4. Agricultural, forestry, and fishery services (0254, *0279, 071-2,075-6,
1992	28251	0.0982	2	——	——	0.7401	0.1911		078, 085, 092)
1987	6807	0.2410	3	——	——	0.5816	0.0634	5-6	5. Metallic ores mining (iron, copper and other; 101-4, 106, *108, 1094,
1992	10749	0.1497	3	——	——	0.4002	0.0549		1099)
1987	25452	0.2792	1	——	——	0.8648	0.3088	7	6. Coal mining (122-3, *124)
1992	26917	0.2763	1	——	——	0.9112	0.3395		
1987	84228	0.5198	1	——	——	0.9498	0.3578	8	7. Crude petroleum and natural gas (131-2, *138)
1992	105369	0.3339	1	——	——	0.9245	0.3243		
1987	12964	0.3244	5	——	——	0.8089	0.1405	9-10	8. Nonmetallic minerals mining (141-2, 144, 145, 147, *148, 149)
1992	13682	0.2715	5	——	——	0.7713	0.1119		
1987	618813	0.1632	5	——	——	0.3795	0.0508	11-12	9. Construction (15, 16, 17, *108, *124, *138, *148, *6552)
1992	679330	0.1027	15	——	——	0.3156	0.0559		
									Manufacturing
1987	2046	0.2643	2	78.5	0.0190	0.6532	0.0754	13A	10. Small arms (3482, 3484)
1992	2539	0.2836	2	80.5	0.0350	0.5827	0.0506		
1987	21218	0.2209	1	100.0	0.0000	0.6445	0.0919	13B	11. Guided missiles and space vehicles (3761)
1992	16558	0.1832	1	100.0	0.0000	0.5109	0.0620		
1987	8173	0.1627	3	69.3	0.0450	0.3376	0.0460	13C	12. Other ordnance (3483, 3489, 3795)
1992	6663	0.1511	3	75.5	0.2120	0.2618	0.0419		
1987	34772	0.0560	9	62.4	0.0830	0.6631	0.2466	14A-15B	13. Milling and oil products (2044, 2046, 2048, 2074-7, 2083, 214)
1992	42714	0.0955	9	59.7	0.1030	0.7803	0.2375		
1987	119730	0.0495	10	78.6	0.0760	0.6827	0.2814	14B	14. Meat and dairy products (2011, 2013, 2015, 2021-4, 2026, 2091-2)
1992	150371	0.0693	10	84.5	0.0750	0.7923	0.2824		
1987	25589	0.4418	3	84.0	0.1990	0.8436	0.1013	14C	15. Alcoholic beverages (2082, 2084-5)
1992	32258	0.4566	3	85.3	0.1480	0.8956	0.1369		
1987	19656	0.1820	1	100.0	0.0000	0.6131	0.0990	14D	16. Soft drinks (2086)
1992	23756	0.1280	1	100.0	0.0000	0.6022	0.1000		
1987	27728	0.3606	3	87.8	0.1030	0.8254	0.1330	14E	17. Bakery goods (2051-3)
1992	33330	0.2369	3	88.1	0.1430	0.7888	0.1416		
1987	14418	0.2167	4	76.8	0.1170	0.7589	0.1751	14F	18. Other flour products (2041, 2043, 2045, 2098)
1992	20056	0.1025	4	75.3	0.0570	0.6694	0.1395		
1987	41118	0.2498	7	75.0	0.0230	0.6825	0.0940	14G	19. Canned and frozen food (exc. fish; 2032-5, 2037-8, 2095)
1992	50201	0.2540	7	76.5	0.0910	0.7410	0.1029		
1987	23475	0.2102	6	76.4	0.1000	0.6898	0.1212	14H	20. Candy and snack foods (2061-4, 2066-8, 2096)
1992	29449	0.2002	5	82.3	0.1070	0.7413	0.1278		
1987	22990	0.2738	5	49.8	0.1230	0.6963	0.0886	14I	21. Food products, n.e.c. (2047, 2079, 2087, 2099)
1992	29919	0.2791	5	58.1	0.2010	0.7565	0.1004		
1987	22878	0.5796	3	96.5	0.1600	0.9370	0.1872	15A	22. Tobacco products (211-3)
1992	36574	0.6052	3	92.3	0.1870	0.9453	0.1567		
1987	38244	0.0974	4	75.6	0.0130	0.5784	0.1368	16	23. Broad and narrow fabrics, yarn and thread mills (221-4, 2261-2,
1992	41646	0.0983	4	82.4	0.0230	0.6636	0.1388		2269, 2281-2, 2284)
1987	15982	0.1017	6	44.6	0.0350	0.5469	0.1189	17	24. Miscellaneous textile goods and floor coverings (227, 2295-9)
1992	17580	0.1238	6	56.5	0.1060	0.5952	0.0995		
1987	64184	0.1480	7	71.3	0.0240	0.7060	0.1856	18	25. Apparel (2251-9, 231-8)
1992	69132	0.0612	7	67.4	0.0300	0.6962	0.1827		
1987	16988	0.1688	8	53.8	0.0930	0.6365	0.1177	19	26. Miscellaneous fabricated textile products (2391-7, 2399)
1992	19055	0.1166	8	56.9	0.1040	0.6876	0.1415		
1987	68792	0.1356	14	61.3	0.0350	0.6151	0.1288	20-21	27. Lumber and wood products (241, 2421, 2426, 2429, 2435-6, 2431,
1992	82383	0.1560	14	68.5	0.0680	0.6767	0.1159		2434, 2439, 2441, 2448-9, 2452, 2491, 2493, 2499)
1987	40859	0.1535	14	46.0	0.0500	0.4668	0.0687	22-23	28. Furniture and fixtures (2451, 2511-2, 2514-5, 2517, 2519, 2521-2,
1992	47459	0.1468	14	52.3	0.0620	0.4803	0.0664		253, 2541-2, 2591, 2599)
1987	46788	0.1977	2	81.1	0.0400	0.6663	0.1154	24A	29. Paper (261-3)
1992	54592	0.1770	2	89.1	0.0330	0.6955	0.1147		
1987	60706	0.1803	8	63.0	0.0930	0.5751	0.0859	24B-25	30. Paper products (265, 2671-9)
1992	76959	0.1577	8	66.5	0.0880	0.5803	0.0831		
1987	72696	0.3061	5	61.7	0.0670	0.7667	0.1132	26A	31. Publishing (271, 272, 2731, 274, 277)
1992	87849	0.2998	5	59.2	0.0920	0.8004	0.1180		
1987	64408	0.1404	7	54.4	0.0470	0.5133	0.0856	26B	32. Printing (2732, 275, 276, 2782, 2789, 2791, 2796)
1992	79426	0.1492	7	55.9	0.0350	0.6319	0.1012		
1987	84374	0.2571	7	44.7	0.0430	0.5948	0.0609	27A	33. Industrial and other chemicals (281, 2861, 2865, 2869, 2891-3, 2895,
1992	109880	0.1668	7	46.3	0.1010	0.4826	0.0616		2899)
1987	13512	0.1046	3	64.1	0.2260	0.6188	0.1548	27B	34. Agricultural fertilizers and chemicals (2873-5, 2879)
1992	17831	0.2073	3	64.3	0.1380	0.8235	0.1983		
1987	40672	0.1919	4	67.2	0.0490	0.6405	0.1057	28	35. Plastics and synthetic materials (2821-4)
1992	48040	0.1155	4	73.2	0.0900	0.5815	0.0987		
1987	36012	0.3854	1	100.0	0.0000	0.8296	0.1207	29A	36. Drugs (283)
1992	62674	0.3178	1	100.0	0.0000	0.8042	0.1124		
1987	33230	0.3713	4	61.4	0.1080	0.7487	0.0704	29B	37. Cleaning and toilet preparations (2841-4)
1992	39628	0.3145	4	59.9	0.0720	0.7181	0.0728		
1987	12072	0.2537	1	100.0	0.0000	0.6855	0.0935	30	38. Paints and allied products (285)
1992	14198	0.2036	1	100.0	0.0000	0.6428	0.0846		
1987	130036	0.1240	3	56.2	0.0350	0.7516	0.2772	31A	39. Petroleum refining (291, 2992, 2999)
1992	137917	0.0677	3	57.7	0.1050	0.7769	0.2604		
1987	7836	0.1623	2	95.4	0.0030	0.7329	0.2003	31B	40. Asphalt (2951-2)
1992	7792	0.1758	2	95.4	0.0510	0.7812	0.1732		
1987	85572	0.1658	6	63.3	0.0310	0.4169	0.0555	32	41. Rubber and miscellaneous plastics products (301, 302, 306, 308,
1992	111361	0.1587	6	63.6	0.0590	0.4018	0.0530	32	3052-3)

YR	Output (mil $)	PCM	N	SE	SD PCM	EO	EC	ID	Sequence, Name (SIC codes)
1987	2544	0.0911	2	75.8	0.0350	0.5421	0.1238	33-34A	42. leather stock (311, 313)
1992	3252	0.0661	2	82.9	0.0690	0.6141	0.1331		
1987	6156	0.1767	7	69.1	0.0620	0.6244	0.1069	33-34B	43. Leather products (3142-4, 3149, 315-6, 3171-2, 319)
1992	6116	0.1521	7	73.6	0.0920	0.6561	0.1089		
1987	11264	0.2134	1	100.0	0.0000	0.5109	0.0570	35A	44. Glass and glass products (321, 3229, 323)
1992	12911	0.2233	1	100.0	0.0000	0.5195	0.0539		
1987	5712	0.1966	4	71.6	0.0480	0.6551	0.1100	36A-35B	45. Glass, stone and clay containers (3221, 3262-3, 3269)
1992	5912	0.1834	4	70.1	0.1030	0.7306	0.1301		
1987	24786	0.1809	4	74.9	0.0280	0.7628	0.2188	36B	46. Concrete (324, 3271-3)
1992	23104	0.1462	4	71.9	0.0500	0.7670	0.1805		
1987	18054	0.2180	15	63.4	0.0600	0.6976	0.1211	36C	47. Other stone and clay products (3251, 3253, 3255, 3259, 3261,
1992	18792	0.1938	15	64.8	0.0670	0.6725	0.0980		3264, 3274-5, 328, 3291-2, 3295-7, 3299)
1987	68090	0.1098	9	46.6	0.1060	0.2942	0.0552	37	48. Primary iron and steel manufacturing (3312-3, 3315-7, 332, 3462,
1992	76565	0.0848	9	48.6	0.0480	0.1420	0.0452		3398-9)
1987	56376	0.0669	12	37.3	0.1340	0.0907	0.0462	38	49. Primary nonferrous metals manufacturing (3331, 3334, 3339, 334,
1992	63773	0.0762	12	43.2	0.0480	0.1103	0.0447		3351, 3353-7, 3363-4, 3365-6, 3369, 3463)
1987	11904	0.1178	2	68.8	0.0460	0.4169	0.0722	39	50. Metal containers (3411-2)
1992	13065	0.0370	2	74.7	0.0310	0.3277	0.0745		
1987	43930	0.1418	10	66.2	0.0490	0.6506	0.1456	40	51. Heating, plumbing, and fab. metal products (3431-3, 3441-4, 3446,
1992	49491	0.1121	10	71.5	0.0420	0.6096	0.1092		3448-9)
1987	23718	0.0781	3	68.5	0.0650	0.4783	0.1076	41A	52. Screw machine products (345, 3465-6)
1992	25272	0.0505	3	71.9	0.0790	0.5414	0.1143		
1987	8256	0.1319	1	100.0	0.0000	0.2923	0.0488	41B	53. Metal stampings (3469)
1992	9431	0.0973	1	100.0	0.0000	0.0000	0.0354		
1987	36656	0.1769	9	59.0	0.0610	0.4598	0.0592	42A	54. Other fabricated metal (3421, 3423, 3425, 3429, 3491-6, 3497-9)
1992	43986	0.1518	9	65.5	0.0760	0.3968	0.0539		
1987	7769	0.1375	2	70.5	0.0140	0.2935	0.0474	42B	55. Metal finishing (3471, 3479)
1992	9988	0.1417	2	70.2	0.0370	0.2605	0.0435		
1987	14096	0.1598	2	73.4	0.0110	0.4630	0.0657	43	56. Engines and turbines (3511, 3519)
1992	17044	0.1217	2	79.7	0.0900	0.2814	0.0489		
1987	10977	0.1921	2	79.6	0.0170	0.5174	0.0655	44	57. Farm and garden machinery (3523-4)
1992	14156	0.1902	2	76.0	0.0030	0.4508	0.0521		
1987	15776	0.1436	3	79.0	0.0540	0.5078	0.0827	45	58. Construction and mining equipment (3531-3)
1992	17875	0.0919	3	76.8	0.0350	0.3571	0.0633		
1987	7194	0.1252	4	71.4	0.0270	0.4957	0.0879	46	59. Materials handling machinery and equipment (3534-7)
1992	8152	0.1033	4	65.9	0.0690	0.4303	0.0704		
1987	21227	0.1238	8	54.8	0.0530	0.2559	0.0470	47	60. Metalworking machinery and equipment (354)
1992	25611	0.1016	8	60.7	0.0570	0.1082	0.0403		
1987	16254	0.1506	6	66.3	0.0210	0.3305	0.0482	48	61. Special industry machinery and equipment (3552-6, 3559)
1992	20231	0.1104	6	70.4	0.0330	0.1923	0.0440		
1987	23236	0.1660	7	63.1	0.0180	0.3720	0.0492	49	62. General industrial machinery and equipment (356)
1992	29814	0.1246	7	64.3	0.0360	0.2552	0.0461		
1987	20003	0.1224	4	58.6	0.0610	0.3355	0.0569	50	63. Miscellaneous machinery, except electrical (3592-4, 3596, 3599)
1992	25071	0.0903	4	62.4	0.0570	0.0972	0.0416		
1987	55820	0.1901	4	80.1	0.0440	0.5217	0.0672	51	64. Computer and office equipment (3571-2, 3575, 3577-9)
1992	63924	0.0725	4	78.2	0.0790	0.5221	0.0993		
1987	22409	0.1715	5	65.5	0.0320	0.5755	0.0903	52	65. Service industry machinery (3581-2, 3585-6, 3589)
1992	26455	0.1317	5	71.7	0.0360	0.4878	0.0718		
1987	22666	0.1628	6	59.2	0.0350	0.3414	0.0463	53	66. Electrical industrial equipment & apparatus (3612-3, 3621, 3624-5,
1992	27809	0.1524	6	50.4	0.0720	0.2869	0.0435		3629)
1987	17237	0.2018	7	63.8	0.0520	0.4795	0.0549	54-58A	67. Household appliances (3631-5, 3639, 3692)
1992	18416	0.1493	7	69.1	0.0720	0.3490	0.0495		
1987	17615	0.2176	3	69.8	0.0790	0.6846	0.1134	55	68. Electric lighting and wiring equipment (3641, 3643-8)
1992	19111	0.1736	3	77.4	0.0950	0.6676	0.1043		
1987	5888	0.1265	1	100.0	0.0000	0.5523	0.1059	56A	69. Household audio-video equipment (3651)
1992	8355	0.0479	1	100.0	0.0000	0.5605	0.1217		
1987	5273	0.2155	2	76.6	0.1700	0.5104	0.0563	56B-58B	70. Recordings (3652, 3695)
1992	6068	0.1783	2	71.1	0.0850	0.5294	0.0662		
1987	32886	0.2281	2	80.4	0.0140	0.6160	0.0779	56C	71. Communication equipment (3661, 3663, 3669)
1992	41937	0.2215	2	82.5	0.0170	0.6744	0.0883		
1987	30307	0.1717	2	74.9	0.0420	0.4171	0.0538	57A	72. Electronic components (3671-2, 3675-9)
1992	40815	0.0634	2	73.4	0.0450	0.3780	0.0739		
1987	18346	0.1725	1	100.0	0.0000	0.4271	0.0551	57B	73. Semiconductors (3674)
1992	30125	0.2734	1	100.0	0.0000	0.6732	0.0715		
1987	15600	0.1219	3	54.6	0.0560	0.4864	0.0869	58C	74. Miscellaneous electrical equipment (3691, 3694, 3699)
1992	15238	0.1078	3	69.9	0.0750	0.4527	0.0728		
1987	134114	0.0729	1	100.0	0.0000	0.5103	0.1227	59A	75. Motor vehicles (passenger cars and trucks; 3711)
1992	150738	0.0463	1	100.0	0.0000	0.5156	0.1085		
1987	8244	0.1562	2	76.9	0.0530	0.4256	0.0601	59B	76. Truck and buses (3713, 3715)
1992	7881	0.0656	2	79.7	0.0380	0.2998	0.0633		
1987	60746	0.0974	1	100.0	0.0000	0.6109	0.1559	59C	77. Motor vehicle parts (3714)
1992	72385	0.0333	1	100.0	0.0000	0.5517	0.1259		
1987	82128	0.1157	3	84.2	0.0500	0.2451	0.0479	60	78. Aircraft (3721, 3724, 3764, 3728, 3769)
1992	101709	0.0828	3	77.8	0.0780	0.1433	0.0456		
1987	8720	0.0922	1	100.0	0.0000	0.3132	0.0636	61A	79. Ships (3731)
1992	10363	0.0980	1	100.0	0.0000	0.2408	0.0500		
1987	2682	0.1135	1	100.0	0.0000	0.5876	0.1299	61B	80. Railroad equipment (374)
1992	4790	0.1221	1	100.0	0.0000	0.5271	0.0825		
1987	12679	0.1241	5	57.2	0.0530	0.3673	0.0611	61C	81. Other transportation equipment (3716, 3732, 375, 3792, 3799)
1992	14847	0.1460	5	57.9	0.0800	0.4009	0.0557		
1987	38962	0.1529	2	69.8	0.0210	0.4196	0.0601	62A	82. Search and navigation equipment (381, 3822)
1992	36875	0.1458	2	72.1	0.0110	0.3992	0.0555		
1987	17023	0.2409	3	70.4	0.0100	0.7376	0.1341	62B	83. Dental and surgical equipment (3841-3)
1992	27856	0.2823	3	78.5	0.0760	0.8424	0.1685		
1987	28354	0.1889	6	70.5	0.0580	0.3948	0.0461	62C	84. Other instruments (3821, 3823-7, 3829, 3844-5)
1992	40031	0.1833	6	68.2	0.0560	0.4370	0.0519		
1987	2665	0.1964	2	74.5	0.0140	0.4542	0.0523	62D-63A	85. Watches and opthalmic goods (385, 387)
1992	3133	0.1740	2	74.7	0.0780	0.5222	0.0661		

