

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). Moreover, 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 heterogeneous 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, Plumbing, 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 Ophthalmic 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 Ophthalmic 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. Ophthalmic goods are more similar to the precision tooling in watches, which together form Watches and Ophthalmic 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).

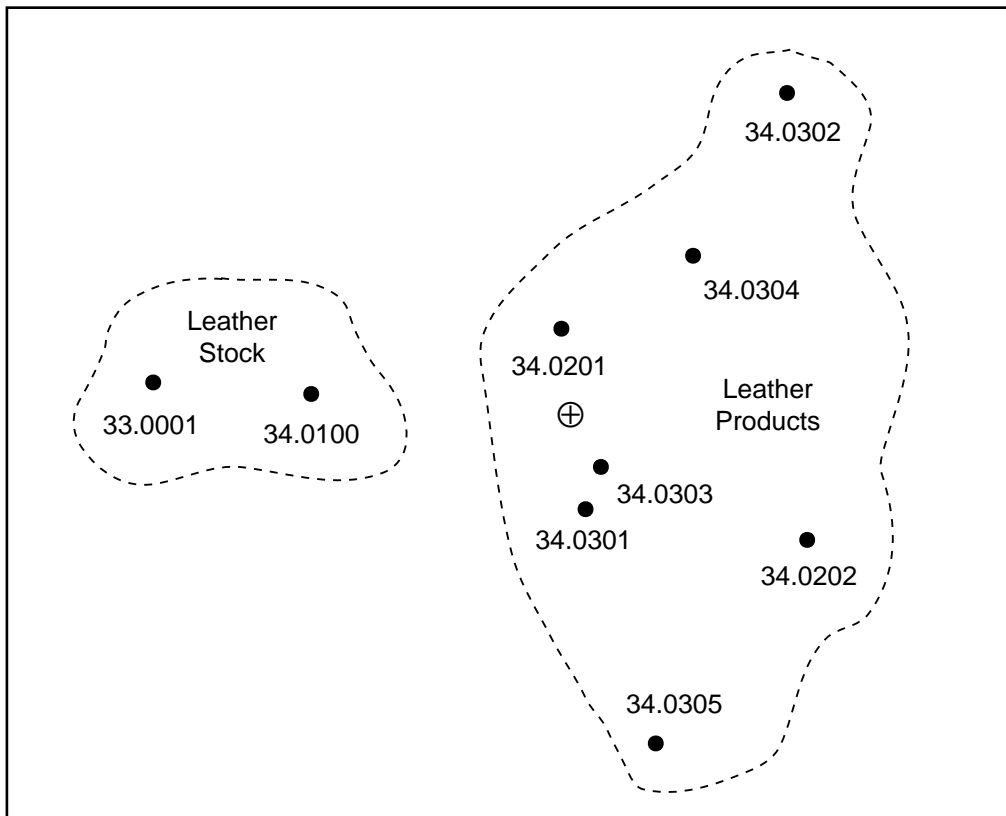
Three of the industries are composed of products that involve diverse patterns of buying and selling but the heterogeneity seems intractable beyond changes already in the current Commerce aggregation. For example, the Hotel and Personal Services industry with only 57.0% equivalence in the prior Commerce 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

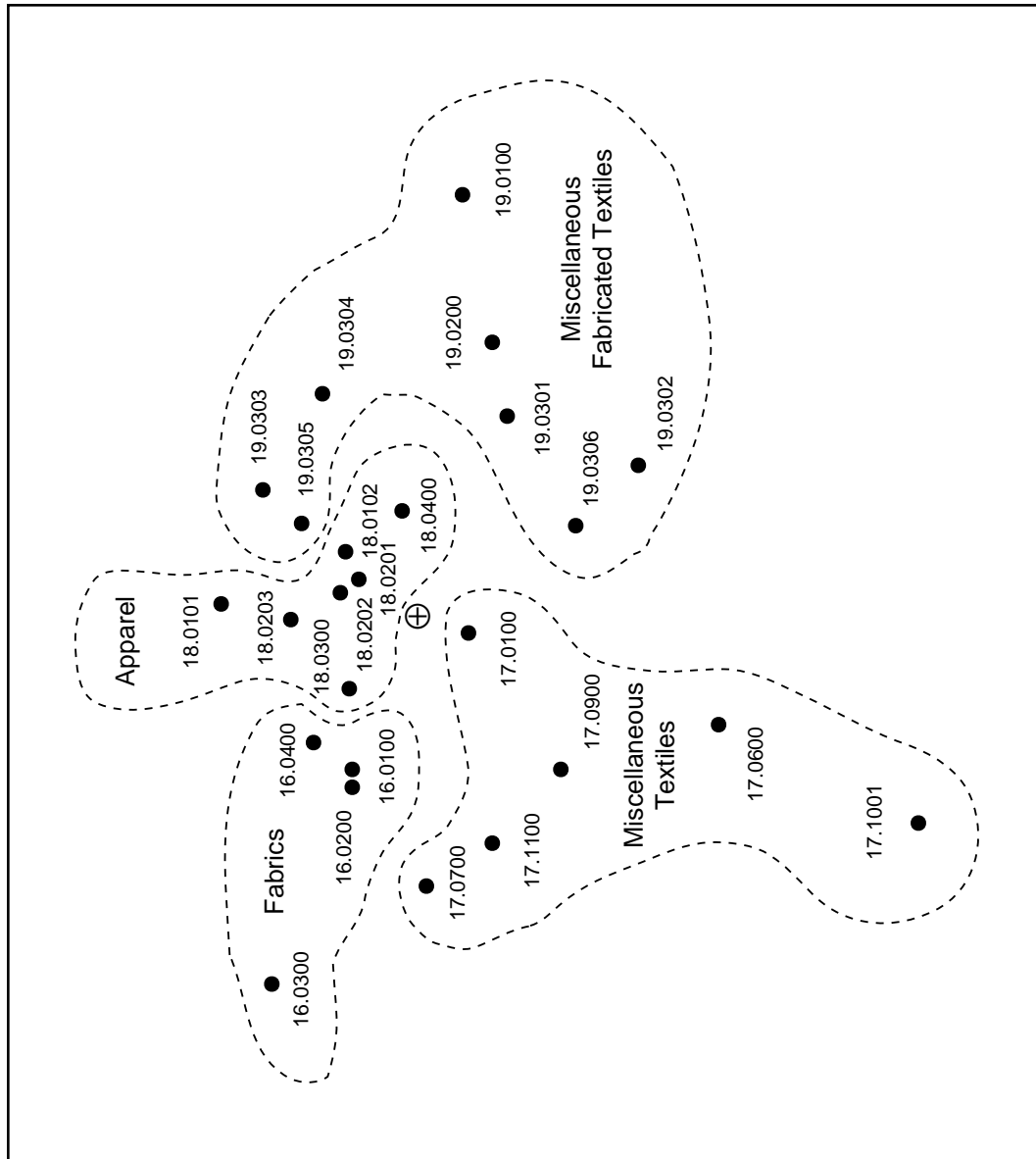
33.0001 leather tanning and finishing
 34.0100 boot and shoe cut stock and findings