YR	Output (mil $)	PCM	N	SE	SD PCM	EO	EC	ID	Sequence, Name (SIC codes)
1987	18186	0.3669	1	100.0	0.0000	0.7060	0.0561	63B	86. Photographic equipment (386)
1992	21725	0.4099	1	100.0	0.0000	0.7898	0.0713		
1987	8137	0.2137	4	67.1	0.0630	0.5108	0.0571	64A	87. Jewelry (3911, 3914-5, 3961)
1992	9106	0.1244	4	72.8	0.0910	0.4376	0.0658		
1987	9244	0.2621	4	65.0	0.0410	0.5653	0.0529	64B	88. Toys and games (393, 3942, 3944, 3949)
1992	12446	0.1369	4	74.3	0.0290	0.5437	0.0813		
1987	15708	0.1874	10	50.6	0.0540	0.4496	0.0542	64C	89. Miscellaneous manufacturing (3951-3, 3955, 3965, 3991,
1992	19763	0.1434	10	50.6	0.0790	0.4454	0.0620		3993, 3995-6, 3999)
									Distribution and Services
1987	43458	0.1849	2	70.8	0.0250	0.4844	0.0611	65A	90. Railroads and related services (40,41, 474)
1992	55754	0.1961	2	70.8	0.0150	0.4952	0.0565		
1987	116095	0.2069	1	100.0	0.0000	0.4766	0.0529	65B	91. Motor freight transportation and warehousing (421-3)
1992	166953	0.1667	2	74.3	0.0750	0.4117	0.0524		
1987	24053	0.0796	1	100.0	0.0000	0.2419	0.0579	65C	92. Water transportation (44)
1992	32440	0.1744	1	100.0	0.0000	0.4557	0.0560		
1987	76253	0.1570	1	100.0	0.0000	0.4675	0.0676	65D	93. Air transportation (45)
1992	94141	0.0999	1	100.0	0.0000	0.4336	0.0718		
1987	18020	0.1480	2	79.6	0.0100	0.5687	0.1000	65E	94. Freight forwarders and travel agents (472-3, 478)
1992	26301	0.1736	2	79.6	0.1090	0.6549	0.0995		
1987	7888	0.5955	1	100.0	0.0000	0.9684	0.4367	65F	95. Piplines (except nat. gas; 46)
1992	7315	0.5944	1	100.0	0.0000	0.9779	0.4015		
1987	161127	0.3611	1	100.0	0.0000	0.7320	0.0672	66	96. Communication (except radio & TV; 481-2, 484, 489)
1992	208094	0.3681	2	75.0	0.0390	0.7674	0.0744		
1987	29396	0.1216	1	100.0	0.0000	0.7283	0.2433	67	97. Radio and TV broadcasting (483)
1992	29359	0.1161	1	100.0	0.0000	0.8531	0.3564		
1987	132372	0.5005	1	100.0	0.0000	0.8115	0.0548	68A	98. Electric services (utilities; 491, 4931)
1992	170896	0.5192	1	100.0	0.0000	0.8344	0.0615		
1987	67548	0.2620	1	100.0	0.0000	0.8051	0.1916	68B	99. Gas production and distribution (utilities; 4922-5, 4932, 4939)
1992	93157	0.1775	2	71.2	0.1520	0.8772	0.3450		
1987	11262	0.0244	2	83.6	0.0010	0.0000	0.0496	68C	100. Water and sanitary services (494, 4952-3, 4959, 496-7)
1992	19182	0.2328	2	83.6	0.0580	0.6275	0.0714		
1987	423750	0.2909	1	100.0	0.0000	0.5513	0.0429	69A	101. Wholesale trade(50, 51)
1992	568970	0.2963	1	100.0	0.0000	0.5361	0.0421		
1987	420694	0.2506	1	100.0	0.0000	0.6963	0.1006	69B	102. Retail trade(52-7, 59)
1992	522519	0.2742	1	100.0	0.0000	0.7817	0.1171		
1987	286612	0.1226	3	69.5	0.3460	0.4196	0.0708	70A	103. Finance (60, 61, 62, 67, excluding 6732)
1992	416272	0.2515	3	71.8	0.1810	0.6822	0.0807		
1987	123974	0.0546	1	100.0	0.0000	0.6652	0.2509	70B	104. Insurance carriers (63)
1992	168993	-0.0276	1	100.0	0.0000	0.7242	0.2630		
1987	48876	0.3544	1	100.0	0.0000	0.9240	0.4886	70C	105. Insurance agents (64)
1992	62104	0.2677	1	100.0	0.0000	0.9287	0.4510		
1987	325144	0.8582	1	100.0	0.0000	0.9816	0.1961	71A	106. Owner-occupied dwellings (—)
1992	457250	0.8722	1	100.0	0.0000	0.9863	0.1953		
1987	347225	0.6340	1	100.0	0.0000	0.8977	0.0680	71B	107. Real estate agents (65, excluding 6552)
1992	494402	0.6233	1	100.0	0.0000	0.8986	0.0727		
1987	33050	1.0000	1	100.0	0.0000	1.0000	0.5109	71C	108. Royalties (—)
1992	55711	1.0000	1	100.0	0.0000	1.0000	0.3543		
1987	56358	0.2317	1	100.0	0.0000	0.5735	0.0644	72A	109. Hotels and lodging places (701-4)
1992	59602	0.2075	2	70.2	0.0320	0.6272	0.0789		
1987	50942	0.2226	6	56.5	0.1220	0.5606	0.0645	72B	110. Personal and repair services (except auto; 721-6, 729, 762-4)
1992	91772	0.2573	6	56.5	0.0740	0.6836	0.0793		
1987	60822	0.1698	1	100.0	0.0000	0.5404	0.0801	73A	111. Computer and data processing services (737)
1992	115730	0.1895	1	100.0	0.0000	0.6171	0.0820		
1987	76890	0.2124	1	100.0	0.0000	0.6501	0.0986	73B	112. Legal services (81)
1992	116396	0.2603	1	100.0	0.0000	0.7160	0.0896		
1987	60154	0.0932	1	100.0	0.0000	0.6262	0.1702	73C	113. Engineering services (871)
1992	84850	0.1318	1	100.0	0.0000	0.6981	0.1389		
1987	105355	0.0651	2	76.2	0.0300	0.2740	0.0673	73D	114. Management consulting (872, 874, 89)
1992	131009	0.2052	2	83.7	0.0230	0.6380	0.0826		
1987	143416	0.2749	6	71.6	0.1260	0.6449	0.0685	73E	115. General business services (7331, 732, 7334, 7338, 734-6,
1992	220808	0.3449	6	71.3	0.1480	0.7489	0.0744		7381-3, 7389, 769)
1987	12844	0.2909	1	100.0	0.0000	0.7073	0.0856	73F	116. Photographic services (7335-6, 7384)
1992	15728	0.3982	1	100.0	0.0000	0.8548	0.1169		
1987	-9	-9.0000	0	-9.0	-9.0000	-9.0000	-9.0000	73G	117. R & D services (8731-2, 8734)
1992	28015	0.0956	1	100.0	0.0000	0.5004	0.0856		
1987	15884	0.2228	1	100.0	0.0000	0.5923	0.0728	73H	118. Advertising (731)
1992	29865	0.2496	1	100.0	0.0000	0.6951	0.0856		
1987	209394	0.1284	1	100.0	0.0000	0.4721	0.0801	74	119. Eating and drinking places (58)
1992	280708	0.1404	1	100.0	0.0000	0.5446	0.0803		
1987	130704	0.2555	3	69.2	0.0900	0.6219	0.0687	75	120. Automotive repair and services (751-3, 7542, 7549)
1992	138381	0.2451	3	68.2	0.0780	0.6492	0.0732		
1987	78192	0.1642	8	61.6	0.2210	0.5837	0.0969	76	121. Amusements (781-4, 791-3, 7941, 7948, 7991-3, 7996-7,
1992	121368	0.2249	8	62.4	0.0940	0.7219	0.1059		7999)
1987	338511	0.1201	4	78.9	0.0790	0.4763	0.0849	77A	122. Health services (074, 801-3, 8041-3, 8049, 805-6, 807-9)
1992	564986	0.1427	6	78.9	0.0840	0.5990	0.0933		
1987	152678	0.0294	11	72.1	0.0950	0.3103	0.0889	77B	123. Educational and social services (6732, 821-4, 829, 832-3,
1992	228332	0.0420	11	72.1	0.0850	0.5388	0.1172		835-6, 839, 84, 861-6, 869, 8733)

TABLE 4. STRUCTURAL EQUIVALENCE WITHIN PRINTING AND PUBLISHING

	1992	1987
Prior Aggregation		
26. Printing & Publishing (12)	46.2%	50.2%
Current Aggregation		
26A. Newspapers & Periodicals (2)	89.0%	76.4%
26B. Other Printing and Publishing (10)	46.9%	50.4%
Proposed Aggregation		
26A. Publishing (5)	59.2%	61.7%
26B. Printing (7)	55.9%	54.4%

NOTE — These are transaction variances described by the first principal component for product categories combined in the same industry. Parentheses contain number of 1992 product categories aggregated in industry.

TABLE 5. STRUCTURAL EQUIVALENCE RESULTS FOR THE ALTERNATIVE AGGREGATIONS

Number of Products in Industry	Prior Aggregation		Current Aggregation		Proposed Aggregation	
	Industries	Mean SE (%)	Industries	Mean SE (%)	Industries	Mean SE (%)
1	13	100.0	32	100.0	67	100.0
2	13	75.4	22	70.2	38	77.3
3	12	71.1	18	68.8	30	74.6
4	19	66.1	19	67.1	23	71.1
5	11	56.9	8	57.7	12	65.2
6	14	59.5	15	61.0	13	61.9
7-8	19	59.4	14	57.0	22	63.9
9 or more	29	53.9	30	54.9	22	60.0
All Industries	130	65.7	158	70.1	227	78.4

NOTE — These are percentages of transaction variance described by the first principal component for product categories combined in the same industry. Results are averaged across 1987 and 1992.

APPENDIX: INDUSTRY ANALYSES

The detailed product categories to be analyzed are grouped into ten broad classes. Classes are broad enough so products are unlikely to be equivalent across classes, which reduces the network analysis to a manageable task of studying equivalence within each class separately. At the same time, classes contain related industries, so products in adjacent markets can be tested for equivalence. Equivalence is not equally useful in all of the analyses. My default is to stay with the current Commerce aggregation unless the analysis reveals a compelling alternative (as in Printing and Publishing). I begin with the least complicated product classes. The ten product classes in order of analysis are: (1) leather, (2) apparel and textiles, (3) primary metals, (4) stone, clay, and glass, (5) lumber, furniture, and paper, (6) chemicals and synthetics, (7) fabricated metals, (8) machines, (9) food and tobacco, and (10) distribution and services.

(1) LEATHER

Each of the benchmark tables contains the same nine leather product categories listed in Figure A1. The aggregation prior to 1987 separated Leather (sector 33) from Leather Products (sector 34). Domestic production has dwindled over the last twenty years (Byron, 1983) to the point where total output was $6.4 billion in 1992, and the current aggregation combines all nine leather products into one market category. The volume of output is low relative to other industries, but it contains two structurally distinct patterns of buying and selling. The proposed aggregation (at the bottom of Figure A1) is to separate Leather Stock ($3.7 billion in 1992) from Leather Products ($2.7 billion).

Structural equivalence results on the products are presented in Figure A1 and Table A1. The tests for the current aggregation are the worst in Table 3; 56.8% of transaction variance described in 1992 (52.9% in 1987). Separating out leather tanning as in the Commerce aggregation before 1987 improves product equivalence within leather, and Figure A1 shows that leather tanning (product 33.0001) involves a transaction profile most distinct from the profiles for the leather products. However, book and shoe cut stock (34.0100) is closer to leather tanning than to the other leather products in Figure A1, and the results in the bottom two rows of Table A1 show that combining leather tanning with cut stock in a Leather Stock industry, distinct from Leather Products, further improves product equivalence within industries.

——— Figure A1 and Table A1 About Here ———

Seven transactions distinguish Leather Stock from Leather Products. The production chain is for Leather Stock producers to purchase raw leather from livestock and food producers, use industrial chemicals to prepare the leather, cut the leather to specifications for Leather Product manufacturers in the U.S. and overseas. Transactions that characterize Leather Stock production are purchases from (1) food and (2) industrial chemicals, then sales to Leather Product manufacturers in the (3) U.S. and (4) overseas. The transactions that characterize Leather Product manufacturing are (5) purchases from Leather Stock, then sales to (6) households and (7) certain membership organizations (labor, civic, social, and fraternal associations). Cut stock, which has been assigned by Commerce to Leather Products is more

like leather tanning because cut stock involves direct purchases from food producers, sales to Leather Product manufacturers, extensive exports, and no sales to households (so cut stock ends up closer to leather tanning in Figure A1).

Imports are high for both industries. Dwindling domestic output explains the Commerce decision to aggregate leather products into a single industry. However, in terms of organization environments, leather involves two resource-dependence patterns of buying and selling reflected in the proposed distinction between Leather Stock and Leather Products.

(2) Apparel and Textiles

Commerce aggregates apparel and textile products into four industries: Fabrics (sector 16, with $41.6 billion output in 1992), Apparel (sector 18, $69.1 billion), and two smaller categories of miscellaneous products (Miscellaneous Textiles in sector 17, $17.6 billion, and Miscellaneous Fabricated Textile Products in sector 18, $19.1 billion). The 1992 component products are listed in Figure A2 and are the same in 1987. Analysis reveals no reasons to modify the Commerce categories.

Equivalence results are presented by industry in Figure A2. Product transaction profiles are reasonably equivalent within the core industries of fabrics (82.4% in 1992, 75.6% in 1987) and apparel (74.9% in 1992, 71.3% in 1987).

——— Figure A2 and Figure A3 About Here ———

Products in the two miscellaneous categories are only weakly equivalent, but there is no evidence of alternative product groups within the miscellaneous categories. For example, nonwoven fabrics (product 17.1001) is at the bottom of Miscellaneous Textiles in Figure A2. It is an obvious product to remove from the category. However, the remaining products in Miscellaneous textiles are so varied that removing nonwoven fabrics only increases the first principal component from the poor 56.5% of transaction variance reported in Figure A2 to an equally poor 56.7%. Studying the transactions that characterize Miscellaneous Textiles shows that the transaction profile for nonwoven fabrics does not involve business with its own unique supplier or customer markets so much as it involves slightly higher proportions of its sales to certain markets that are customers for all of Miscellaneous Textiles (most notably, surgical supplies, sanitary paper products, and the household sector). Similarly, Miscellaneous Fabricated Textiles could be viewed as two separate industries in Figure A2, one composed of the three products at the top of the cluster and the other composed of the remaining five products at the bottom of the cluster. Again, however, the transaction profiles are more different in magnitude than in supplier or customer markets, and the products in Miscellaneous Fabricated Textiles are so varied that removing the three products at the top of the cluster in Figure A2 only increases the first principal component from the poor 56.9% reported in Figure A2 to 61.9%, which is too small an improvement to warrant change to the Commerce category.

(3) Primary Metals

Commerce has aggregated primary metal products into two industries; Primary Iron and Steel (sector 37, with $76.6 billion output in 1992), and a residual category of everything except iron and steel, Primary Nonferrous Metals (sector 38, $63.8 billion). Twenty-one product categories are listed in Figure A3. These are the categories for 1992 and 1987. Again, network analysis reveals no reasons to modify the Commerce categories.

These are not substitutable products so much as they are stages in a production chain within large, vertically integrated firms (e.g., Stuckey, 1983). The sociogram in Figure A3 illustrates the point for three products in Primary Iron and Steel. The sociogram contains every transaction of marginal strength greater than .5 in the transaction profile for each of the three products. Goods flow from suppliers on the left to customers on the right. The production chain for primary metals starts with metal heat treating, for which the largest customer is blast furnaces and steel mills, which is the largest supplier for iron and steel forgings. The three iron and steel products have some supplier and customer markets in common as expected of structurally equivalent products. For example, electric utilities are an important supplier to the first two, final demand from the federal government is important to the first and third, and motor vehicle parts is an important customer market for the second and third. However, there are more transactions unique to each product. Metal heat treating is the only one of the three to purchase extensive supplies from industrial chemicals, petroleum, and mechanical measuring devices. Blast furnaces and steel mills is the only one of the three to face extensive imports, purchase iron ores directly, and sell directly to construction. Iron and steel forgings is the only one of the three for which internal combustion engines are an important customer market. Moreover, the three product categories are structurally nonequivalent with respect to their strong asymmetric transactions of one being a primary supplier to the next. The low transaction variance described by a principal component fit to just the three iron and steel products in Figure A3 shows that they are not structurally equivalent (52.4%), so it is not surprising to see the much lower levels reported in Figure A3 for all products within each of the two industries. There are no changes proposed to the Commerce categories in Figure A3 because structural equivalence is not a useful guide to aggregation here.

(4) Stone, Clay, and Glass

Commerce aggregates stone, clay, and glass products into two industries, one for glass and the other for stone and clay. The 1992 products are listed in Figure A4 within four industries inferred from the network analysis.

——— Figure A4 and Table A2 About Here ———

The first inference from the network analysis was to separate containers from glass and other glass products. Glass containers, and glass except containers, are the two products combined by Commerce to define the Glass and Glass Products industry (sector 35). The multidimensional scaling in Figure A4 shows the two products on opposite sides of the transaction space spanned by stone, clay, and glass products. Glass and Glass Products (except containers) is at the top of the space (product category 35.0100). The product category is apart

from all others in Figure A4 and it is large with output of $12.9 billion in 1992, so it can be treated as its own industry. Glass containers appear at the bottom of Figure A4, with china, earthenware, and pottery. The equivalence results in Table A2 show that the four container products have sufficiently similar transaction patterns to combine them as Glass, Stone, and Clay Containers (sector 36A). Containers is not as large as the Glass industry, but with $5.9 billion of output in 1992, it is larger than either of the two leather industries.

A look at the transactions that define glass and containers reveals several similarities; electric utilities and paper packaging are important suppliers to both kinds of producers, and both kinds of producers live on extensive sales to households, a large import-export market, a large wholesale market.

However, glass and containers are far apart in Figure A4 because of the transactions unique to each. Industrial chemicals is an important supplier to glass producers, but not to container producers. Construction and motor vehicles are important customer markets for glass producers, but not to container producers. Container producers have their own important customer markets in which glass producers are not important suppliers; malt beverages and soft drinks for glass containers, restaurants for china and earthenware, hospitals for pottery products, not elsewhere classified.

The second inference from the network analysis was to break out a separate Concrete industry (sector 36B). The spread of stone and clay products across the spatial map in Figure A4, and the poor equivalence tests in the second row of Table A2, show that stone and clay products do not have similar supplier and customer markets. The four concrete products are clustered together in Figure A4, involve similar patterns of suppliers and customers judging from the percent of their transaction variance described by a principal component (fifth row of Table A2), and involve a sufficiently large volume of business to warrant their own market category ($24.0 billion in 1992).

The residual category is Other Stone and Clay Products ($17.9 billion in 1992). The bottom row of Table A2 shows that the products in this residual category are not much more structurally equivalent than the larger set of products in the Commerce category (second row of Table A2). However, there is no further clustering to suggest more refined industries. Note in Figure A4 that four of the other stone and clay products are on the periphery of the space, separated from a cluster of 11 stone and clay products in the center of the space. The peripheral products are asbestos (product 36.1700 at the top of the space, $71 million in 1992), lime (36.1200 in the southeast corner of the space, $896 million), nonclay refractories (36.2100 at the bottom of the space, $1.1 billion), and nonmetallic mineral products, not elsewhere classified (36.2200 in the west of the space, $702 million). The four peripheral products involve completely distinct transaction patterns judging from their separation from one another in Figure A4, and they involve too little business to put aside as a residual category. Further, even if the four peripheral products were put aside, transaction patterns for the cluster of 11 stone and clay products in the center of the space are so varied that equivalence measures for them are not much higher than for the entire set of Other Stone and Clay Products (73.9% for 1992 and 68.4% for 1987, versus the results in the bottom row of Table A2). Therefore, the uncircled products in

Figure A4 together form the Other Stone and Clay Products industry. The important caution for organization research is that the transaction patterns in Other Stone and Clay are so varied that market environments should be defined for individual firms at the product level rather than the aggregate level.

(5) Lumber, Furniture, and Paper

The current Commerce aggregation of these products continues the prior distinction between Paper Containers (which is a large market of $31.9 billion output in 1992) versus Paper and Paper Products (except containers), combines Wood Containers with Lumber and Wood Products (for a combined market of $86.9 billion in 1992), and combines Household Furniture with Other Furniture and Fixtures (for a combined market of $43.0 billion). The proposed aggregation, listed in Figure A5, is to move the product category of mobile homes from Lumber to Furniture, and to distinguish Paper ($54.6 billion in 1992) from Paper Products ($77.0 billion).

——— Figure A5 and Table A3 About Here ———

The network analysis confirms the first two changes in the Commerce aggregation. Adding wood containers (product category 21.000) to Lumber and Wood Products makes sense since it is in the Figure A5 spatial map among the other wood products, including it has little or no effect on the summary measure of structural equivalence within the Lumber and Wood Products industry (first and seventh rows of Table A3), and it is in any event a small portion of the industry (less than 1% of output). Combining the Household Furniture market with Other Furniture also makes sense, but it is less obvious. Summary measures of structural equivalence are higher if the two industries are separated (third and fourth rows of Table A3 noticeably higher than their combination in the eighth row), but product categories from the two furniture industries clearly overlap one another in the Figure A5 spatial map (the 22.xxxx products are not segregated away from the 23.xxxx products). Morever, there are four core product categories in Furniture and Fixtures (wood household furniture, 22.0101 and 22.0200, and office furniture, 23.0100 and 23.0200). These four product categories represent 52.3% of the combined output from both furniture industries, are tightly clustered together in the spatial map indicating similar patterns of buying and selling (enclosed in solid-line circle within Furniture and Fixtures), and have an acceptable level of structural equivalence, increasing in more recent years (Table A3 results in brackets, third row from the bottom).

Mobile homes — a product category of $4.8 billion in 1992, about the average size of wood and furniture product categories — is a wood product in the Commerce aggregation, but the pattern of buying and selling to produce mobile homes has become more similar to the pattern associated with furniture products. The 949 transactions in the profile for mobile homes are correlated .63 with the average profile for furniture products versus .11 with the average profile for wood products. Strong transactions for mobile homes and furniture that are weak for wood products are a substantial wholesale market, strong final demand from state and local government, and purchases from Lumber and Wood Products as a supplier market. Strong transactions for wood products that are weak for mobile homes and furniture are the extensive

import-export business for American lumber, extensive lumber sales to construction, and of course sales to Furniture and Fixtures as a customer market. Similarity between the transaction profiles for mobile homes and furniture result in mobile homes appearing in the Furniture and Fixtures cluster in Figure A5, well away from the Lumber and Wood Products cluster (look for product 20.0703 in the southeast corner of Furniture and Fixtures). Treating mobile homes as a furniture product slightly improves the 1992 summary measure of structural equivalence within Furniture and Fixtures in Table A3 by increasing the number of equivalent products (49.6% increases to 52.3%), and slightly improves equivalence within Lumber and Wood Products by removing a nonequivalent product (64.2% increases to 68.5%). The advantage of treating mobile homes as furniture is less in earlier tables.