*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

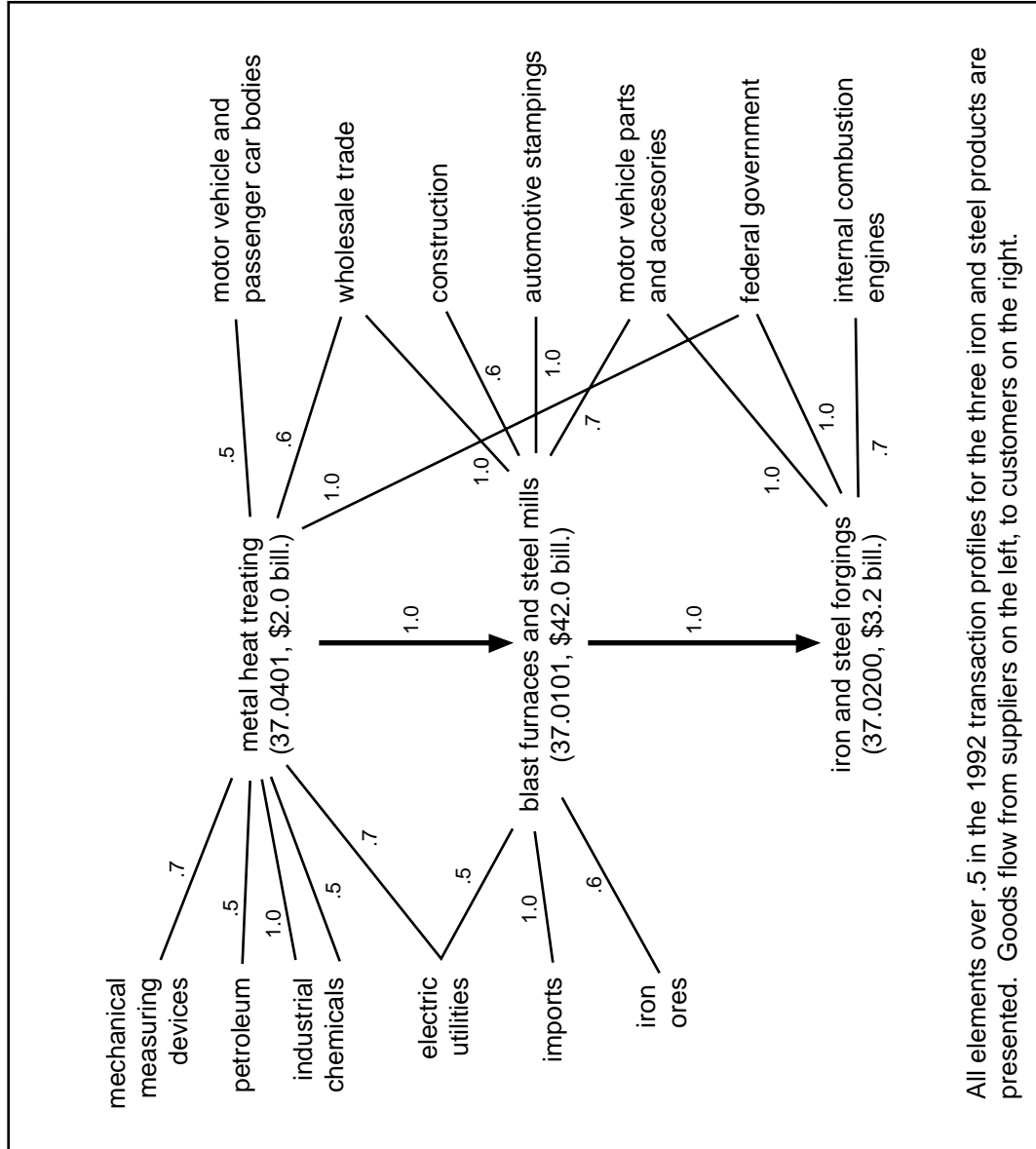
(⊕) marks the center of the space, stress = .154



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

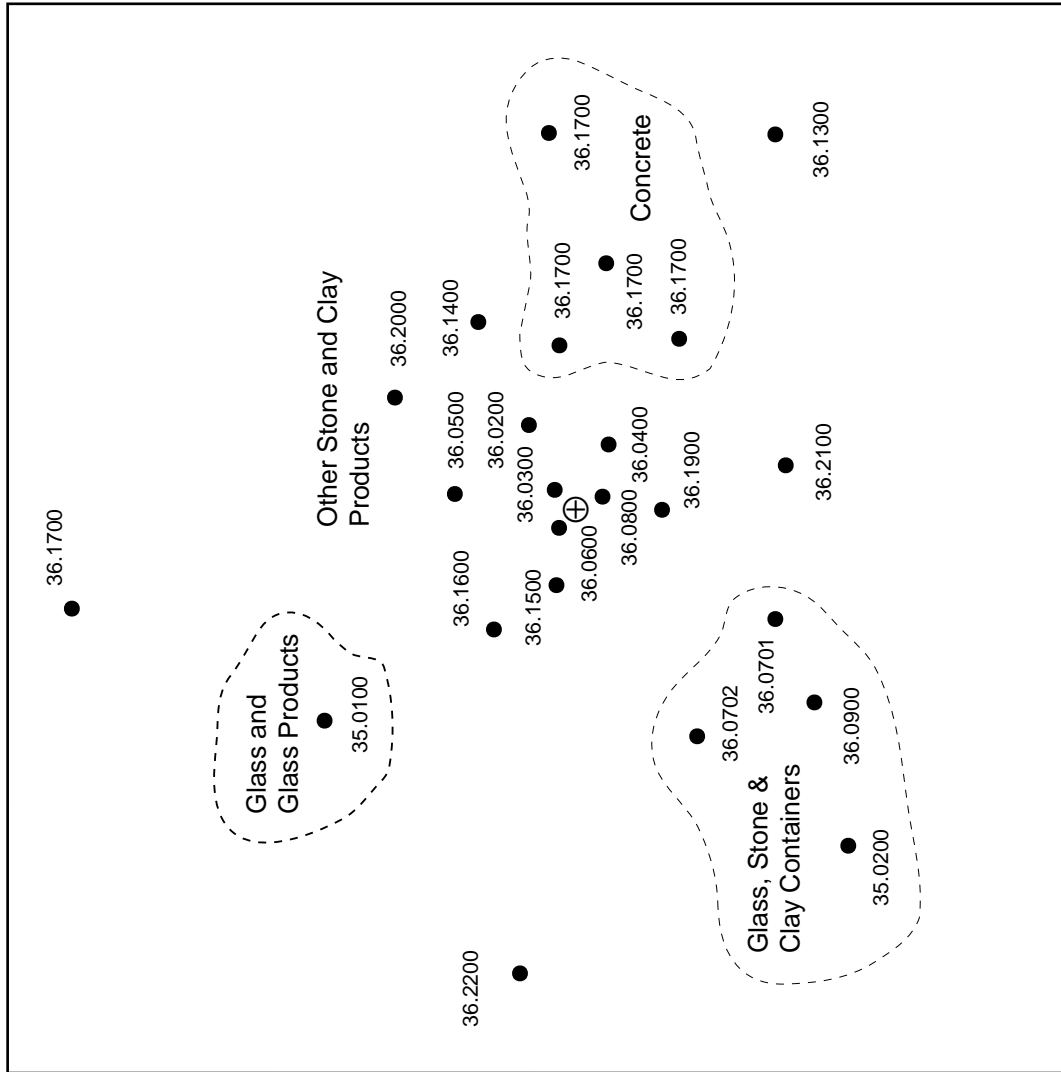


Retained Commerce Aggregation:

- 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

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.