The more consequential implication of the network analysis is to separate Paper from Paper Products. The summary measures of structural equivalence in Table A3 are least adequate for the Commerce aggregation for Paper and Paper Products (47.1% in 1992, 40.1% in 1987). The reason is apparent in Figure A5. Paper mills are at the bottom of the spatial map (categories 24.0100 and 24.0800), while paper products, including paper containers, are in the northwest corner of the map. There is an obvious production chain difference between the two clusters or products. Paper mills buy supplies from lumber mills, sell to paper product manufacturers, who sell to final demand from households and the government. There are also other transaction differences. Paper manufacturing involves substantial use of industrial chemicals, which paper products does not, and wholesale and retail trade are a much larger customer for the companies that make paper products than the companies that manufacture paper. Not surprisingly, separating Paper from Paper Products improves the summary measures of structural equivalence in Table A3 (e.g., 47.1% for the combined industry in 1992 increases to 89.1% and 66.5% for the separated industries).

(6) Chemicals and Synthetics

Lawrence and Lorsch (1967) studied the plastics industry as illustrative of organizations in a complex markets. Plastic products were tailored to so many individual customer needs, and success so depended on inventing new products to serve new needs, that the organization optimum for success in the plastics industry was any form that allowed for loose-coupling between tasks within the firm (as opposed to the tight-coupling associated with success in the Metal Container industry). That image continues today in the broader category of chemicals and synthetics. The patterns of buying and selling are so varied for chemicals and synthetics producers that it is often difficult to see where the market for one product ends and the next market begins. The lack of clear market boundaries means that chemicals and synthetics are products for which boundaries have to be defined close to the level of individual products. The boundaries around aggregate industries are complex and ambiguous.

The complexity and ambiguity are apparent from the equivalence measures in Table A4, and the spatial map in Figure A6. Low percentages in Table A4 show that products in the same industry are manufactured from nonequivalent patterns of buying and selling. The exception is Plastics, for which a principal component describes 73.2% of transaction variance in the four

product categories ($39.6 billion in 1992 output). In Figure A6, dashed lines enclose products in the same industry, but the industry boundaries are close and overlapping through the center of the space. Products assigned to one industry could just as accurately be assigned to an adjacent industry. The exception is Rubber, a cluster of six products at the top of the spatial map ($111.4 billion in 1992). However even in Rubber, separated by a clear boundary from the other industries, products have sufficiently diverse transaction patterns to be scattered over a wide interval of the space and poorly described by a single principal component in Table A4 (63.6%).

———Table A4 and Figure A6 About Here ———

Equivalence was not much improved with the two changes from the prior to the current Commerce aggregation. First, the Chemicals industry was divided into Agricultural Chemicals ($62.7 billion in 1992 output) and Industrial Chemicals ($109.9 billion). The spatial map in Figure A6 shows Chemical products in all quadrants of the map. The Industrial Chemicals industry so overlaps with others that I could not enclose its constituent products in a dashed line without confusing the industry with the others in the map. That is why there is so little increase in equivalence — 44.2% increases to 46.3% — when Agricultural Chemicals is made a separate industry. Even the three Agricultural Chemicals products are too heterogeneous to define a single industry (64.3% equivalence in Table A4). Transaction profiles for the three product categories are diverse such that the three product categories stretch from north to south in Figure A6. Pesticides are especially different from the other two (27.0300 at the bottom of Figure A6). Further deletions do not improve equivalence within Industrial Chemicals. The 46.3% equivalence measure increases to 51.2% if I remove gum and wood chemicals (product 27.0401, to the far left in Figure A6), and to 54.6% if I remove explosives (product 27.0403 to the far right in the spatial map). The improved fit seems too small given the small number of remaining products (five) and the cost of deciding what to do with the two excluded products (explosives, and gum and wood chemicals). My summary conclusion is that products in the Chemicals industry involve such heterogenous transaction patterns that they do not aggregate clearly into any industry of three or more products. Markets exist close to the product level.

Commerce's second change to the prior aggregation was to separate Drugs ($62.7 billion in 1992 output) from Cleaning and Toilet Preparations ($39.6 billion). Drugs is a single product category, so equivalence is trivially 100%. However, removing Drugs from the prior aggregate market of Drugs, Cleaning, and Toilet Preparations has almost no effect on equivalence among Cleaning and Toilet Preparations products (59.6% for five products in the prior aggregation, 59.9% for four products in the current aggregation). Figure A6 shows the Cleaning and Toilet Preparation products scattered from the center of the spatial map to the extreme left. In fact, the product categories of drugs (29.0100) and soaps (29.0101) are closer together than any two product categories within Cleaning and Toilet Preparations.

The one revision I infer from the network analysis is to separate Petroleum Refining from Asphalt. Petroleum Refining and Related Industries in the current Commerce aggregation contains five product categories that together produced $145.7 billion dollars in output. The products involve such diverse patterns of buying and selling that they are scattered in a semi-circle in Figure A6, and poorly described by a single principal component in Table A4 (47.7%).

However, the five products cluster into the two industries indicated in Figure A6, Petroleum Refining (to the lower left in the spatial map, $137.9 billion in 1992) and Asphalt (in the middle of the map, $7.8 billion). Equivalence increases (bottom of Table A4) from the poor 47.7% for the five product categories combined in the Commerce aggregation, to 57.7% for Petroleum Refining and 95.4% for Asphalt.

(7) Fabricated Metal

Thirty-nine categories of fabricated metal products are listed in Figure A7. The industries I infer from the network analysis are listed in Figure A7 with equivalence results in parentheses (e.g., the three products in Screw Machine Products are 71.9% equivalent in 1992, 68.5% equivalent in 1987).

——— Figure A7 About Here ———

The first two industries in Figure A7 are unchanged from prior and current Commerce aggregations. Metal cans and metal drums are structurally equivalent products in the Metal Containers industry at the top of Figure A7 (74.7% equivalent in 1992 with $13.1 billion in output). Similarly, the ten products in Heating, Plumbling, and Fabricated Structural Metal (HPFSM) are reasonably equivalent, especially for so many product categories (71.5% equivalence in 1992 with $49.5 billion in output).

Though combined in the current Commerce aggregation, Metal Stampings are an industry separate from Screw Machine Products. The three Screw Machine Products appear in the northeast corner of the spatial map in Figure A7 and combine to a $25.3 billion business in 1992. Metal Stampings is the lone product category in the southeast corner of the spatial map ($9.4 billion in 1992). The three Screw Machine Products have a transaction profile of buying steel then selling to motor vehicles, against a large volume of imports. Metal Stampings, in contrast, involves buying steel then selling (with little competition from imports) to electronics, engines and motors, and refrigeration and heating equipment. The very different transaction profiles are responsible for the distance between Metal Stampings and Screw Machine Products in Figure A7. A single principal component describes 59.0% of the 1992 transaction variance in all four product categories, which increases to 71.9% when metal stampings, n.e.c. are removed as a separate industry.

Other Fabricated Metals is a more complex industry. Commerce distinguishes 11 product categories in Other Fabricated Metals, seven of which are clustered in the middle of Figure A7 with the ten HPFSM products. Structural equivalence is high among these seven products (78.1% in 1992). In fact, a single principal component can describe 70.3% of the transaction variance in all 17 products in the center of the spatial map (10 HPFSM products and the 7 Other Fabricated Metals products).

The problem is the other four products scattered around the periphery of the spatial map; cutlery at the top of the map, metal foil and leaf in the southwest of the map, and in the southeast of the map: plating and polishing, and coating and engraving. Where cutlery involves buying steel, plastic, and plating then selling to retail, households, and barber/beauty shops, the coating

and plating products at the opposite side of Figure A7 involve buying steel and chemical preparations then selling to electronics and motor vehicles. Metal foil and leaf is away from both ends of the contrast because they involve buying aluminum, paper, and plastic then selling to households and companies that produce frozen fruit, juice, and vegetables. In short, there are very different resource-dependence concerns for organizations around the periphery of Other Fabricated Metals. Cutlery ($1.5 billion in 1992) and metal foil and leaf ($3.1 billion) represent too little business in fabricated metals to treat as separate industries, and they are as nonequivalent to one another as to the other products in their industry (59.1% equivalence in 1992 between cutlery and metal foil and leaf). However, the two Plating and Coating products in the southeast of Figure A7 involve transaction patterns more similar to one another than to the other products in their industry (70.2% equivalence in 1992 between plating and polishing, and coating and engraving), combine to a $10.0 billion business in 1992, and separating them from Other Fabricated Metals increases equivalence among the remaining 9 product categories from 56.3% to 65.5%. I conclude that the two plating and coating product categories should be distinguished as a Metal Finishing industry separate from Other Fabricated Metals, with a note that cutlery and metal foil and leaf are distinct niches within Other Fabricated Metals.

The remaining two industries in Figure A7 come from Commerce's residual category of Miscellaneous Manufacturing. Miscellaneous Manufacturing is a structurally heterogeneous collection of products; jewelry, toys, pens and pencils, inked ribbons, fasteners, brooms, burial caskets, signs, and manufacturing not elsewhere classified. The principal component measure of equivalence for the 18 product categories in Commerce's Miscellaneous industry is 47.1% for 1992 and 45.2% for 1987. I began with a spatial map like the one in Figure A7, but expanded to include all 18 product categories in Miscellaneous Manufacturing. A cluster of Jewelry products, and a cluster of Toys and Games products were the only clusters of Miscellaneous Manufacturing products evident in the expanded spatial map. Jewelry contained four product categories that together produced $9.1 billion in 1992 output from reasonably equivalent transaction patterns (72.8% in 1992). Toys and Games contained four product categories that together produced $12.4 billion in 1992, also from reasonably equivalent transaction patterns (74.3% in 1992). These are not products equally relevant to fabricated metals. Dolls and stuffed toys are typically not fabricated metal, but they are produced in a pattern of buying and selling similar to the pattern in which musical instruments, children's vehicles, and sporting goods are produced. The remaining ten Miscellaneous products were scattered around the spatial map and so quite heterogeneous (50.6% equivalence in 1992, 49.3% in 1987). This includes three obvious candidates for fabricated metals; fasteners, buttons, needles and pins (product 64.0700, which was located with Other Fabricated Metal products in the center of the map), and pens (product 64.0501, which was located further west than cutlery in Figure A7). I returned the ten remaining products to the residual category of Miscellaneous Manufacturing.

(8) Machines

A large number of manufacturing industries produce machines — mechanical machines, electrical machines, transportation equipment, ordnance and instruments. The aggregation of

machine products into industries is often clear from the network analysis, but there are several industries in which structural equivalence is as strong between products in adjacent industries as between products in the same industry.

Mechanical Machines

The network analysis reveals no reasons to change the current Commerce aggregation of mechanical machine products, with the one exception that two industries combined from the prior aggregation should be returned to their status as separate industries. Product categories for mechanical machines are listed in Table A5 with the output for each product category in 1992, and the factor loading (correlation) between the product transaction profile and the principal component for the product's industry.

The typical pattern in Table A5 is factor loadings similar within an industry such that no product clusters stand out to be separated as their own industry. This is the pattern in seven of the nine industries: Engines and Turbines, Farm and Garden Machinery, Construction and Mining Machinery, Materials Handling Machinery, Special Industry Machinery, General Industrial Machinery, and Service Industry Machinery. Structural equivalence within these industries varies from a high of 79.7% in Engines and Turbines to a low of 64.3% in General Industrial Machinery, but the similar factor loadings within each market — and so of course multidimensional scalings of distances between product transaction profiles — do not reveal product clusters to be separated as their own industry. In fact, equivalence is almost as high across industries as within. The 64.3% equivalence for the 7 products in General Industrial Machinery decreases only slightly to 63.0% if the industry is expanded to include the 6 Special Industry Machinery products. Equivalence only decreases to 63.1% if the industry is expanded to include the 5 products in Service Industry Machinery. As in Chemicals, these are industries with ambiguous boundaries. The buying and selling associated with any one product is in some important ways similar, and other important ways different, from products in the same and adjacent industries. My default is to use the current Commerce aggregation.

——— Table A5 About Here ———

The one exception is the one change in 1987 that Commerce made in aggregating mechanical machine products into industries. The prior aggregation separated two products in Farm and Garden Machinery (second category in Table A5) from three products in Construction and Mining Machinery (third category in Table A5). The two industries are combined in the current Commerce aggregation (industry 44-45: Farm, Construction, and Mining Equipment). Producers in the two industries are similar in buying steel and engines, selling to state and local government, and an active import/export trade. However, they differ sharply in their most important customer markets — agriculture for Farm and Garden Machinery (sector 2 at the top of Table 1), coal mining and construction for Construction and Mining Machinery (sectors 6 and 9). The differences are large enough to create the nonequivalence evident in Table A5; 76.0% and 76.8% equivalence in the separate industries drop to 63.9% within the combined industry. Since the separate industries each contain structurally equivalent transaction patterns (respective

equivalence measures of 76.0% and 76.8%), and involve a substantial volume of business ($14.2 billion and $17.9 billion respectively as reported in the first column of Table A5), the proposal is to return to the prior Commerce aggregation in keeping the two industries separate.

The two remaining industries in Table A5 each contain an outlier product obviously nonequivalent to the others in its industry: Metalworking Machinery (.50 loading for the product category of industrial patterns), and Miscellaneous Machinery Except Electrical (.56 loading for the product category of scales and balances). Deleting the outlier products increases structural equivalence among the remaining products (60.7% for Metalworking Machinery in Table A5 increases to 70.7%, and the 62.4% for Miscellaneous Machinery increases to 76.1%). Nevertheless, the outliers belong in the industries to which Commerce assigned them. Two reasons: First, the outliers represent small volumes of business, so where they are assigned will have little effect on the patterns of industry transactions and my default is to stay with the Commerce aggregation. Second, the two outlier product categories are slightly more structurally equivalent to their assigned industries than to adjacent industries. I correlated elements in the transaction profile for each of the two outlier products with a profile of average elements for products in each of the industries in Table A5 (excluding the two outlier products from the average for their own category). Industrial patterns is the outlier product in Metalworking Machinery, but the product's pattern of buying and selling is more similar to Metalworking Machinery than to any other industry (.56 correlation with Metalworking Machinery, versus the next highest correlation of .50 with General Industrial Machinery, and the subsequent highest correlation of .46 with Miscellaneous Machinery). Scales and balances is the outlier product in Miscellaneous Machinery, but the product's transaction profile is more similar to Miscellaneous Machinery than to any other industry (.60 correlation with Miscellaneous Machinery, versus the next highest correlation of .53 with Special Industry Machinery, and the subsequent highest correlation of .52 with Service Industry Machinery). The industry to which the outliers were assigned by Commerce are the ones to which they are most structurally equivalent, but it is clear from the correlations almost as strong with other industries that the outliers are almost as equivalent to buying and selling in adjacent industries.

Electrical Machines

The seven industries in the current and prior Commerce aggregation of electrical machines are listed in Table A6 with their product categories. As in Table A5, each product category is reported with its output in 1992, and the factor loading between its transaction profile and the principal component for its industry.

The network analysis reveals no reason to change three of the industries in the current Commerce aggregation. Computer and Office Equipment is at the top of Table A6. This is a mechanical machines industry in the Commerce aggregation because the industry labels come from an era when office machines were primarily mechanical. I analyzed the four computer categories as electrical machines to see how they combined with other electrical machine products. The four computer products are more structurally equivalent to one another than to

other products. As an industry pattern of buying and selling, they are at the center of the spatial map of electrical machine equivalencies (Figure A8). Structural equivalence is high within the industry (78.2% in 1992), and the factor loadings are evenly high for each product category. Similarly, the Household Appliances industry is an accurate summary of its six product patterns of buying and selling (structural equivalence is 72.8% in 1992 and the factor loadings are even across the six products), and the Electric Lighting and Wiring industry is an accurate summary of its products (structural equivalence is 77.4% in 1992 and the factor loadings are even across its three products).

——— Table A6 and Figure A8 About Here ———

The other four industries are problematic. The diverse patterns of buying and selling in Electrical Industrial Equipment can be inferred from the low variance described by the principal component of its six product transaction profiles (50.4% in the left column of Table A6). The six product factor loadings indicate two outlier products. The first four products in the left column of Table A6 have factor loadings greater than .75. The last two products have much lower loadings (.42 for carbon and graphite products, and .47 for electrical industrial equipment not elsewhere classified). Nevertheless, the transaction profiles for the two outlier products are more correlated with the average profile for the first four products in Electrical Industrial Equipment (correlations of .52 and .48) than they are with the average profile for the next closest industries of Computers (.27 and .29 correlations) or Communication Equipment (correlations of .16 and .31). The explanation is apparent in Figure A8, a multidimensional scaling of distance between product transaction profiles. To simplify the spatial map, I averaged transaction profiles within the three industries mentioned above that accurately summarize their product transaction profiles (see the note under the map). Returning to the Electrical Industrial Equipment industry; it is the area to the right in the map. The large area across which this industry's products are spread shows the heterogeneity of its product transaction profiles. The two outlier products are the furthest to the right (53.0700 and 53.0800). It makes sense that the two outlier products have low factor loadings within Electrical Industrial Equipment at the same time that they have higher correlations within the industry than with products in other industries: They are on the periphery of the industry in Figure A8, but closer to other products within their industry than they are to any other electrical machine products. I take the default of retaining the current Commerce aggregation despite the structural heterogeneity of products within the industry.

Irregularities in the other three industries are more tractable. There is even more structural heterogeneity within Audio, Video, and Communication Equipment than the heterogeneity just described within Electrical Industrial Equipment (49.9% equivalence in 1992 for Commerce's Audio, Video, and Communication Equipment industry in the left column of Table A6). The industry contains products from three separate industries. The two Communication Equipment product categories appear to the right of the center in Figure A8, involve similar patterns of buying and selling (equivalence is 82.5% in 1992 in the right column of Table A6), and produce a large volume of output ($41.9 billion in 1992). Further to the left in Figure A8 is the separate industry of Household Audio-Visual Equipment, and at the extreme left is the product category of prerecorded records and tapes.

Second, the three product categories in Electronic Components are better treated as two separate industries. The product categories of tubes and other electronic components are proximate to one another near the center of Figure A8, involve similar patterns of buying and selling (73.4% equivalence in the right column of Table A6), and produce a large volume of output ($40.8 billion in 1992). They together form the Electronic Components industry. Semiconductor manufacturers are a structurally distinct industry at the bottom of Figure A8 and they also produce a large volume of output ($30.1 billion in 1992).

Third, Miscellaneous Electrical Machinery is only 54.0% equivalent in 1992. The five products in this industry are scattered around the center of the map in Figure A8. Two can be combined with other industries: magnetic and optical recording media combines with prerecorded tapes to define a Recordings industry (southwest of Figure A8; 71.1% equivalence in the right column of Table A6; $6.1 billion in 1992), and primary batteries fit in Household Appliances (northwest of Figure A8; .62 factor loading in the right column of Table A6). The remaining three product categories are more equivalent without the two reassigned products (69.9% equivalence at the bottom of the right column in Table A6).

Transportation Equipment

The network analysis reveals six transportation equipment industries among Commerce's four. Current and proposed aggregations are given in Figure A9 with a multidimensional scaling of structural equivalence distances between product categories. Two weapons products that involve transportation-equipment production, tanks and missiles, are included to illustrate their separation from the civilian industries. Again, each product category is reported with its output in 1992, and the factor loading between its transaction profile and the principal component for its industry in the current Commerce aggregation.

The Aircraft industry is unaffected by the network analysis. The Aircraft product categories involve similar patterns of buying and selling (77.8% equivalence in 1992 and high factor loadings for each product category within the industry) and stand apart as their own industry to the left in Figure A9.

Commerce divided the Motor Vehicles industry into two separate industries in 1987; Auto (which was a large industry all by itself, $150.7 billion in 1992 output) versus three product categories combined in Trucks, Buses, and Parts (another $80.3 billion). The separation was wise. Structural equivalence among the four products is low (61.3% equivalence in 1992), and it is still low within Trucks, Buses, and Parts (66.5%). The problem is that Motor Vehicle Parts is a structurally distinct industry in its own right as illustrated at the top of the spatial map in Figure A9. The remaining two product categories combine to define the Trucks, Buses, and Trailers industry (79.7% equivalence in 1992).

——— Figure A9 About Here ———

Heterogeneity in the remaining industry, Other Transportation Equipment, can also be corrected (46.1% equivalence in 1992). The primary reason for the poor aggregate level of equivalence within the industry is two outlier product categories, ship building and railroad

equipment. These two categories have the lowest factor loadings within the industry (.57 and .42 respectively), and clearly stand apart in the spatial map from the other product categories in the industry (one at the top of the spatial map in Figure A9, the other at the bottom). If Ships are put aside as their own industry ($10.4 billion in 1992 output), and Railroad Equipment is put aside as its own industry ($4.8 billion in 1992 output), then the remaining products are personal transportation equipment of one kind or another (boats, motorcycles, recreation vehicles, etc.) which involve more similar patterns of buying and selling than is the case with ships and railroad equipment included in the industry (46.1% equivalence increases to 57.9%).

A final point to note here is the separation between tanks and missiles. They are not only separate from one another (66.6% equivalent in 1992), they are also clearly apart from the other transportation equipment industries in Figure A9. Adding missiles to the Aircraft industry would lower equivalence from the 73.7% in Figure A9 to 61.7%. Tanks similarly do not fit within the Auto industry (54.1% equivalence for only two product categories) or the Trucks, Buses, and Trailers industry (79.7% equivalence in Figure A9 drops to 53.8%). Tanks and missiles involve much of the technology used to manufacture transportation equipment for civilians, but it is clear that tanks and missiles are their own industries apart from the civilian industries.

Ordnance and Instruments

The network analysis reveals eight ordnance and instrument industries among Commerce's three. Current and proposed aggregations are given in Figure A10 with a multidimensional scaling of structural equivalence distances between product categories. As a frame of reference, I have included five other machine industries in the spatial map (see box in the map). Each industry is positioned in the map by the average transaction profile for its component product categories. Again, each product category is reported with its output in 1992 and the factor loading between its transaction profile and the principal component for its industry in the current Commerce aggregation. Equivalence is low within all three of the Commerce industries; 51.4% in Ordnance, 56.4% in Scientific and Controlling Equipment, 60.3% for the two products in Opthalmic and Photographic Equipment.

——— Figure A10 About Here ———

Ordnance contains three industries. Missiles are the largest industry ($16.6 billion output in 1992) and involve a pattern of buying and selling least like the other ordnance products (.55 factor loading). The Missile industry appears at the top of the spatial map in Figure A10, next to the Aircraft industry, just to the left of search and navigational products. Small Arms manufacturers are the smallest of the ordnance industries ($2.5 billion), but the two product categories of small arms and small arms ammunition appear at the bottom of the spatial map in Figure A10 well away from other ordnance products and involve similar patterns of buying and selling (80.5% equivalence in 1992). The remaining three ordnance products form a third industry, Other Ordnance ($6.7 billion), in the middle of the spatial map to the right of the Ship industry, and they too involve similar patterns of buying and selling (75.7% equivalence).

The two product categories in Opthalmic and Photographic Equipment both involve the use of eyes, but very different patterns of buying and selling (60.3% equivalence is low for an

industry containing only two product categories). Photographic Equipment is its own large industry ($21.7 billion output in 1992) that appears to the extreme right in the Figure A10 spatial map, structurally distinct from all other products in the map. Opthalmic goods are more similar to the precision tooling in watches, which together form Watches and Opthalmic Goods in the south of the Figure A10 map (74.7% equivalence), next to Small Arms.

Scientific and Controlling Instruments is a potpourri of products in which three industries can be distinguished. The twelve product categories in the Commerce aggregation are scattered across the spatial map in Figure A10 (56.4% equivalence in 1992). Three products cluster together in the center of the map to define Dental and Surgical Equipment ($27.9 billion in 1992 output and 78.5% equivalence). Two products cluster together, between the Missiles and Communication Equipment industries in the spatial map, to define Search and Navigation Equipment ($36.9 billion and 72.1% equivalence). The uncircled products at the top of the spatial map constitute a third industry, Other Instruments. The products are spread over a relatively large area in the map, so it is not accurate to say that they are structurally equivalent, however, they are more equivalent than the larger set of instrument products (68.2% equivalence versus 56.4% for the Commerce aggregation).

(9) Food and Tobacco

The 52 manufacturing industries in the current Commerce aggregation generated $56.8 billion per industry on average in 1992. The Tobacco industry at $40.1 billion was smaller than average. Food, on the other hand, dwarfed the other 51 industries with $408.5 billion in output (followed by the Auto industry's distant second of $150.7 billion).

It is all the more striking, therefore, to see the 46 product categories within the food industry hold together as well as they do (61.7% equivalence in 1992). The reason is that the food industry stands well away from other aggregate industries in a spatial map of equivalence distances between industries (Burt and Carleton, 1989:728; Burt, 1992:86-87), and product categories are not sharply differentiated within the food industry. Figure A11 is a multidimensional scaling of equivalence distances among the 4 tobacco product categories and the 46 food product categories. Dashed lines indicate some of the partitions to be proposed, but if you imagine the dashed lines removed, there would be little evidence to justify changes to the current Commerce aggregation. In fact, I have not marked with dashed lines all of the partitions to be proposed because they so overlap that they obscure one another in the map. Despite the extreme magnitude of food output and number of product categories in the current Commerce aggregation, the aggregation is justified by a structural equivalence criterion.

——— Figure A11 and Table A7 About Here ———

Nevertheless, the industry is too broad for organizational research. The many product categories are structural equivalent in processing raw agricultural materials to ship to the retail sector, but they differ in the kind of product shipped and in their position at the beginning or end of the food manufacturing process. Organization research typically compares organizations within segments of the food industry; beverage firms compared to one another, or cereal firms compared to one another, or meat processing firms compared to one another. Even the broad

industry categories in Fortune distinguish beverages from other food products in the annual report on the largest 500 companies.

Therefore, I used the network analysis not to correct mis-aggregations by Commerce, but to find reasonable partitions between industry segments; segments more likely to be useful in organization research. I began by reversing the aggregation question used in the preceding sections. Instead of looking at a representation of equivalence distances to see if any partitions exist within the industry (as in Figure A11), I used a hierarchical cluster analysis of equivalence distances to reveal where the most clear partitions exist to the extent that any exist. The result is the ten proposed industry segments in Table A7.

The sharpest distinction in the cluster analysis separates Milling and Oil Products from the other products. The nine product categories in Milling and Oil appear to the far west in Figure A11. Two of them produced more than $10 billion in 1992 output (indicated in the map by solid dots and Commerce product identification codes); prepared feeds (14.1502) and soybean oil mills (14.2500). The nine Milling and Oil Products are structurally equivalent in being early steps in the process of food manufacture. They are typically inputs for other food products. The fact that they are not inputs to the same food products means that they involve diverse patterns of buying and selling, which results in them being scattered over a wide area of the spatial map, and showing a low level of structural equivalence across the nine products (59.7% equivalence in 1992). Still, they are the most distinct industry segment within Food and Tobacco, and the factor loadings in Table A7 are on the whole high and even. The one outlier product is animal and marine fats with its .53 loading. Animal and marine fats is the dot to the extreme south in the Milling and Oil Products cluster in Figure A11. However, factor analysis corroborates the spatial map in showing that animal and marine fats involve a pattern of buying and selling more equivalent to Milling and Oil Products than to any other industry.

The only other clear distinction, on the other extreme of the cluster analysis, separated a Meat and Dairy segment within the industry. The 10 product categories of Meat and Dairy Products are the cluster in the southwest of the spatial map in Figure A11 and show a high level of structural equivalence across categories (84.5% equivalence in Table A7 with high, even factor loadings for the product categories). The two fish products have the lowest factor loadings (.85 and .76), but even these loadings are high and loadings for both fish products would be lower if they were added to other industries (e.g., .68 and .67 if they were added to Canned and Frozen Foods, which would also lower equivalence within Canned and Frozen Foods to 64.3% from the 76.5% reported in Table A7). Another reasonable distinction would be to separate meat from dairy products, both of which are large business segments (5 meat product categories, 81.5% equivalence, $99.9 billion in 1992 output; and 5 dairy product categories, 91.6% equivalence, $50.4 billion in output). I have not separated the two because patterns of buying and selling are so equivalent across all 10 products (84.5% equivalence in Table A7) and profit margins are similar in the two (.07 average across meat products, .13 average across dairy products).

There are no industry segments so clearly distinguished in the cluster analysis, so I used a three-step "snowball" method to assign the remaining products to industry segments. First, I

began with a large product category as the kernel of an industry segment. For example, the next largest product category in Table A7 not yet assigned to an industry segment is cigarettes, with $34.7 billion in 1992 output.

Second, I added product categories from an increasing radius of equivalence distance around the kernel product. For example, adding the two tobacco product categories adjacent to cigarettes in Figure A11 yields the circled Tobacco industry which has a high level of equivalence (92.6% and high, even factor loadings for the three combined products).

Third, I stopped where structural equivalence was difficult to justify quantitatively, or interpret substantively. For example, the product category closest to Tobacco in Figure A11 is the dot between the circled Tobacco products and the circled Meat and Dairy Products. The dot is manufactured ice, so it not an obvious product to add to the Tobacco industry on substantive grounds, but it is also a poor fit on equivalence grounds (92.6% equivalence for Tobacco in Table A7 would drop to 77.1% with manufactured ice included and the .63 factor loading for ice would make it a clear outlier product within the industry). Stopping at the three product categories listed for Tobacco in Table A7 excludes a fourth category included in the current Commerce aggregation. Commerce includes tobacco stemming and redrying in the Tobacco industry, but the network analysis puts tobacco stemming and redrying in the Milling and Oil Products industry (look for 15.0200 to the far west in Figure A11). If tobacco stemming and redrying is added to the Tobacco industry, it has only a .45 factor loading with the other three products and equivalence drops to 70.6% from the 92.6% reported in Table A7. Further, the three product categories combined as the Tobacco industry in Figure A11 and Table A7 enjoy much higher profit margins (.61, .25, and .53) than the margin in tobacco stemming and redrying (.07, similar to the low .09 average margin for the other 8 categories in Milling and Oil Products).

Two beverage industries are proposed; Alcoholic Beverages (beer, liquor, and wine; $32.3 billion in 1992 output) and Soft Drinks ($23.8 billion). The three categories of Alcoholic Beverages involve very similar patterns of buying and selling (85.3% equivalence in Table A7 with high, even factor loadings for the product categories). This excludes the product category of malt that is included with alcoholic products in the current Commerce aggregation, however, the network analysis puts malt in the Milling and Oil Products industry (look for 14.2102 to the far west in Figure A11). If malt is added to Alcoholic Beverages, equivalence for the industry drops to 66.2% from the 85.3% reported in Table A7 and malt is a clear outlier product with its a .36 factor loading. Further, the three categories of Alcoholic Beverages yield higher profit margins (.44, .32, and .62) than malt's margin (which is .10, similar to the low .09 average margin for the other 8 categories in Milling and Oil Products). In fact, the two beverage industries involve more similar patterns of buying and selling than either is similar to malt. Equivalence would be high in a four-product industry combining Alcoholic Beverages and Soft Drinks (80.0% equivalence for four products), but would drop appreciably if malt were then added to the combined industry (65.1% equivalence for five products). Separate beverage industries are proposed in Table A7 for three reasons, despite their reasonably equivalent patterns of buying and selling: One, Soft Drinks is further removed in the spatial map from any

of the three categories of Alcoholic Beverages than they are from one another (also indicated by Soft Drinks having the lowest factor loading within a combined four-category beverages industry). Two, Soft Drinks is a large industry in its own right with $23.8 billion in 1992 output. Three, Soft Drinks return a much lower margin than Alcoholic Beverages (.13 for Soft Drinks versus .44, .32, and .62 for the three categories of Alcoholic Beverages).

I used the network analysis to aggregate the remaining products into five industry segments. Three combine to form the Bakery Goods industry (88.1% equivalence in Table A7 with high, even factor loadings as in all but the last of these five industries) which is anchored on bread, cake, and related products ($24.1 billion in 1992 output; look for the solid dot labelled 14.1801 in Figure A11). Four Other Flour Products combine to form their own industry (75.3% equivalence) anchored on cereal breakfast foods ($9.0 billion; look for the hollow dot labelled 14.1402 in Figure A11). Seven products form the Canned and Frozen Food industry (76.5% equivalence) anchored on canned fruits, vegetables, preserves, jams, and jellies ($14.5 billion; look for the solid dot labelled 14.0900 in Figure A11). Canned and frozen fish are excluded from this industry because the pattern of buying and selling in fish product manufacturing more resembles the pattern in Meat and Dairy Products as explained above. Five products form the Candy and Snack Foods industry (82.3% equivalence; six categories in 1987 because chewing gum is a separate product category) anchored on candy ($9.9 billion; look for the hollow dot labelled 14.2005 in Figure A11). The remaining five product categories form a residual industry of Food Products, not elsewhere classified, appropriately anchored on the large product category of food preparations, n.e.c. ($11.9 billion, look for the solid dot labelled 14.3202 in Figure A11). There were initially nine products in the residual category, but I correlated the transaction profile for each residual product with average transaction profiles for the eight preceding industry segments and found four of the nine products to be better assigned to one of the other segments (the two categories of fish products, coffee, and pasta).

(10) Distribution and Services

Distribution and services is the tenth, final, and most complex cluster of products to be network analyzed. It is the most complex because it contains more product categories (78 in 1992) than the product clusters already discussed, and it represents a disproportionate share of the American economy (distribution and services produce 59% of the total 1992 output from all industries in Table 1). At the same time, the analysis is simplified because the current Commerce aggregation already contains many of the needed revisions to the prior aggregation. The 13 distribution and service industries in the Commerce aggregation before 1987 are expanded to 27 in the current aggregation. The equivalence results in Table A8 show that the finer industry distinctions were much needed. Product categories are listed in Table A8 with the equivalence results for each industry in the prior aggregation. The often low principal component measures in the header for each industry (e.g., 59.2% equivalence in 1992 for Transportation and Warehousing), and often low factor loadings in the second column (e.g., .659 loading for pipelines within Transportation and Warehousing), show the need for finer industry distinctions between products. The current Commerce aggregation makes more distinctions within industries. All of changes from the prior

to the current aggregation in distribution and services were additional distinctions within industries in the prior aggregation. These too are indicated in Table A8 by the Commerce industry identification code for each product in the current aggregation (fourth column) and a space between industries. Where the second column of Table A8 contains each product's factor loading on its industry in the prior aggregation, the third column contains each product's loading on its industry in the current aggregation. Equivalence measures for industries in the current aggregation are given in Table 1.

Distribution Industries

The first five industries in Table A8 provide distribution (Commerce codes 65 through 69). The current Commerce aggregation alleviates two problems in the prior aggregation. The five product categories in the Utilities industry were only 58.5% equivalent in 1992. Separating them into the three industry segments of Electric, Gas, Water and Sanitation, increased equivalence to 100%, 71.2% and 83.6% respectively. Also, the nine product categories in Transportation and Warehousing were only 52.2% equivalent in 1992. Separating them into the five industry segments at the top of Table A8 increased equivalence to 70.8%, 74.3%, 100%, 100%, and 61.4%. The 61.4% for the fifth segment is poor and the factor loadings in the third column show that pipelines are an outlier from the other two products of freight forwarders and travel agents. Pipelines could be added to the Natural Gas segment of the Utilities industry (decreasing equivalence from the 71.2% in Table 1 to 67.1%, but factor loadings are high for all three product categories). Since the pipelines product category is all pipeline distribution other than natural gas, however, it seems better to separate pipelines as its own industry with $7.3 billion output in 1992 (to be industry code 65F in the proposed aggregation). Equivalence between the remaining two travel services of freight forwarders and travel agents increases from 61.4% to 79.6%.

In fact, there are more industry distinctions than necessary in the current Commerce aggregation. For example, Wholesale and Retail Trade involve such similar patterns of buying and selling at the aggregate level (and similar price-cost margins of .30 and .27 respectively in 1992), that they could be treated as part of the same industry, as they were in the prior aggregation (92.2% equivalence). However, the two industries each produce a large volume of output and such different distribution channels that it seems preferable to continue with the current Commerce aggregation in which the industries are separate. A second example is Electric Services, which involves a pattern of buying and selling very similar to the pattern for Water and Sanitation. The 83.6% equivalence for Water and Sanitation only drops to 80.2% if Electric Services is added to form a broader utilities industry. With the coming de-regulation of the power industry, however, it makes sense to stay with Commerce's separate Electric industry to monitor that market directly.

Financial, Real Estate, and Business Services

Structural equivalence is low within all three of these industries in the prior Commerce aggregation; 58.7% for the five products in Finance and Insurance (code 70 in Table A8, 56.4% for the three products in Real Estate and Rental (code 71), and 60.2% for the 14 products in Business and Professional Services (excluding medical, code 73). All three industries are divided into finer-grain categories in the current Commerce aggregation but equivalence remains an issue.

The prior Finance and Insurance industry is currently divided into Finance (composed of three products, 71.8% equivalent) and an Insurance industry composed of two products, but the 51.9% equivalence for the two insurance products shows that they are too nonequivalent to be combined in the same industry. The volume of business in both categories is sufficient to treat them as separate industries; Insurance Carriers (code 70B in the proposed aggregation; $169.0 billion in 1992) separate from Insurance Agents (code 70C in the proposed aggregation; $62.1 billion in 1992).

The prior Real Estate and Rental industry is also divided currently into two industries. Owner-Occupied Dwellings is a half-trillion dollar business contained in one product category. Real Estate and Royalties contains two product categories, but the categories involve very different patterns of buying and selling (53.8% equivalence). Real Estate Agents a business for which construction is the primary supplier, retail trade is the primary customer, and households are the primary final demand. Royalties is a very different transaction pattern generating a sizeable $55.7 billion in 1992. Crude petroleum is the primary customer market, exports are the primary final demand, and there is no primary supplier market. In other words, Royalties is primarily the business of selling petroleum drilling rights to overseas oil companies. It is distinct from Petroleum Refining (.13 correlation between the transaction patterns for Royalties and Petroleum Refining). Whatever the Royalties business is, it is clearly nonequivalent to the market for Real Estate Agents. I have put Royalties aside as a separate category in the proposed aggregation (code 71C).

The prior Business and Professional Services industry is currently divided into four industries. Two of them contain a single product category so equivalence is trivial; Computer and Data Processing Services ($115.7 billion in 1992), and Advertising ($29.9 billion in 1992). The other two industries are composed of nonequivalent products that require more than two industry distinctions (Legal, Engineering, Accounting and Related Services composed of three product categories at only 64.8% equivalence, and Other Business Services composed of nine product categories at only 62.8% equivalence).

Figure A12 is a multidimensional scaling of equivalence distances in 1992 among 19 product categories, 14 within business and professional services, and five within Finance and Insurance. The proposed aggregation of the product categories is listed to the right of the spatial map. I've already discussed Finance and Insurance. They are only included here as a point of reference. It is clear to see why the two insurance product categories do not fit into the same industry (as in the current and prior Commerce aggregation); insurance carriers are in the

northeast of Figure A12 and insurance agents are in the southeast. It is also clear to see the lack of structural equivalence within the two broad categories of business services in the current Commerce aggregation. First, legal services are close to banking, and engineering is at the bottom of the spatial map. These are large product categories that can be treated as industries in their own right. Accounting, the third product combined with legal and engineering services in the current Commerce aggregation, involves a pattern of buying and selling more similar to management services. Accounting and management services are combined to form the Management Consulting industry circled in the center of the spatial map. The low equivalence score of 64.8% in the prior aggregation increases to 84.5% within the proposed Management Consulting industry. There is also an industry composed of General Business Services at the top of the spatial map. Here too, equivalence is higher than in the current Commerce aggregation (71.5%, up from 62.8%). The remaining product categories in the spatial map are too structurally nonequivalent to one another to be combined as components of a broader industry. Legal services could be added to the Finance industry without eroding the level of structural equivalence within Finance (the 71.8% equivalence in Figure A12 for three product categories would be 71.9% for four products). Even if legal and financial services involve similar supplier and customer markets, however, Legal Services are a large industry in their own right ($116.7 billion in 1992), substantively distinct from Finance, and I would rather not change the Finance industry in the current Commerce aggregation since structural equivalence is acceptable as the industry is now defined by Commerce.

Personal, Health, and Educational Services

These industries in the prior Commerce aggregation are Hotels and Personal Services (code 72 in Table A8), Eating and Drinking Places (code 74), Automobile Services (code 75), Amusements (code 76), and Health, Education, and Social Services (code 77).