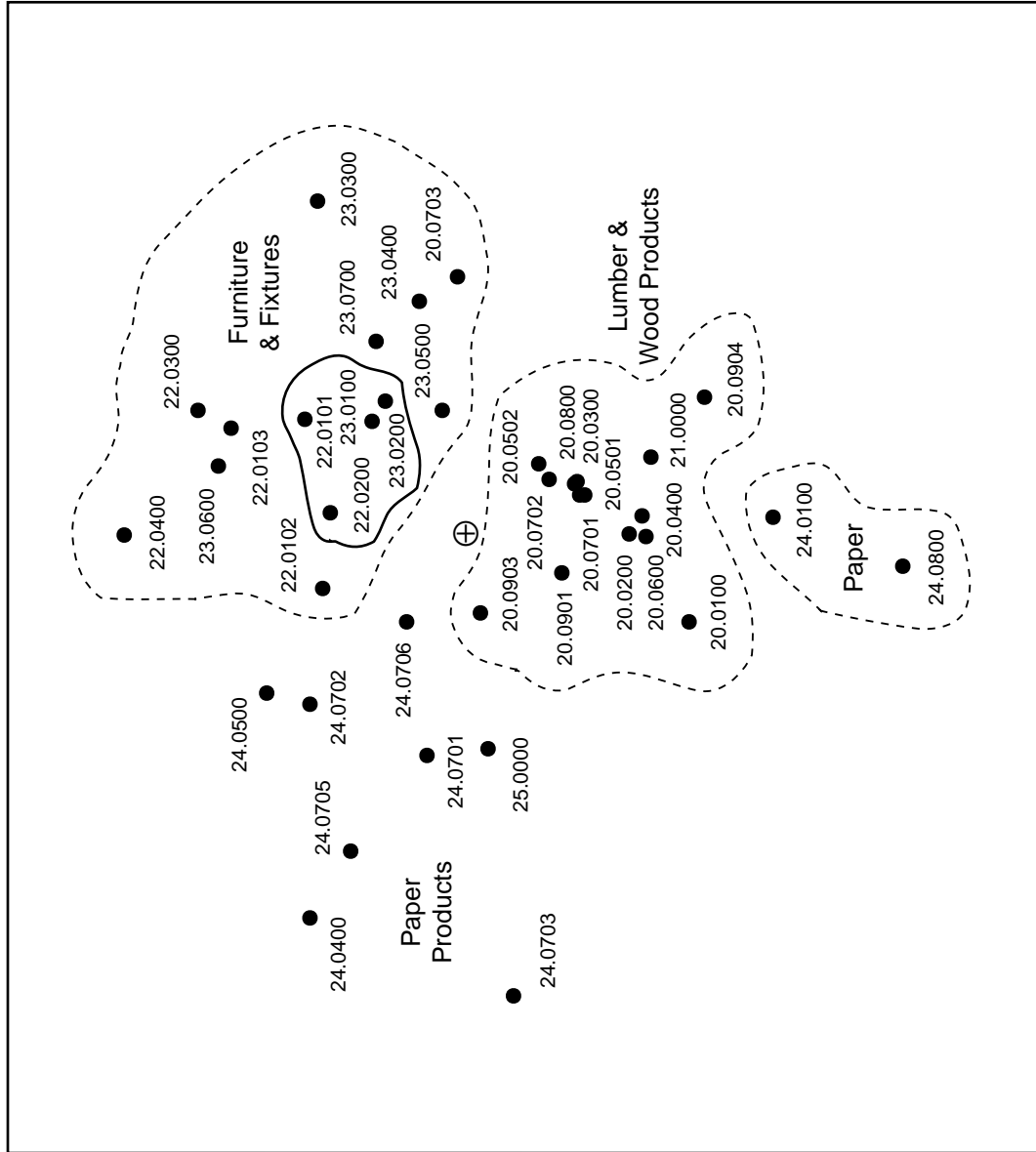
***36B. Concrete**
 36.0100 cement, hydraulic
 36.1000 concrete block and brick
 36.1100 concrete products, except block and brick
 36.1200 ready-mixed concrete