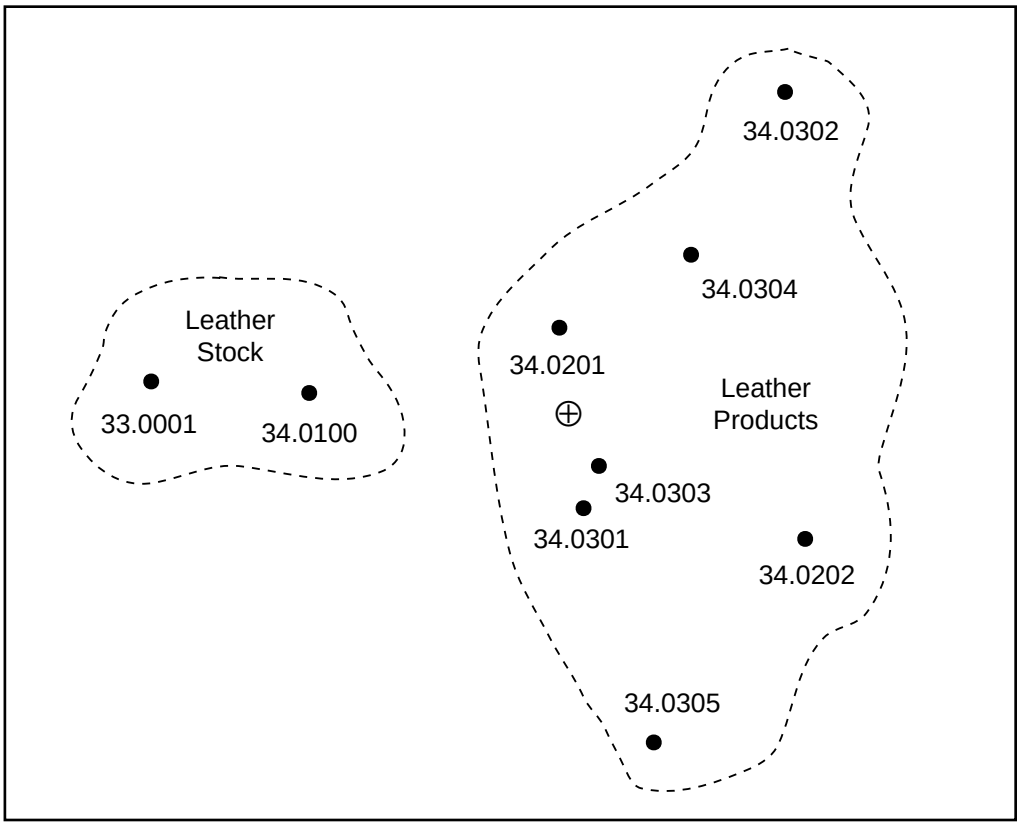
Three of the industries are composed of products that involve diverse patterns of buying and selling but the heterogeneity seems intractable beyond changes already in the current Commerce aggregation. For example, the Hotel and Personal Services industry with only 57.0% equivalence in the prior Commerce aggregation is now two, more internally homogeneous, industries; Hotels (70.2% equivalence) and Personal Services (56.5% equivalence). Equivalence is low for Personal Services, but it is difficult improve the current industry boundary. The factor loadings in Table A8 show that the two outlier products within Personal Services are funeral services (.696 loading) and watch, clock, jewelry, and furniture repair (.683 loading). The transaction profiles for these product categories are dissimilar from one another (65.5% equivalence), removing them from Personal Services doesn't improve equivalence for the remaining four products (61.0% equivalence), the outlier products involve too little output to treat them as separate service industries (service industries run large), they yield price-cost margins similar to the other products in the industry (about .3), and it is not clear where the outlier products would be put if not in Personal Services. Thus, the product heterogeneity within Personal Services seems intractable. The network analysis does not imply any change to the industry.

Heterogeneity is similar within Automobile Services and Amusements. Both of these industries continue unchanged from the prior to the current Commerce aggregation. The three categories within Automobile Services (code 75) involve three different patterns of buying and selling such that equivalence is low across the products (68.2% in 1992), but the factor loadings for each product are high and even. There is no obvious outlier to remove from the industry, and this is the substantively correct industry to contain each product. The eight product categories within Amusements (code 76 at the bottom of Table A8) are similarly heterogeneous (62.4% equivalent), but there is an outlier product. The product category of physical fitness facilities has a factor loading on the Amusements industry that is much lower than the loadings for other products (.6, versus the other loadings closer to .8), and physical fitness facilities were a $12.6 billion business in 1992 so they could constitute their own service industry, albeit a small one. Again, however, deleting the outlier product from the Amusements industry does not much improve equivalence among the remaining products (62.4% equivalence in Table A8 only increases to 66.7%), so the network analysis provides no reason to change from the current Commerce aggregation.

Structural equivalence is reasonably high in the remaining industries; in Eating and Drinking Places by default because it contains only one product category, in Health, Education, and Social Services because the already acceptable level of equivalence in the prior aggregation (71.5% for 17 product categories) is higher in the current aggregation (78.9% for the six products in Health Services, and 72.1% for the 11 products in Educational and Social Services).

FIGURE A1. LEATHER

(⊕ marks the center of the space, stress = .070)



Current Aggregation:

33-34. Leather and Leather Products

33.0001	leather tanning and finishing
34.0100	boot and shoe cut stock and findings
34.0201	shoes, except rubber
34.0202	house slippers
34.0301	leather gloves and mittens
34.0302	luggage
34.0303	women's handbags and purses
34.0304	personal leather goods, n.e.c.
34.0305	leather goods, n.e.c.

Proposed Aggregation

(* marks revised category)**:**

*33-34A. Leather Stock

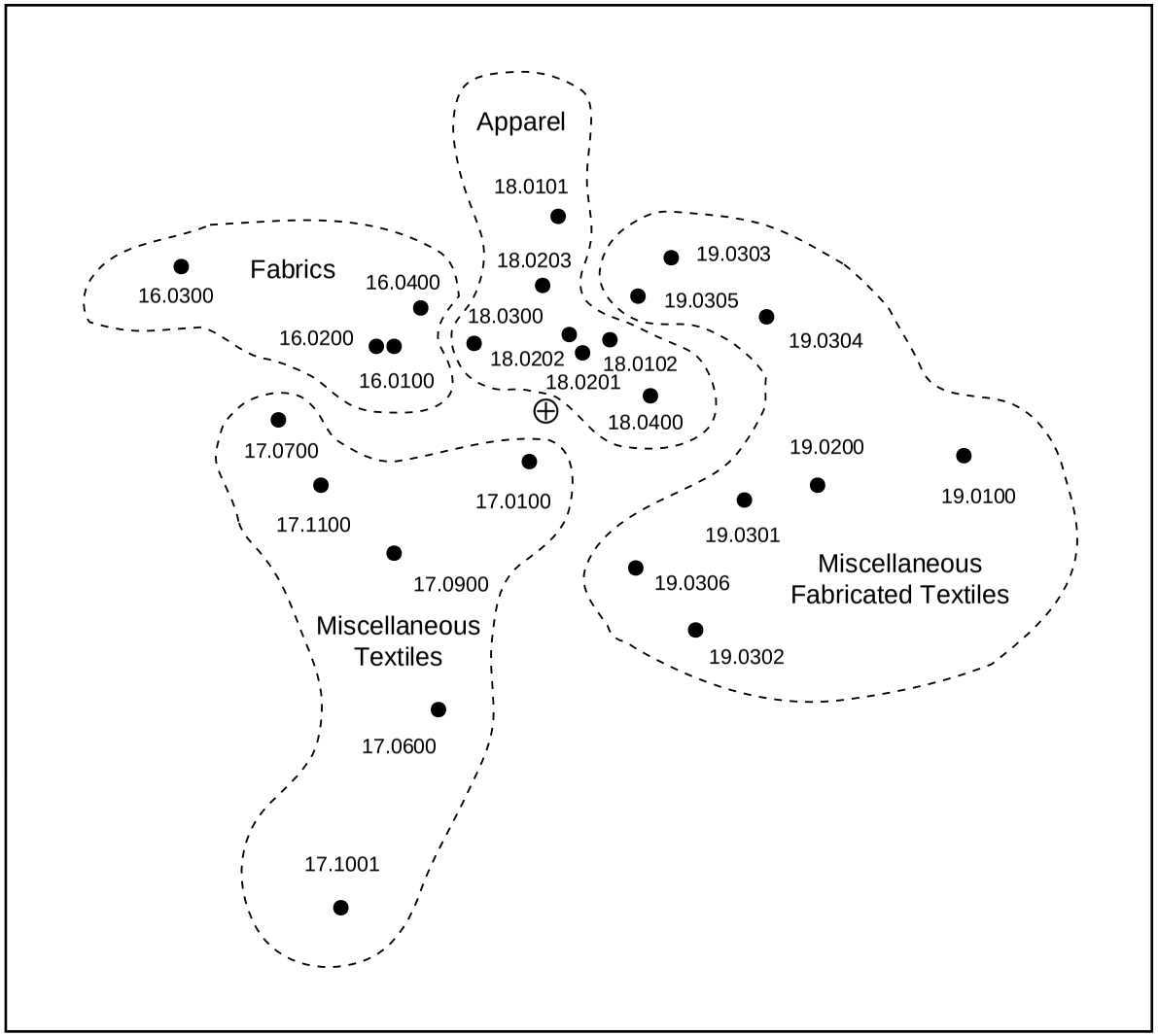
33.0001	leather tanning and finishing
34.0100	boot and shoe cut stock and findings

*33-34B. Leather Products

34.0201	shoes, except rubber
34.0202	house slippers
34.0301	leather gloves and mittens
34.0302	luggage
34.0303	women's handbags and purses
34.0304	personal leather goods, n.e.c.
34.0305	leather goods, n.e.c.

FIGURE A2. APPAREL AND TEXTILES

(⊕ marks the center of the space, stress = .154)



Retained Commerce Aggregation:

16. Fabrics (82.4% in 1992, 75.6% in 1987)

16.0100	broadwoven fabric mills and fabric finishing plants
16.0200	narrow fabric mills
16.0300	yarn mills and finishing of textiles, n.e.c.
16.0400	thread mills

17. Miscellaneous Textiles (56.5%, 44.6%),

17.0100	carpets and rugs
17.0600	coated fabrics, not rubberized
17.0700	tire cord and fabrics
17.0900	cordage and twine
17.1001	nonwoven fabrics
17.1100	textile goods, n.e.c.

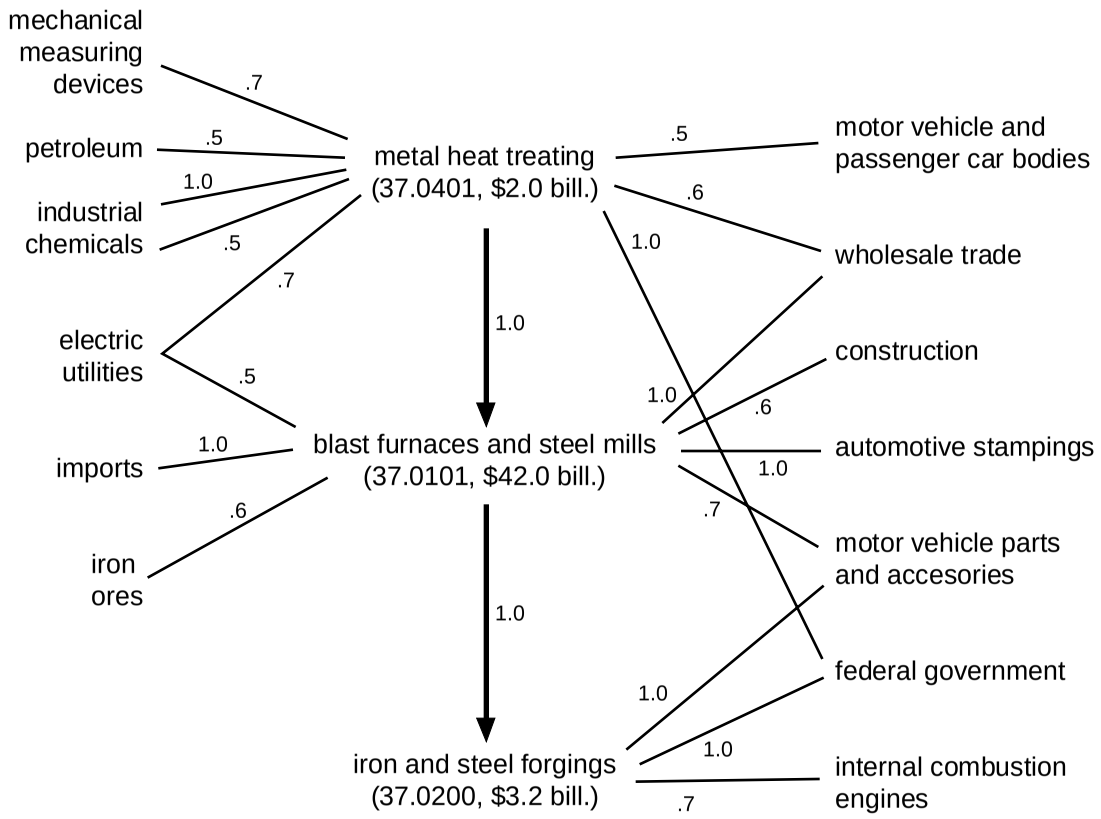
18. Apparel (67.4%, 71.3%)

18.0101	women's hosiery, except socks
18.0102	hosiery, n.e.c.
18.0201	knit outerwear mills
18.0202	knit underwear and nightwear mills
18.0203	knitting mills, n.e.c.
18.0300	knit fabric mills
18.0400	apparel made from purchased materials

19. Miscellaneous Fabricated Textiles (56.9%, 53.8%)

19.0100	curtains and draperies
19.0200	house furnishings, n.e.c.
19.0301	textile bags
19.0302	canvas and related products
19.0303	pleating and stitching
19.0304	automotive and apparel trimmings
19.0305	schiffli machine embroideries
19.0306	fabricated textile products, n.e.c.

FIGURE A3. PRIMARY METALS



All elements over .5 in the 1992 transaction profiles for the three iron and steel products are presented. Goods flow from suppliers on the left, to customers on the right.

Retained Commerce Aggregation:

37. Primary Iron and Steel
(48.6% in 1992, 46.6% in 1987)

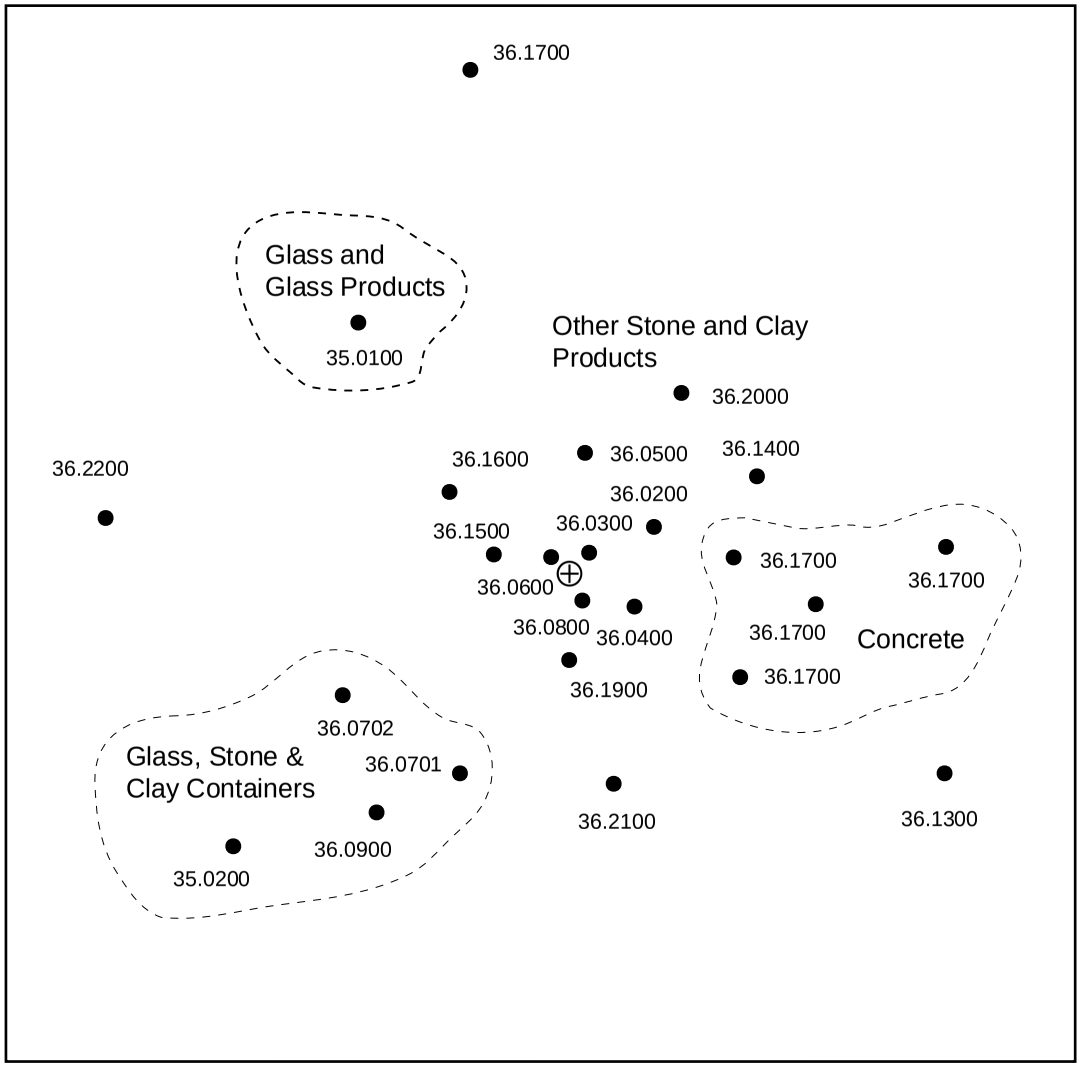
37.0101	blast furnaces and steel mills
37.0102	electrometallurgical products, except steel
37.0103	steel wiredrawing and steel nails and spikes
37.0104	cold-rolled steel sheet, strip, and bars
37.0105	steel pipe and tubes
37.0200	iron and steel foundries
37.0300	iron and steel forgings
37.0401	metal heat treating
37.0402	primary metal products, n.e.c.

38. Primary Nonferrous Metals
(43.2% in 1992, 37.3% in 1987)

38.0100	primary smelting and refining of copper
38.0400	primary aluminum
38.0501	primary nonferrous metals, n.e.c.
38.0600	secondary nonferrous metals
38.0700	rolling, drawing, and extruding of copper
38.0800	aluminum rolling and drawing
38.0900	nonferrous rolling and drawing, n.e.c.
38.1000	nonferrous wiredrawing and insulating
38.1100	aluminum castings
38.1200	copper foundries
38.1300	nonferrous castings, n.e.c.
38.1400	nonferrous forgings

FIGURE A4. GLASS, STONE, AND CLAY

(⊕ marks the center of the space, stress = .179)



Proposed Aggregation (* marks revised category)**:**

35. Glass and Glass Products

35.0100 glass and glass products, except containers

***36A. Glass, Stone, and Clay Containers**

35.0200 glass containers
36.0701 vitreous china table and kitchenware
36.0702 fine earthenware table and kitchenware
36.0900 pottery products, n.e.c.