***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

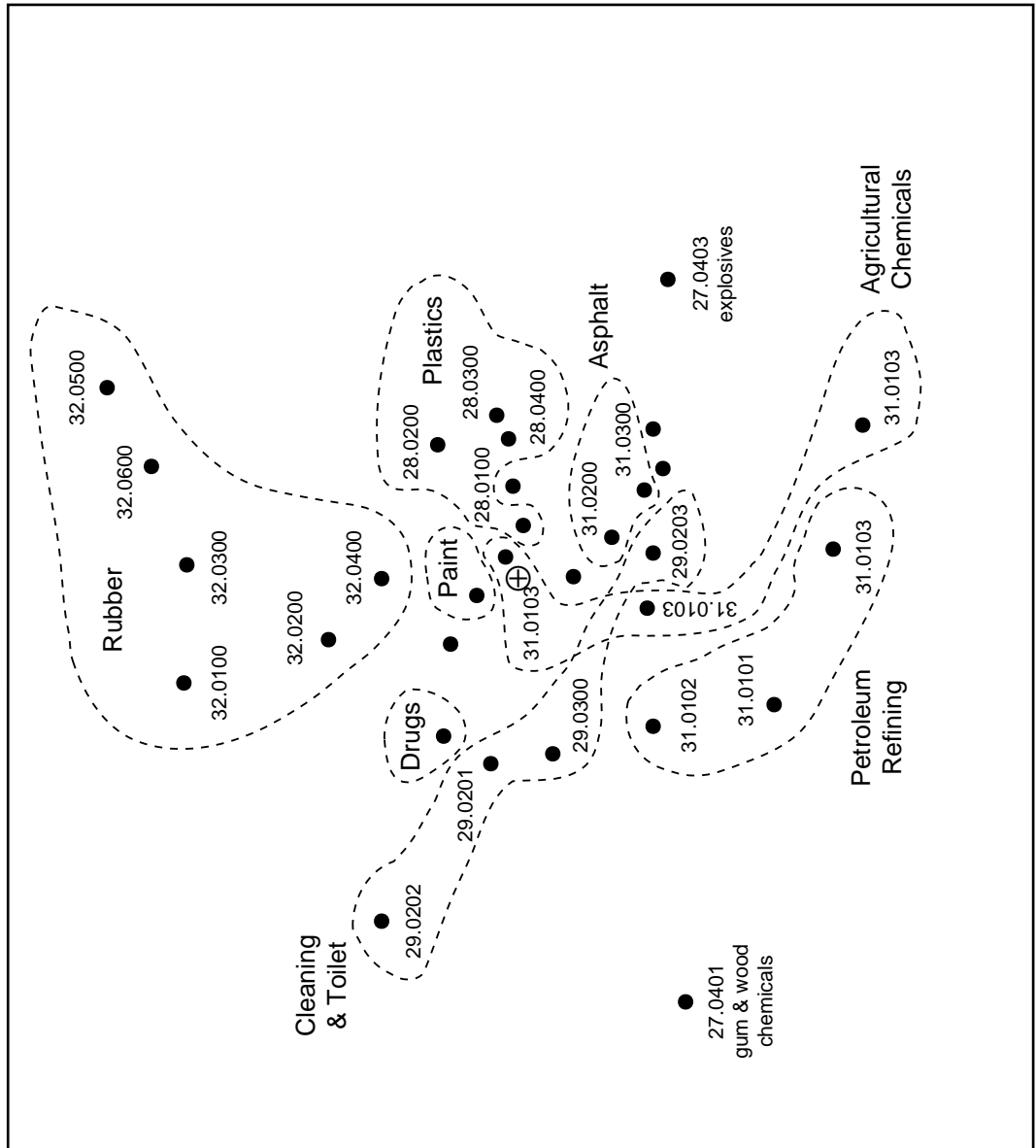
*24B-25. Paper Products

- 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

FIGURE A6. CHEMICALS AND SYNTHETICS

Proposed Aggregation:
(* marks revised category)

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



27A. Industrial Inorganic and Organic Chemicals
 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.

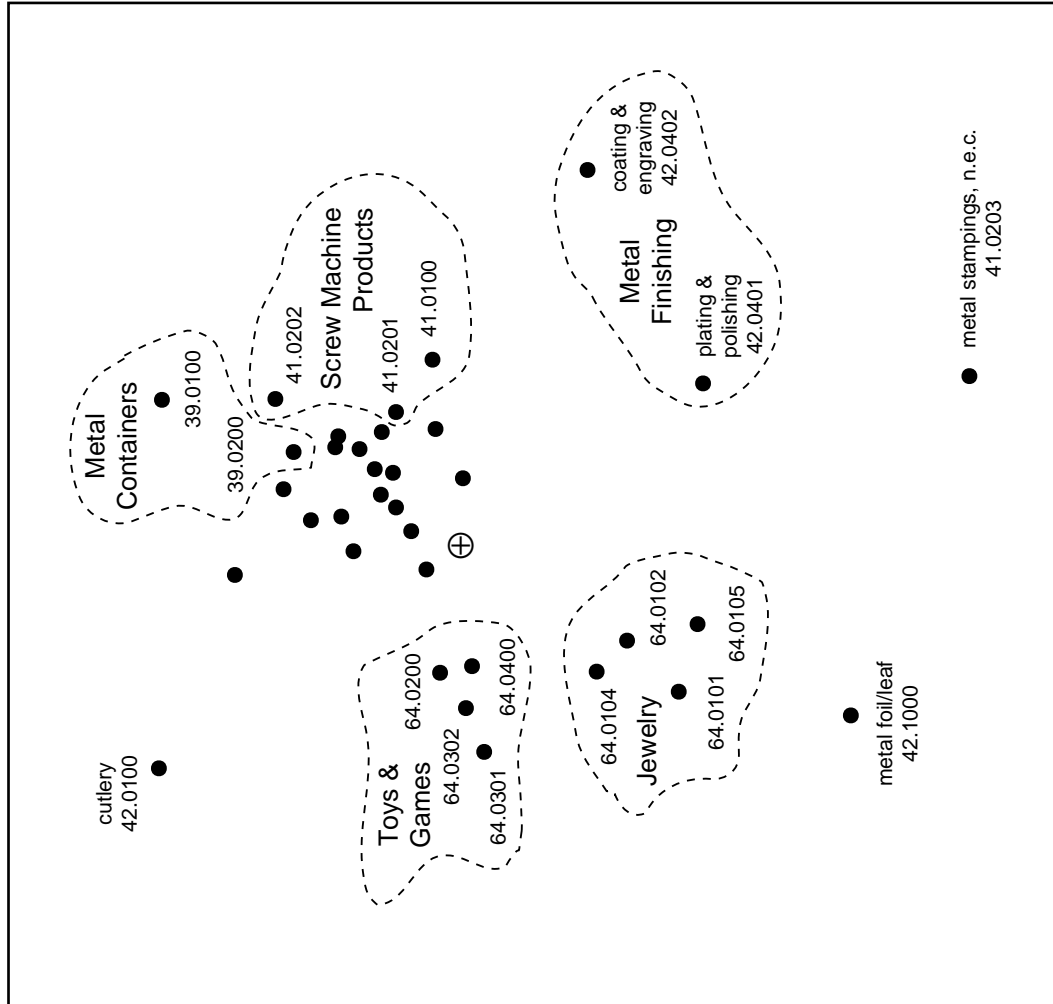
*31B. Asphalt
 31.0200 asphalt paving mixtures and blocks
 31.0300 asphalt felts and coatings