***36B. Concrete**

36.0100 cement, hydraulic
36.1000 concrete block and brick
36.1100 concrete products, except block and brick
36.1200 ready-mixed concrete

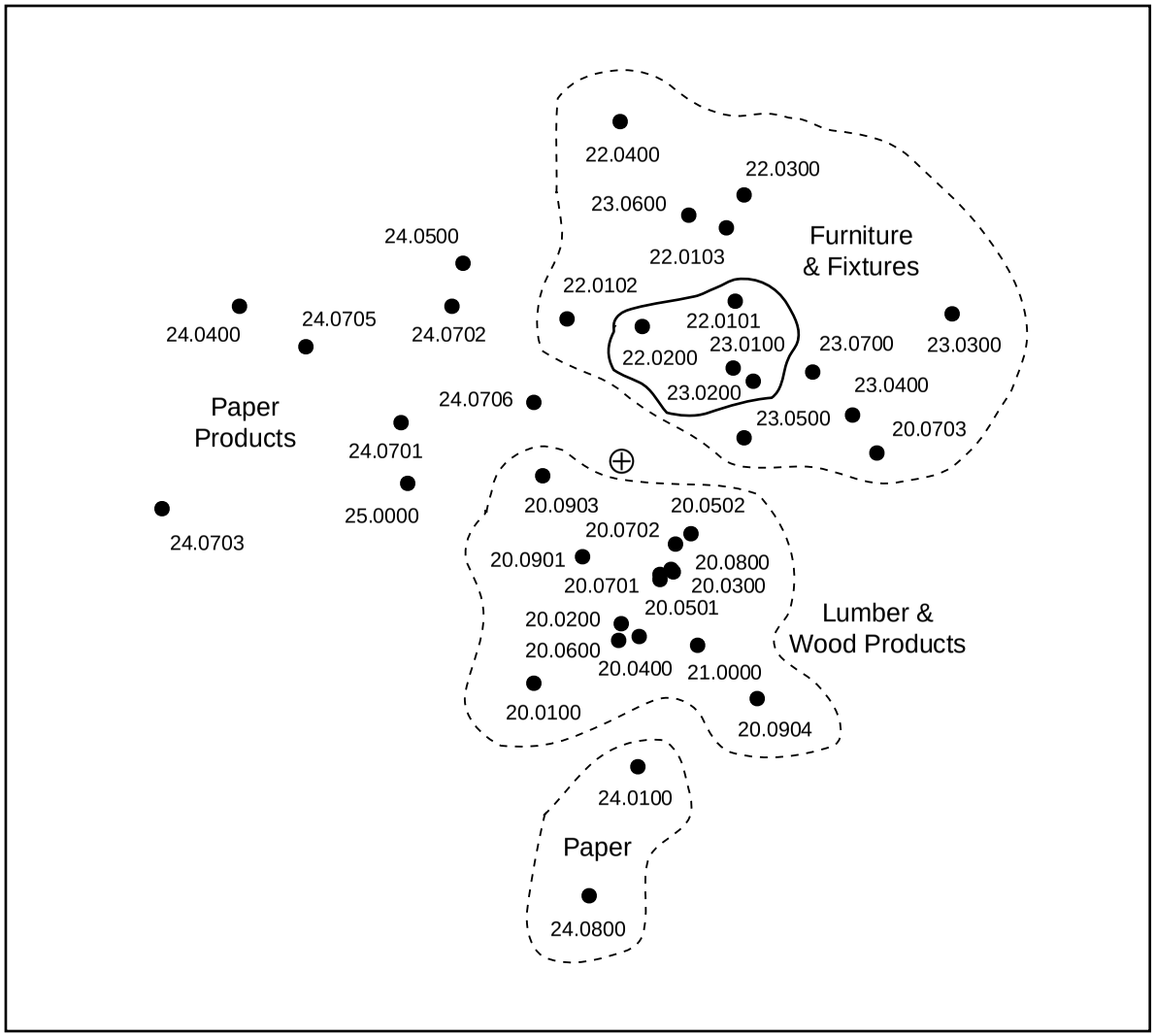
***36C. Other Stone and Clay Products**

36.0200 brick and structural clay tile
36.0300 ceramic wall and floor tile
36.0400 clay refractories
36.0500 structural clay products, n.e.c.
36.0600 vitreous china plumbing fixtures
36.0800 porcelain electrical supplies
36.1300 lime
36.1400 gypsum products
36.1500 cut stone and stone products
36.1600 abrasive products
36.1700 asbestos products
36.1900 minerals, ground or treated
36.2000 mineral wool
36.2100 nonclay refractories
36.2200 nonmetallic mineral products, n.e.c.

FIGURE A5.
LUMBER, FURNITURE, AND PAPER

Proposed Aggregation:
(* marks revised category)

(⊕ marks the center of the space, stress = .166)



20-21. Lumber and Wood Products

20.0100	logging
20.0200	sawmills and planing mills, general
20.0300	hardwood dimension and flooring mills
20.0400	special product sawmills, n.e.c.
20.0501	millwork
20.0502	wood kitchen cabinets
20.0600	veneer and plywood
20.0701	structural wood members, n.e.c.
20.0702	prefabricated wood buildings and components
20.0800	wood preserving
20.0901	wood pallets and skids
20.0903	wood products, n.e.c.
20.0904	reconstituted wood products
21.0000	wood containers, n.e.c.

22-23. Furniture and Fixtures

20.0703	mobile homes
22.0101	wood household furniture, except upholstered
22.0102	household furniture, n.e.c.
22.0103	wood television and radio cabinets
22.0200	upholstered household furniture
22.0300	metal household furniture
22.0400	mattresses and bedsprings
23.0100	wood office furniture
23.0200	office furniture, except wood
23.0300	public building and related furniture
23.0400	wood partitions and fixtures
23.0500	partitions and fixtures, except wood
23.0600	drapery hardware and window blinds and shades
23.0700	furniture and fixtures, n.e.c.

*24A. Paper

24.0100	pulp mills
24.0800	paper and paperboard mills

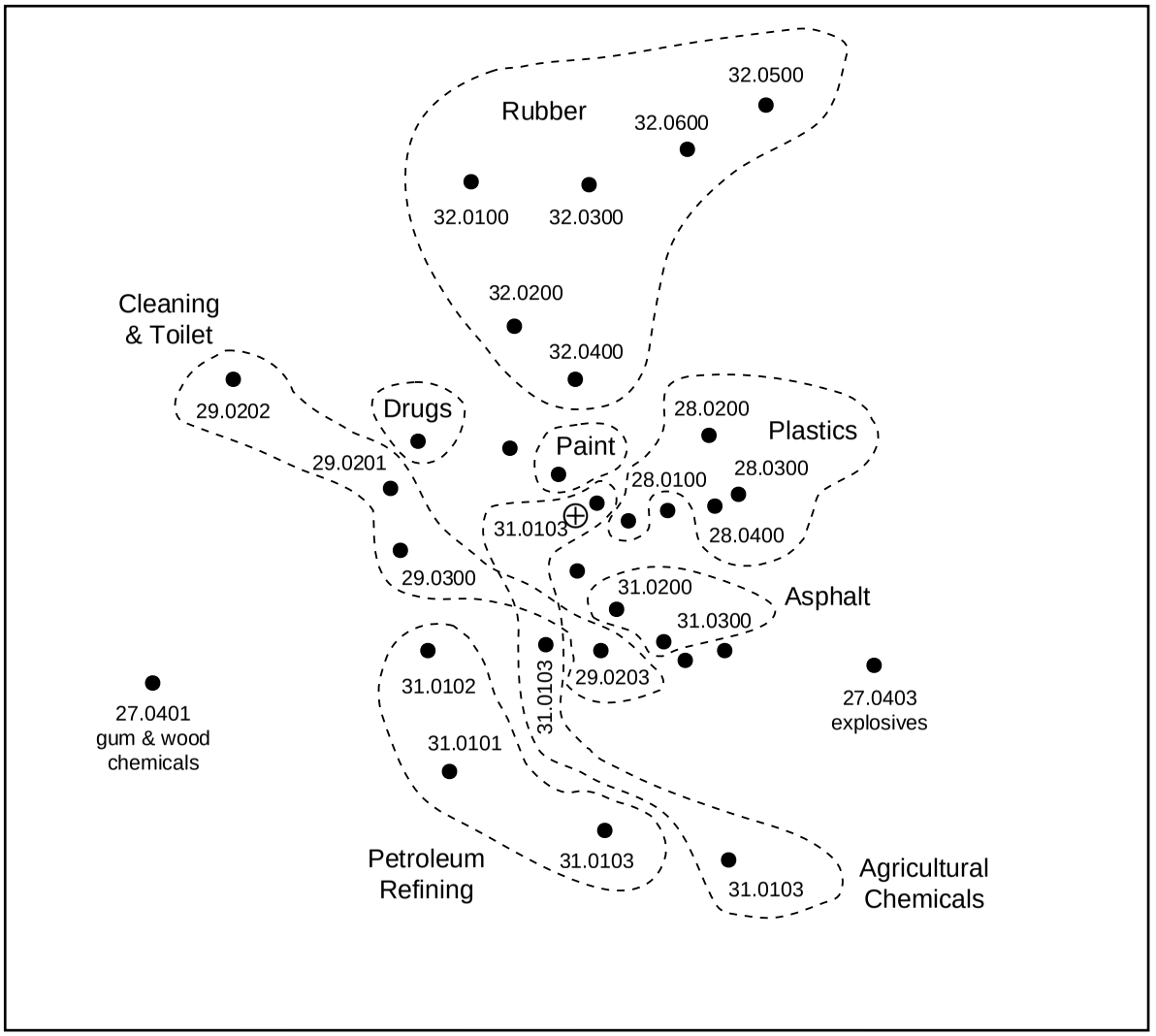
*24B-25. Paper Products

24.0400	envelopes
24.0500	sanitary paper products
24.0701	paper coating and glazing
24.0702	bags, except textile
24.0703	die-cut paper and paperboard and cardboard
24.0705	stationery, tablets, and related products
24.0706	converted paper products, n.e.c.
25.0000	paperboard containers and boxes

Proposed Aggregation:
(* marks revised category)

FIGURE A6.
CHEMICALS AND SYNTHETICS

(⊕ marks the center of the space, stress = .187)



27A. Industrial Inorganic and Organic Chemircals
27.0100 industrial inorganic and organic chemicals
27.0401 gum and wood chemicals
27.0402 adhesives and sealants
27.0403 explosives
27.0404 printing ink
27.0405 carbon black
27.0406 chemicals and chemical preparations, n.e.c.

27B. Agricultural Fertilizers and Chemicals
27.0201 nitrogenous and phosphatic fertilizers
27.0202 fertilizers, mixing only
27.0300 pesticides and agricultural chemicals, n.e.c.

28. Plastics and Synthetic Materials
28.0100 plastics materials and resins
28.0200 synthetic rubber
28.0300 cellulosic manmade fibers
28.0400 manmade organic fibers, except cellulosic

29A. Drugs
29.0100 drugs

29B. Cleaning and Toilet Preparations
29.0201 soap and other detergents
29.0202 polishes and sanitation goods
29.0203 surface active agents
29.0300 toilet preparations

30. Paints and Allied Products
30.0000 paints and allied products

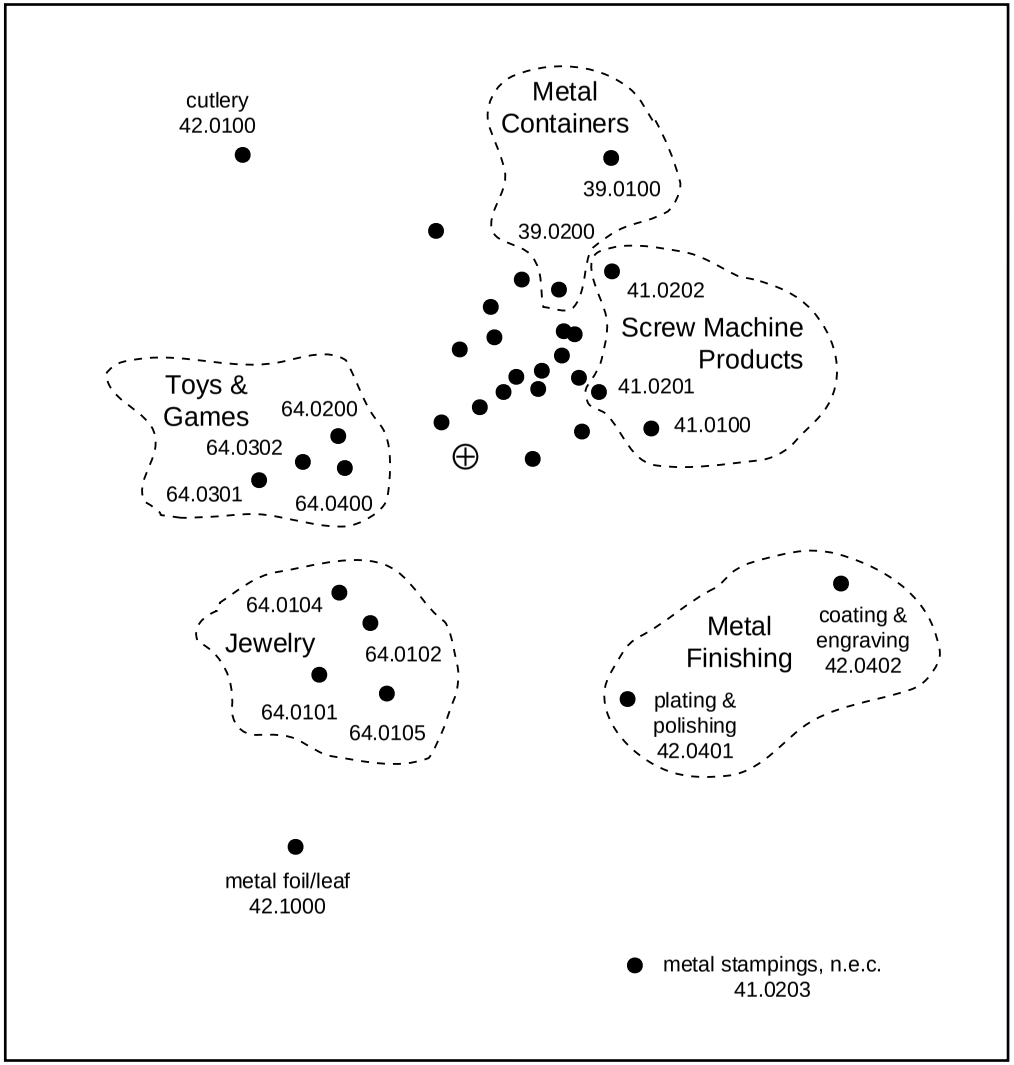
*31A. Petroleum Refining
31.0101 petroleum refining
31.0102 lubricating oils and greases
31.0103 products of petroleum and coal, n.e.c.

*31B. Asphalt
31.0200 asphalt paving mixtures and blocks
31.0300 asphalt felts and coatings

32. Rubber and Miscellaneous Plastics Products
32.0100 tires and inner tubes
32.0200 rubber and plastics footwear
32.0300 fabricated rubber products, n.e.c.
32.0400 miscellaneous plastics products, n.e.c.
32.0500 rubber and plastics hose and belting
32.0600 gaskets, packing, and sealing devices

FIGURE A7. FABRICATED METALS

(⊕ marks the center of the space, stress = .195)



*64A: Jewelry (72.8%, 67.1%)

64.0101	jewelry, precious metal
64.0102	jewelers' materials and lapidary
64.0104	silverware and plated ware
64.0105	costume jewelry

*64B: Toys & Games (74.3%, 65.0%)

64.0200	musical instruments
64.0301	games, toys, and children's vehicles
64.0302	dolls and stuffed toys
64.0400	sporting and athletic goods, n.e.c.

Proposed Aggregation: (* marks revised category)

39. Metal Containers (74.7% in 1992, 68.8% in 1987)

39.0100	metal cans
39.0200	metal shipping barrels, drums, kegs, and pails

40. Heating, Plumbling & Fab. Structural Metal (71.5%, 66.2%)

40.0100	enameled iron and metal sanitary ware
40.0200	plumbing fixture fittings and trim
40.0300	heating equipment, except electric and warm air furnaces
40.0400	fabricated structural metal
40.0500	metal doors, sash, frames, molding, and trim
40.0600	fabricated plate work (boiler shops)
40.0700	sheet metal work
40.0800	architectural and ornamental metal work
40.0901	prefabricated metal buildings and components
40.0902	miscellaneous structural metal work

*41A. Screw Machine Products (71.9%, 68.5%)
[Commerce aggregation with next category: 59.0%, 59.0%]

41.0100	screw machine products, bolts, etc.
41.0201	automotive stampings
41.0202	crowns and closures

*41B. Metal Stampings (100%)

41.0203	metal stampings, n.e.c.

*42A. Other Fabricated Metal (65.5%, 59.0%)
[Commerce aggregation with next category: 56.3%, 50.6%]

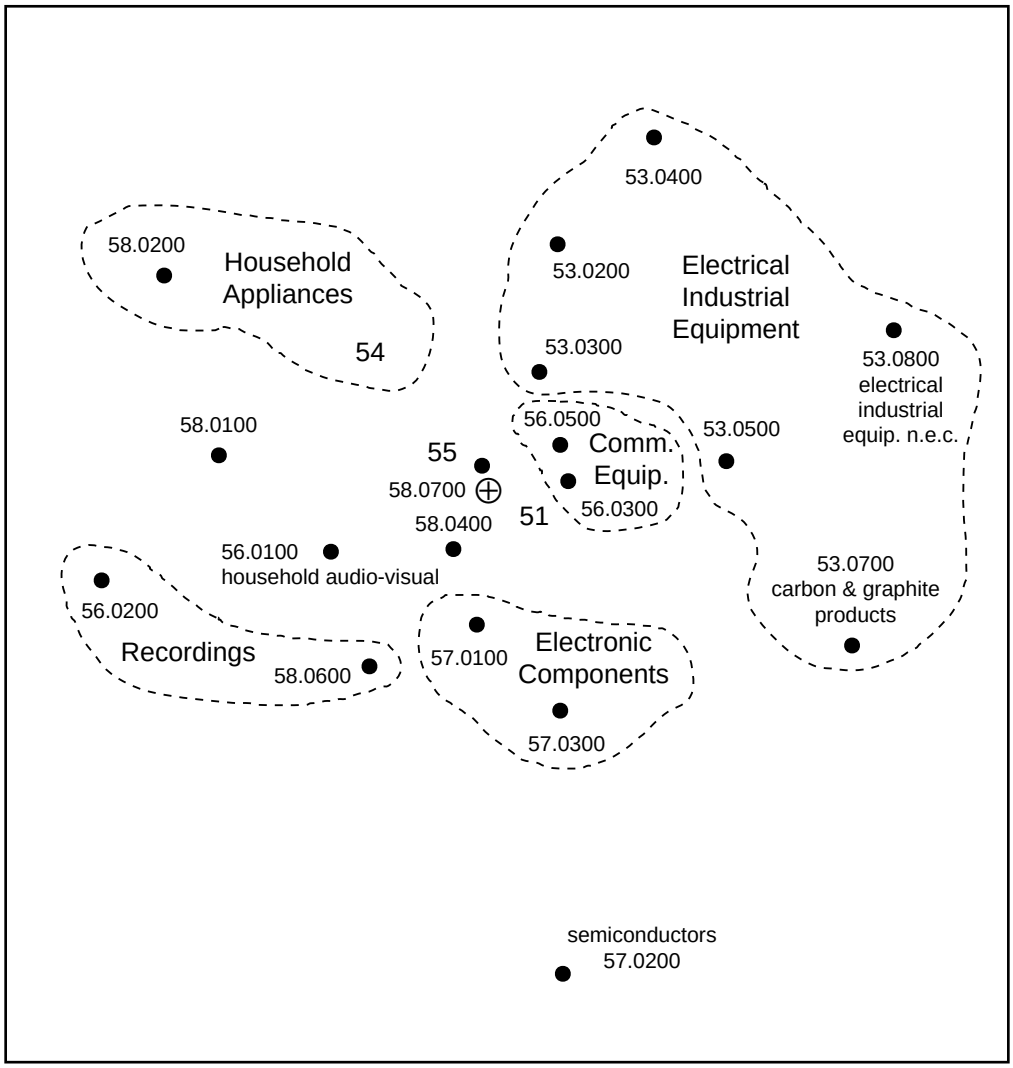
42.0100	cutlery
42.0201	hand and edge tools, except machine tools and handsaws
42.0202	saw blades and handsaws
42.0300	hardware, n.e.c.
42.0500	miscellaneous fabricated wire products
42.0700	steel springs, except wire
42.0800	pipe, valves, and pipe fittings
42.1000	metal foil and leaf
42.1100	fabricated metal products, n.e.c.

*42B. Metal Finishing (70.2%, 70.5%)

42.0401	plating and polishing
42.0402	coating,engraving, and allied services, n.e.c.

FIGURE A7. ELECTRIC MACHINES

(⊕ marks the center of the space, stress = .185)



Product category titles are listed in Table A6. "51" marks the position of the average transaction profile for the four products in the Computer industry. "54" marks the position of the average transaction profile for the six products in Commerce's Household Appliances industry. "55" marks the position of the average transaction profile for the three products in the Electric Lighting and Wiring industry.

(⊕ marks the center of the space, stress = .147)

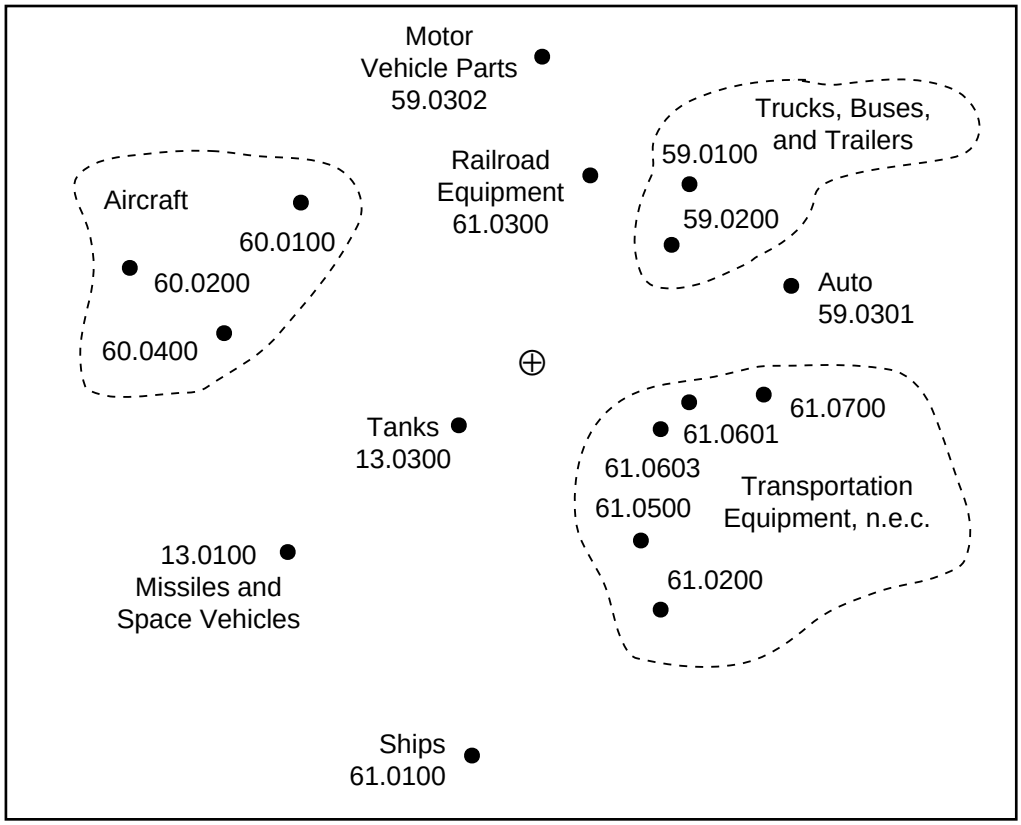


FIGURE A9. TRANSPORTATION EQUIPMENT

(see note to Table A5 for explanation of columns)

Current Aggregation:

59A. Auto (100%) [prior Commerce aggregation with 59B; 61.3%, 56.2%]
150738 1.000 59.0301 motor vehicles & passenger car bodies

59B. Trucks, Buses, and Parts (66.5%, 65.6%)
4470 0.875 59.0100 truck and bus bodies
3411 0.815 59.0200 truck trailers
72385 0.752 59.0302 motor vehicle parts and accessories

60. Aircraft and Parts (77.8%, 82.4%)
56448 0.778 60.0100 aircraft
24885 0.886 60.0200 aircraft and missile engines and parts
20376 0.906 60.0400 aircraft and missile equipment, n.e.c.

61. Other Transportation Equipment (46.1%, 44.9%)
10363 0.565 61.0100 ship building and repairing
5237 0.736 61.0200 boat building and repairing
4790 0.415 61.0300 railroad equipment
1720 0.748 61.0500 motorcycles, bicycles, and parts
2043 0.778 61.0601 travel trailers and campers
2846 0.659 61.0603 Motor homes
3001 0.771 61.0700 Transportation equipment, n.e.c.

Weapons (from Ordnance; 66.6%, 65.9%)
16558 0.816 13.0100 guided missiles and space vehicles
2274 0.816 13.0300 tanks and tank components

Proposed Aggregation:

(* marks revised category)

59A. Auto (100%)
59.0301 motor vehicles and passenger car bodies

*59B. Trucks, Buses, and Trailers (79.7%, 76.9%)
59.0100 truck and bus bodies
59.0200 truck trailers

*59C. Motor Vehicle Parts (100%)
59.0302 motor vehicle parts and accessories

60. Aircraft and Parts (77.8%, 82.4%)
60.0100 aircraft
60.0200 aircraft and missile engines and parts
60.0400 aircraft and missile equipment, n.e.c.

*61A. Ships (100%)
61.0100 ship building and repairing

*61B. Railroad Equipment (100%)
61.0300 railroad equipment

*61C. Transportation Equipment, n.e.c. (57.9%, 57.2%)
61.0200 boat building and repairing
61.0500 motorcycles, bicycles, and parts
61.0601 travel trailers and campers
61.0603 motor homes
61.0700 transportation equipment, n.e.c.

(⊕ marks the center of the space, stress = .145)

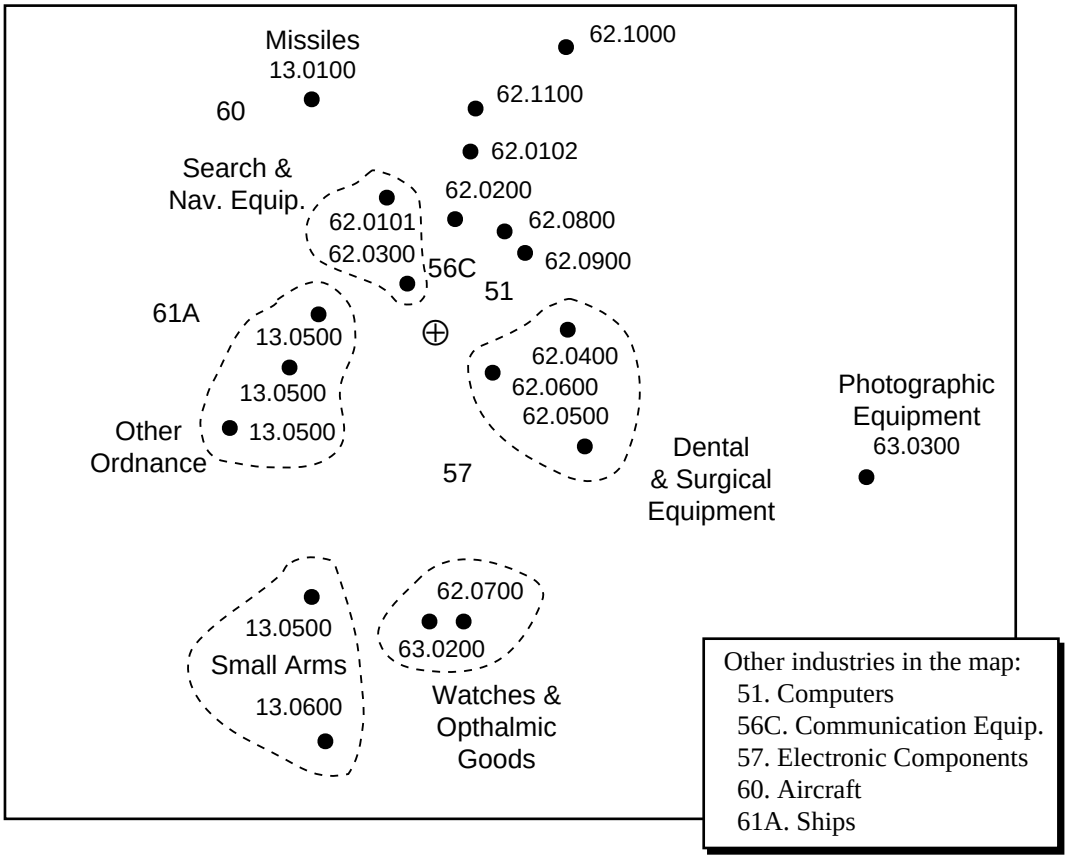


FIGURE A10.
ORDNANCE AND INSTRUMENTS

(see note to Table A5 for explanation of columns)

Current Aggregation:

13. Ordnance and Accessories (51.4%, 54.1%)

16558	0.550	13.0100	guided missiles and space vehicles
3042	0.819	13.0200	ammunition, except small arms, n.e.c.
2274	0.694	13.0300	tanks and tank components
1375	0.767	13.0500	small arms
1164	0.696	13.0600	small arms ammunition
1347	0.755	13.0700	ordnance and accessories, n.e.c.

62. Scientific and Controlling Equipment (56.4%, 53.8%)

34438	0.657	62.0101	search and navigation equipment
2012	0.782	62.0102	laboratory apparatus and furniture
13031	0.800	62.0200	mechanical measuring devices
2437	0.657	62.0300	environmental controls
13089	0.809	62.0400	surgical and medical instruments
13020	0.700	62.0500	surgical appliances and supplies
1747	0.737	62.0600	dental equipment and supplies
727	0.478	62.0700	watches, clocks, cases, and parts
2908	0.848	62.0800	x-ray apparatus and tubes
6714	0.863	62.0900	electromedical apparatus
7129	0.712	62.1000	laboratory and optical instruments
8237	0.877	62.1100	instruments to measure electricity

63. Opthalmic and Photographic Equipment (60.3%, 61.1%)

2406	0.777	63.0200	ophthalmic goods
21725	0.777	63.0300	photographic equipment and supplies

Proposed Aggregation: (* marks revised category)

*13A. Small Arms (80.5%, 78.5%)
13.0500 small arms
13.0600 small arms ammunition

*13B. Missiles (100%)
13.0100 guided missiles and space vehicles

*13C. Other Ordnance (75.7%, 69.3%)
13.0200 ammunition, except for small arms, n.e.c.
13.0300 tanks and tank components
13.0700 ordnance and accessories, n.e.c.

*62A. Search and Navigation Equip. (72.1%, 69.8%)
62.0101 search and navigation equipment
62.0300 environmental controls

*62B. Dental and Surgical Equip. (578.5%, 70.4%)
62.0400 surgical and medical instruments and apparatus
62.0500 surgical appliances and supplies
62.0600 dental equipment and supplies

*62C. Other Instruments (68.2%, 70.5%)
62.0102 laboratory apparatus and furniture
62.0200 mechanical measuring devices
62.0800 x-ray apparatus and tubes
62.0900 electromedical and electrotherapeutic apparatus
62.1000 laboratory and optical instruments
62.1100 instruments to measure electricity

*62D-63A. Watches and Opthalmic Goods (74.7%, 74.5%)
62.0700 watches, clocks, watchcases, and parts
63.0200 ophthalmic goods

*63B. Photographic Equipment (100%)
63.0300 photographic equipment and supplies

FIGURE A11. FOOD AND TOBACCO

(product categories given in Table A7; ● marks product categories over $10 billion in output)

(⊕ marks the center of the space, stress = .177)

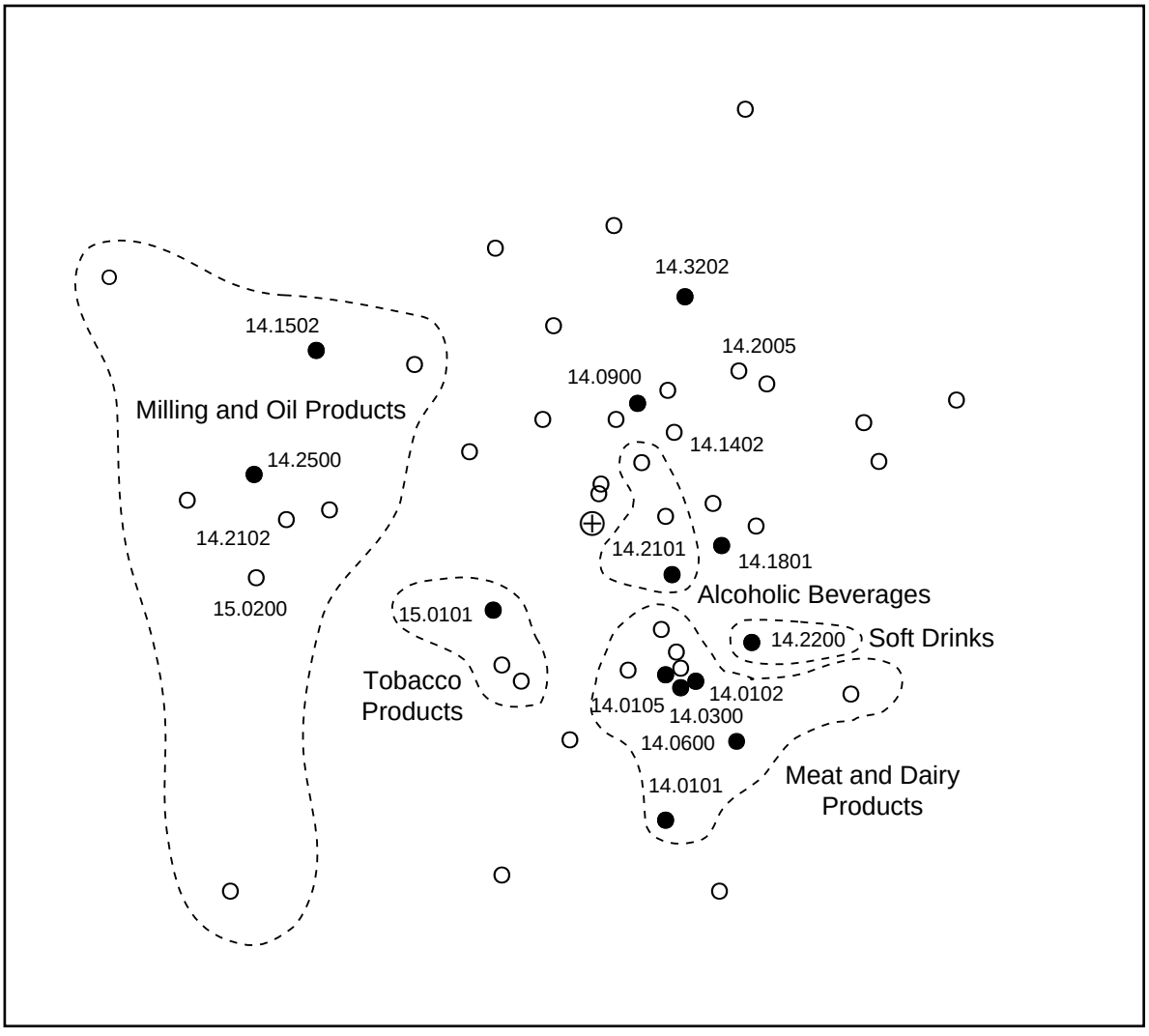
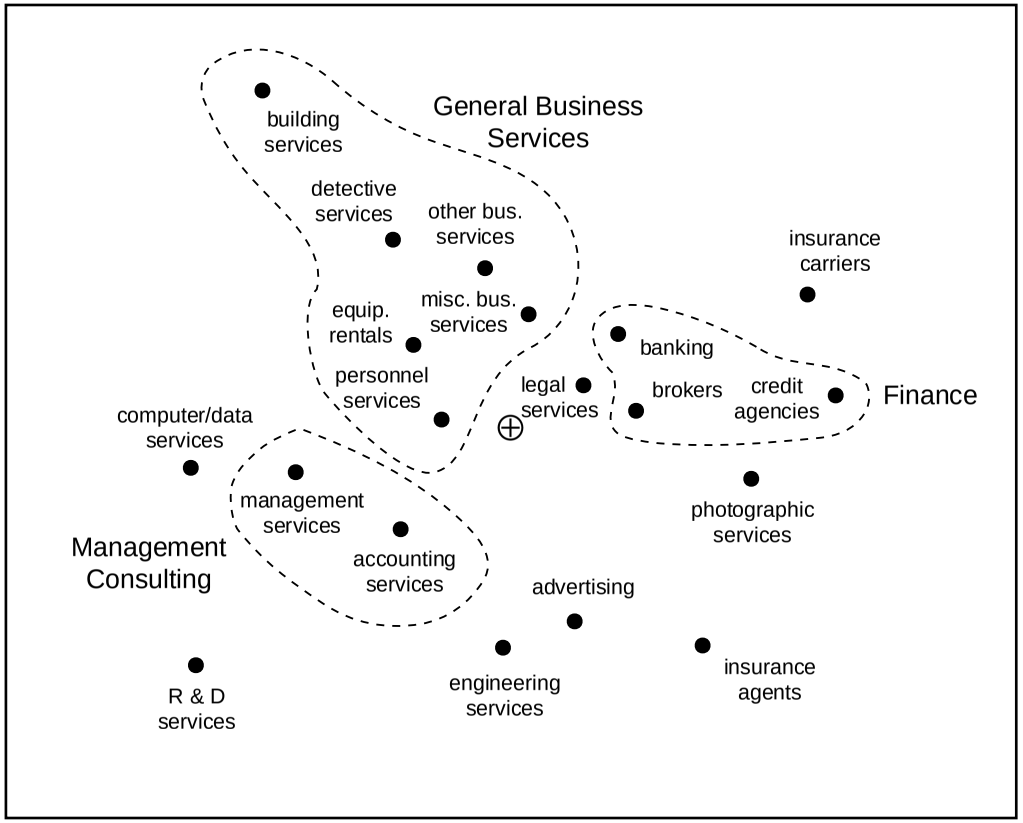


FIGURE A12.
FINANCE AND BUSINESS SERVICES

(⊕ marks the center of the space, stress = .212)



Proposed Aggregation:
(* marks revised category)

70A. Finance (71.8%, 69.5%)
268591 70.0100 banking
62049 70.0200 credit agencies other than banks
85632 70.0300 security and commodity brokers

*70B. Insurance Carriers (100%)
168993 70.0400 insurance carriers

*70C. Insurance Agents (100%)
62104 70.0500 insurance agents, brokers, and services

73A. Computer and Data Processing (100%)
115730 73.0104 computer and data processing services

*73B. Legal Services (100%)
116396 73.0301 legal services

*73C. Engineering Services (100%)
84850 73.0302 engineering, architectural, and surveying services

*73D. Management Consulting (84.5%, 76.2%)
55115 73.0303 accounting services, n.e.c.
75894 73.0111 management and public relations services

*73E. General Business Services (71.5%, 71.6%)
30896 73.0101 miscellaneous repair shops
26882 73.0102 services to dwellings and other buildings
39803 73.0103 personnel supply services
13675 73.0106 detective and protective services
30694 73.0107 miscellaneous equipment rental and leasing
78858 73.0109 other business services

*73F. Photographic Services (100%)
15728 73.0108 photofinishing labs and commercial photography

*73G. R & D Services (100%; not distinguished in the 1987 data)
28015 73.0112 R & D and testing services, except noncommercial

73H. Advertising (100%)
29865 73.0200 advertising

TABLE A1. STRUCTURAL EQUIVALENCE WITHIN LEATHER

	1992	1987
Prior Aggregation		
33. Leather Preparation (1)	———	———
34. Leather Products (8)	69.0%	66.5%
Current Aggregation		
33-34. Leather & Leather Products (9)	56.8%	52.9%
Proposed Aggregation		
33-34A. Leather Stock (2)	82.9%	75.8%
33-34B. Leather Products (7)	73.6%	69.1%

NOTE — These are transaction variances described by the first principal component for product categories combined in the same industry. Leather preparation in the prior aggregation contains only one product so equivalence is trivially 100%. Parentheses contain number of 1992 product categories aggregated in industry.

TABLE A2. STRUCTURAL EQUIVALENCE WITHIN GLASS, STONE, AND CLAY

	1992	1987
Current Aggregation		
35. Glass and Glass Products (2)	75.4%	75.3%
36. Stone and Clay Products (22)	60.8%	58.8%
Proposed Aggregation		
35A. Glass and Glass Products (1)	———	———
36A-35B. Glass, Stone and Clay Containers (4)	70.1%	71.6%
36B. Concrete (4)	71.9%	74.9%
36C. Other Stone and Clay Products (15)	64.8%	63.4%

NOTE — These are transaction variances described by the first principal component for product categories combined in the same industry. Glass (sector 35) in the proposed aggregation contains only one product category so equivalence is trivially 100%. Parentheses contain number of 1992 product categories aggregated in industry.

TABLE A3. STRUCTURAL EQUIVALENCE WITHIN LUMBER, FURNITURE, AND PAPER

	1992	1987
Prior Aggregation		
20. Lumber and Wood Products (14, not containers)	66.6%	59.8%
21. Wood Containers (1)	———	———
22. Household Furniture (6)	58.6%	51.6%
23. Other Furniture and Fixtures (7)	66.8%	57.7%
24. Paper and Paper Products (9, not containers)	47.1%	40.1%
25. Paper Containers and Boxes (1)	———	———
Current Aggregation		
20-21. Lumber and Wood Products (15)	64.2%	57.5%
22-23. Furniture and Fixtures (13)	49.6%	43.3%
24. Paper and Paper Products (9, not containers)	47.1%	40.1%
25. Paper Containers and Boxes (1)	———	———
Proposed Aggregation		
20-21. Lumber and Wood Products (14)	68.5%	61.3%
22-23. Furniture and Fixtures (14) [core four core products circled in Figure A4]	52.3% [65.4%]	46.0% [60.3%]
24A. Paper (2)	89.1%	81.1%
24B-25. Paper Products (8)	66.5%	63.0%

NOTE — These are transaction variances described by the first principal component for product categories combined in the same industry. A "——" indicates an industry containing only one product category, so equivalence is trivially 100%. Parentheses contain number of 1992 product categories aggregated in industry.