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

Proposed Aggregation: (* marks revised category)

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



- 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, Plumbing & 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.

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

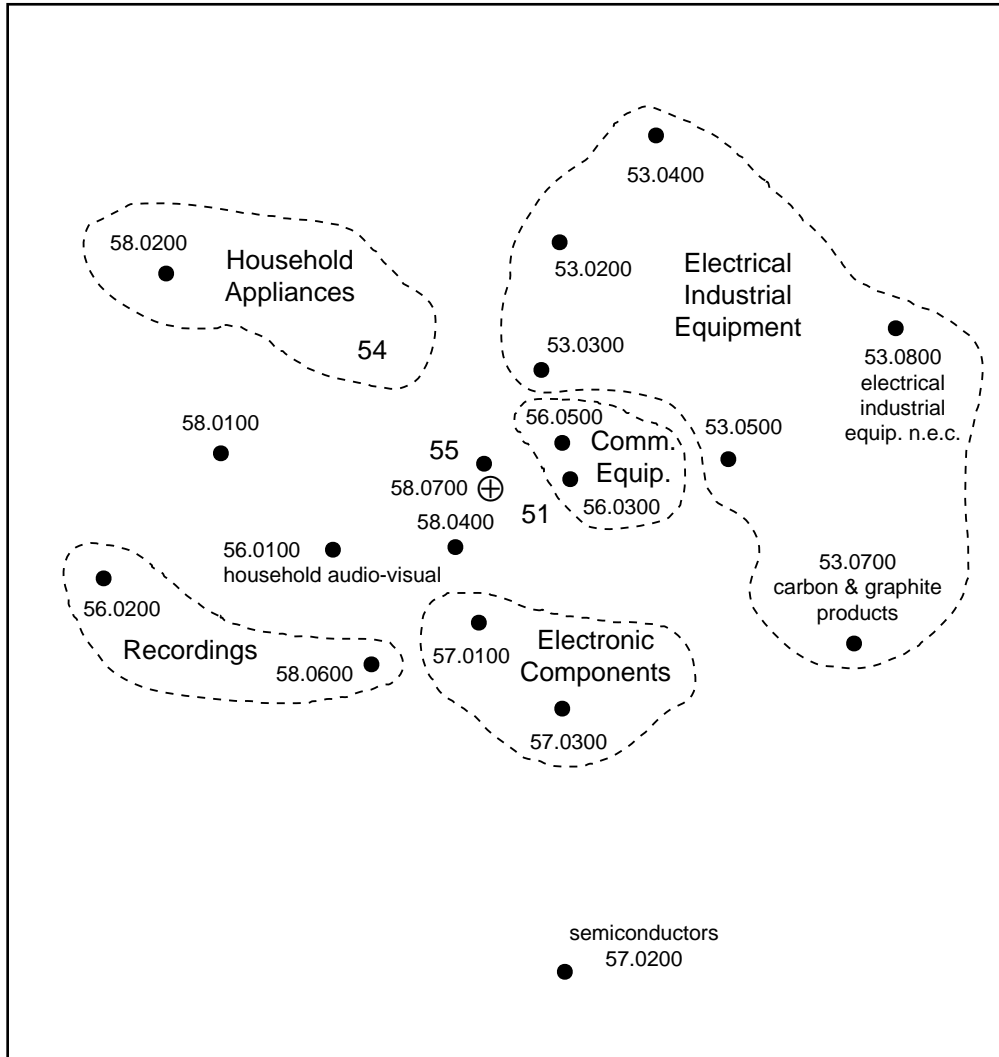
- 64.0200 musical instruments
- 64.0301 games, toys, and children's vehicles
- 64.0302 dolls and stuffed toys
- 64.0400 sporting and athletic goods, n.e.c.