TABLE A4. STRUCTURAL EQUIVALENCE WITHIN CHEMICALS AND SYNTHETICS

	1992	1987
Prior Aggregation		
27. Chemicals and Selected Chemical Products (10)	44.2%	40.5%
28. Plastics and Synthetic Materials (4)	73.2%	67.2%
29. Drugs, Cleaning, and Toilet Preparations (5)	59.6%	60.9%
30. Paints and Allied Products (1)	———	———
31. Petroleum Refining and Related Industries (5)	47.7%	47.1%
32. Rubber and Miscellaneous Plastics Products (6)	63.6%	63.3%
Current Aggregation		
27A. Industrial Inorganic and Organic Chemicals (7)	46.3%	44.7%
27B. Agricultural Fertilizers and Chemicals (3)	64.3%	64.1%
28. Plastics and Synthetic Materials (4)	73.2%	67.2%
29A. Drugs (1)	———	———
29B. Cleaning and Toilet Preparations (4)	59.9%	61.4%
30. Paints and Allied Products (1)	———	———
31. Petroleum Refining and Related Industries (5)	47.7%	47.1%
31A. proposed Petroleum Refining (3)	57.7%	56.2%
31B. proposed Asphalt (2)	95.4%	95.4%
32. Rubber and Miscellaneous Plastics Products (6)	63.6%	63.3%

NOTE — These are transaction variances described by the first principal component for product categories combined in the same industry. A "——" indicates an industry containing only one product category, so equivalence is trivially 100%. Parentheses contain number of 1992 product categories aggregated in industry.

TABLE A5. MECHANICAL MACHINES

(* marks revision from current Commerce aggregation)

43. Engines and Turbines (79.7% in 1992, 73.4% in 1987)

5626	0.893	43.0100	turbines and turbine generator sets
11418	0.893	43.0200	internal combustion engines, n.e.c.

*44. Farm and Garden Machinery (76.0%, 79.6%)
[current Commerce aggregation with next category: 63.9%, 64.7%]

9197	0.872	44.0001	farm machinery and equipment
4959	0.872	44.0002	lawn and garden equipment

*45. Construction and Mining Machinery (76.8%, 79.0%)

12796	0.936	45.0100	construction machinery and equipment
1412	0.930	45.0200	mining machinery, except oil field
3667	0.750	45.0300	oil and gas field machinery and equipment

46. Materials Handling Machinery (65.9%, 71.4%)

942	0.773	46.0100	elevators and moving stairways
3724	0.812	46.0200	conveyors and conveying equipment
865	0.868	46.0300	hoists, cranes, and monorails
2621	0.791	46.0400	industrial trucks and tractors

47. Metalworking Machinery (60.7%, 54.8%)

3418	0.783	47.0100	machine tools, metal cutting types
1418	0.864	47.0200	machine tools, metal forming types
12931	0.766	47.0300	special dies and tools and machine tool accessories
2499	0.789	47.0401	power-driven handtools
579	0.872	47.0402	rolling mill machinery and equipment
2610	0.813	47.0404	electric and gas welding and soldering equipment
553	0.500	47.0405	industrial patterns
1603	0.783	47.0500	metalworking machinery, n.e.c.

48. Special Industry Machinery (70.4%, 66.3%)

2262	0.871	48.0100	food products machinery
1447	0.841	48.0200	textile machinery
798	0.786	48.0300	woodworking machinery
2340	0.845	48.0400	paper industries machinery
2393	0.851	48.0500	printing trades machinery and equipment
10991	0.838	48.0600	special industry machinery, n.e.c.

49. General Industrial Machinery (64.3%, 63.1%)

8768	0.824	49.0100	pumps and compressors
1474	0.766	49.0200	ball and roller bearings
2916	0.888	49.0300	blowers and fans
4029	0.737	49.0500	mechanical power transmission equipment
1710	0.739	49.0600	industrial process furnaces and ovens
5194	0.911	49.0700	general industrial machinery and equipment, n.e.c.
3023	0.726	49.0800	packaging machinery

50. Miscellaneous Machinery, Except Electrical (62.4%, 58.6%)

2067	0.753	50.0100	carburetors, pistons, rings, and valves
3134	0.882	50.0200	fluid power equipment
625	0.562	50.0300	scales and balances, except laboratory
19245	0.915	50.0400	industrial and commercial machinery and equipment, n.e.c.

52. Service Industry Machinery (71.7%, 65.5%)

772	0.858	52.0100	automatic vending machines
546	0.843	52.0200	commercial laundry equipment
19195	0.860	52.0300	refrigeration and heating equipment
779	0.784	52.0400	measuring and dispensing pumps
5163	0.885	52.0500	service industry machinery, n.e.c.

NOTE — The first column is 1992 product category output in millions of dollars. The second column is the factor loading of the product's transaction profile on the principal component for all products combined in the industry. The third column is the Commerce identification number followed by the Commerce title for the product category.

TABLE A6. ELECTRICAL MACHINES

(see Note to Table A5 for explanation of columns)

Current and Prior Aggregation:

51. Computer and Office Equipment (78.2%, 80.1%)

1263	0.872	51.0102 calculating and accounting machines
37305	0.891	51.0103 electronic computers
22296	0.927	51.0104 computer peripheral equipment
3060	0.846	51.0400 office machines, n.e.c.

53. Electrical Industrial Equipment (50.4%, 59.2%)

4008	0.775	53.0200 power, distribution, and specialty transformers
5421	0.874	53.0300 switchgear and switchboard apparatus
7975	0.822	53.0400 motors and generators
7170	0.768	53.0500 relays and industrial controls
1259	0.420	53.0700 carbon and graphite products
1976	0.468	53.0800 electrical industrial apparatus, n.e.c.

54. Household Appliances (72.8%, 69.8%)

2604	0.900	54.0100 household cooking equipment
4030	0.825	54.0200 household refrigerators and freezers
3098	0.734	54.0300 household laundry equipment
2635	0.892	54.0400 electric housewares and fans
1828	0.854	54.0500 household vacuum cleaners
2441	0.902	54.0700 household appliances, n.e.c.

55. Electric Lighting and Wiring (77.4%, 69.8%)

2946	0.826	55.0100 electric lamp bulbs and tubes
8579	0.941	55.0200 lighting fixtures and equipment
7586	0.868	55.0300 wiring devices

56. Audio, Video, and Communication Equip. (49.9%, 50.9%)

8355	0.681	56.0100 household audio and video equipment
1863	0.448	56.0200 prerecorded records and tapes
20139	0.818	56.0300 telephone and telegraph apparatus
21798	0.814	56.0500 communication equipment

57. Electronic Components (70.6%, 67.7%)

3086	0.727	57.0100 electron tubes
30125	0.873	57.0200 semiconductors and related devices
37729	0.910	57.0300 other electronic components

58. Miscellaneous Electrical Machinery (54.0%, 46.9%)

3401	0.733	58.0100 storage batteries
1780	0.583	58.0200 primary batteries, dry and wet
7244	0.819	58.0400 electrical equipment for internal combustion engines
4205	0.697	58.0600 magnetic and optical recording media
4593	0.816	58.0700 electrical machinery, equipment, and supplies, n.e.c.

Proposed Aggregation: (* marks revised category)

51. Computer and Office Equipment (78.2%, 80.1%)

1263	0.872	51.0102 calculating and accounting machines
37305	0.891	51.0103 electronic computers
22296	0.927	51.0104 computer peripheral equipment
3060	0.846	51.0400 office machines, n.e.c.

53. Electrical Industrial Equipment (50.4%, 59.2%)

4008	0.775	53.0200 power, distribution, and specialty transformers
5421	0.874	53.0300 switchgear and switchboard apparatus
7975	0.822	53.0400 motors and generators
7170	0.768	53.0500 relays and industrial controls
1259	0.420	53.0700 carbon and graphite products
1976	0.468	53.0800 electrical industrial apparatus, n.e.c.

*54,58A. Household Appliances (69.1%, 63.8%)

2604	0.898	54.0100 household cooking equipment
4030	0.820	54.0200 household refrigerators and freezers
3098	0.727	54.0300 household laundry equipment
2635	0.887	54.0400 electric housewares and fans
1828	0.840	54.0500 household vacuum cleaners
2441	0.901	54.0700 household appliances, n.e.c.
1780	0.622	58.0200 primary batteries, dry and wet

55. Electric Lighting and Wiring (77.4%, 69.8%)

2946	0.826	55.0100 electric lamp bulbs and tubes
8579	0.941	55.0200 lighting fixtures and equipment
7586	0.868	55.0300 wiring devices

*56A. Household Audio-Video Equipment (100%)

8355	1.000	56.0100 household audio and video equipment

*56C. Communication Equipment (82.5%, 80.4%)

20139	0.908	56.0300 telephone and telegraph apparatus
21798	0.908	56.0500 communication equipment

*56B,58B. Recordings (71.1%, 76.6%)

1863	0.843	56.0200 prerecorded records and tapes
4205	0.843	58.0600 magnetic and optical recording media

*57A. Electronic Components (73.4%, 74.9%)

3086	0.857	57.0100 electron tubes
37729	0.857	57.0300 other electronic components

*57B. Semiconductors (100%)

30125	1.000	57.0200 semiconductors and related devices

*58C. Miscellaneous Electrical Machinery (69.6%, 54.6%)

3401	0.758	58.0100 storage batteries
7244	0.890	58.0400 electrical equipment for internal combustion engines
4593	0.856	58.0700 electrical machinery, equipment, and supplies, n.e.c.

TABLE A7. FOOD AND TOBACCO

(see Note to Table A5 for explanation of columns; * marks revised category; products are listed by industry in descending order of output)

*14A-15B. Milling and Oil Products (59.7%, 62.4%)

16790	0.784	14.1502	prepared feeds, n.e.c.
10204	0.940	14.2500	soybean oil mills
6907	0.798	14.1700	wet corn milling
3572	0.781	15.0200	tobacco stemming and redrying
1787	0.531	14.2700	animal and marine fats and oils
1593	0.790	14.1600	rice milling
658	0.846	14.2400	cottonseed oil mills
637	0.706	14.2600	vegetable oil mills, n.e.c.
566	0.800	14.2102	malt

*14B. Meat and Dairy Products (84.5%, 78.6%)

48871	0.939	14.0101	meat packing plants
24800	0.971	14.0105	poultry slaughtering and processing
19689	0.970	14.0600	fluid milk
18670	0.917	14.0102	sausages and other prepared meat products
17720	0.974	14.0300	natural, processed, and imitation cheese
7187	0.975	14.0400	dry, condensed, and evaporated dairy products
6665	0.853	14.1200	prepared fresh or frozen fish and seafoods
4828	0.887	14.0500	ice cream and frozen desserts
1003	0.929	14.0200	creamery butter
938	0.755	14.0700	canned and cured fish and seafoods

*14C. Alcoholic Beverages (85.3%, 84.0%)

20593	0.870	14.2101	malt beverages
6576	0.942	14.2104	distilled and blended liquors
5089	0.957	14.2103	wines, brandy, and brandy spirits

*14D. Soft Drinks (100%)

23756	1.000	14.2200	bottled and canned soft drinks

*14E. Bakery Goods (88.1%, 87.8%)

24073	0.929	14.1801	bread, cake, and related products
7604	0.964	14.1802	cookies and crackers
1653	0.924	14.1803	frozen bakery products, except bread

*14F. Other Flour Products (75.3%, 76.8%)

8974	0.899	14.1402	cereal breakfast foods
6053	0.787	14.1401	flour and other grain mill products
3669	0.926	14.1403	prepared flour mixes and doughs
1360	0.852	14.3100	macaroni, spaghetti, vermicelli, and noodles

*14G. Canned and Frozen Food (except fish, 76.5%, 75.0%)

14497	0.940	14.0900	canned fruits, vegetables, preserves, jams, jellies
7513	0.781	14.1302	frozen specialties, n.e.c.
7420	0.949	14.1301	frozen fruits, fruit juices, and vegetables
6566	0.847	14.0800	canned specialties
6324	0.840	14.1100	pickles, sauces, and salad dressings
5083	0.923	14.2800	roasted coffee
2798	0.827	14.1000	dehydrated fruits, vegetables, and soups

*14H. Candy and Snack Foods (82.3%, 76.4%)

9859	0.869	14.2005	candy and other confectionery products
7076	0.919	14.3201	potato chips and similar snacks
6644	0.890	14.1900	sugar
3038	0.924	14.2002	chocolate and cocoa products
2832	0.932	14.2004	salted and roasted nuts and seeds

*14I. Food Products, n.e.c. (58.1%, 49.8%)

11898	0.851	14.3202	food preparations, n.e.c.
6876	0.721	14.2300	flavoring extracts and flavoring syrups, n.e.c.
6176	0.807	14.1501	dog and cat food
4614	0.697	14.2900	edible fats and oils, n.e.c.
355	0.758	14.3000	manufactured ice

*15A. Tobacco Products (92.6%, 96.5%)

34720	0.956	15.0101	Cigarettes
1539	0.988	15.0103	Chewing and smoking tobacco and snuff
315	0.941	15.0102	Cigars

TABLE A8. COMMERCE AGGREGATION OF DISTRIBUTION AND SERVICES

(Equivalence percentages in parentheses are for prior Commerce aggregation in 1992, then 1987. Percentages for current aggregation are in Table 1.)

65. Transportation and Warehousing (52.2%, 50.3%)

35588	0.797	0.841	65A	65.0100	railroads and related services
20166	0.709	0.841	65A	65.0200	local and suburban transit and interurban highway passenger transportation
157105	0.782	0.862	65B	65.0301	trucking and courier services, except air
9848	0.721	0.862	65B	65.0302	warehousing and storage
32440	0.726	1.000	65C	65.0400	water transportation
94141	0.798	1.000	65D	65.0500	air transportation
7315	0.659	0.652	65E	65.0600	pipelines, except natural gas
13193	0.573	0.809	65E	65.0701	freight forwarders and other transportation services
13108	0.711	0.873	65E	65.0702	arrangement of passenger transportation

66. Communications (except radio and TV; 75.0%, 100%)

180317	0.866	0.866	66	66.0100	telephone, telegraph communications, and communications services n.e.c.
27777	0.866	0.866	66	66.0200	cable and other pay television services

67. Radio and TV Broadcasting (100%)

29359	1.000	1.000	67	67.0000	radio and TV broadcasting

68. Utilities (58.5%, 62.2%)

170896	0.857	1.000	68A	68.0100	electric services (utilities)
15778	0.361	0.844	68B	68.0201	natural gas transportation
77379	0.793	0.844	68B	68.0202	natural gas distribution
3715	0.906	0.914	68C	68.0301	water supply and sewerage systems
15467	0.780	0.914	68C	68.0302	sanitary services, steam supply, and irrigation systems

69. Wholesale and Retail Trade (92.2%, 89.1%)

568970	0.960	1.000	69A	69.0100	wholesale trade
522519	0.960	1.000	69B	69.0200	retail trade, except eating and drinking

70. Finance and Insurance (58.7%, 55.0%)

268591	0.871	0.862	70A	70.0100	banking
62049	0.813	0.820	70A	70.0200	credit agencies other than banks
85632	0.810	0.859	70A	70.0300	security and commodity brokers
168993	0.766	0.721	70B	70.0400	insurance carriers
62104	0.524	0.721	70B	70.0500	insurance agents, brokers, and services

NOTE — The first column is 1992 product output in millions of dollars. The second column is the factor loading of the product's transaction profile on the principal component for all products combined in the prior Commerce aggregation. The third column is the factor loading for the current Commerce aggregation. The fourth column is the industry identification code for the current Commerce aggregation (also in Table 1). The fifth column is the Commerce product identification number, followed by the Commerce title for the product category.

Table A8 (continued)

71. Real Estate and Rental (56.4%, 55.8%)

457250	0.909	1.000	71A	71.0100	owner-occupied dwellings
494402	0.909	0.734	71B	71.0201	real estate agents, managers, operators, and lessors
55711	0.198	0.734	71B	71.0202	royalties

72. Hotels; Personal and Repair Services (except auto; 57.0%, 53.7%)

52407	0.726	0.838	72A	72.0101	hotels
7195	0.836	0.838	72A	72.0102	other lodging places
20796	0.810	0.798	72B	72.0201	laundry, cleaning, garment services, and shoe repair
6928	0.680	0.696	72B	72.0202	funeral service and crematories
22608	0.749	0.759	72B	72.0203	portrait photographic studios, and other miscellaneous personal services
19433	0.673	0.710	72B	72.0204	electrical repair shops
3843	0.671	0.683	72B	72.0205	watch, clock, jewelry, and furniture repair
18164	0.866	0.849	72B	72.0300	beauty and barber shops

73. Business and Professional Services (except medical; 60.2%, 55.4%)

115730	0.719	1.000	73A	73.0104	computer and data processing services
116396	0.781	0.812	73B	73.0301	legal services
84850	0.594	0.707	73B	73.0302	engineering, architectural, and surveying services
55115	0.823	0.886	73B	73.0303	accounting, auditing and bookkeeping, and miscellaneous services, n.e.c.
30896	0.806	0.828	73C	73.0101	miscellaneous repair shops
26882	0.715	0.765	73C	73.0102	services to dwellings and other buildings
39803	0.939	0.891	73C	73.0103	personnel supply services
13675	0.899	0.902	73C	73.0106	detective and protective services
30694	0.821	0.813	73C	73.0107	miscellaneous equipment rental and leasing
15728	0.694	0.629	73C	73.0108	photofinishing labs and commercial photography
78858	0.768	0.801	73C	73.0109	other business services
75894	0.852	0.836	73C	73.0111	management and public relations services
28015	0.660	0.617	73C	73.0112	research, development, and testing services, except noncommercial
29865	0.718	1.000	73D	73.0200	advertising

74. Eating and Drinking Places (100%)

280708	1.000	1.000	74	74.0000	eating and drinking places

75. Automobile Repair and Services (68.2%, 69.2%)

22590	0.872	0.872	75	75.0001	automotive rental and leasing, without drivers
107056	0.806	0.806	75	75.0002	automotive repair shops and services
8735	0.798	0.798	75	75.0003	automobile parking and car washes

76. Amusements (62.4%, 61.6%)

36660	0.828	0.828	76	76.0101	motion picture services and theaters
6278	0.836	0.836	76	76.0102	video tape rental
16321	0.710	0.710	76	76.0201	theatrical producers (except motion picture), bands, orchestras and entertainers
1988	0.828	0.828	76	76.0202	bowling centers
6179	0.847	0.847	76	76.0203	professional sports clubs and promoters
5542	0.797	0.797	76	76.0204	racing, including track operation
12603	0.614	0.614	76	76.0205	physical fitness facilities and membership sports and recreation clubs
35797	0.831	0.831	76	76.0206	other amusement and recreation services

77. Health, Education, and Social Services and Nonprofit Organizations (71.5%, 64.3%)

216111	0.965	0.954	77A	77.0100	doctors and dentists
219439	0.928	0.952	77A	77.0200	hospitals
50459	0.928	0.955	77A	77.0301	nursing and personal care facilities
18971	0.729	0.823	77A	77.0303	other medical and health services
6593	0.551	0.654	77A	77.0304	veterinary services
53413	0.895	0.950	77A	77.0305	other medical and health services
18001	0.835	0.849	77B	77.0401	elementary and secondary schools
43704	0.702	0.716	77B	77.0402	colleges, universities, and professional schools
12985	0.862	0.868	77B	77.0403	private libraries, vocational schools, and educational services, n.e.c.
13666	0.653	0.667	77B	77.0501	business associations and professional membership organizations
17964	0.947	0.957	77B	77.0502	labor organizations, civic, social, and fraternal associations
30605	0.945	0.944	77B	77.0503	religious organizations
21534	0.688	0.734	77B	77.0504	other membership organizations
6851	0.755	0.760	77B	77.0600	job training and related services
17566	0.967	0.957	77B	77.0700	child day care services
15374	0.928	0.916	77B	77.0800	residential care
30082	0.895	0.905	77B	77.0900	social services, n.e.c.

NOTE — The first column is 1992 product output in millions of dollars. The second column is the factor loading of the product's transaction profile on the principal component for all products combined in the prior Commerce aggregation. The third column is the factor loading for the current Commerce aggregation. The fourth column is the industry identification code for the current Commerce aggregation (also in Table 1). The fifth column is the Commerce product identification number, followed by the Commerce title for the product category.