*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

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)

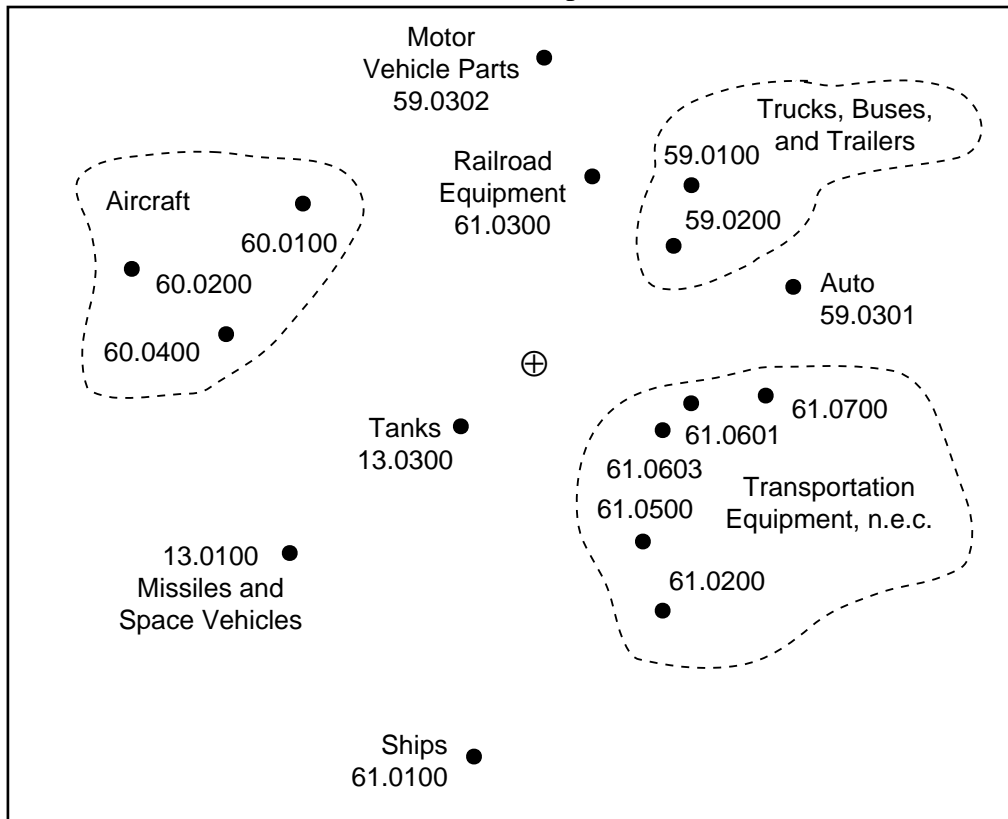


FIGURE A9. TRANSPORTATION EQUIPMENT

(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.

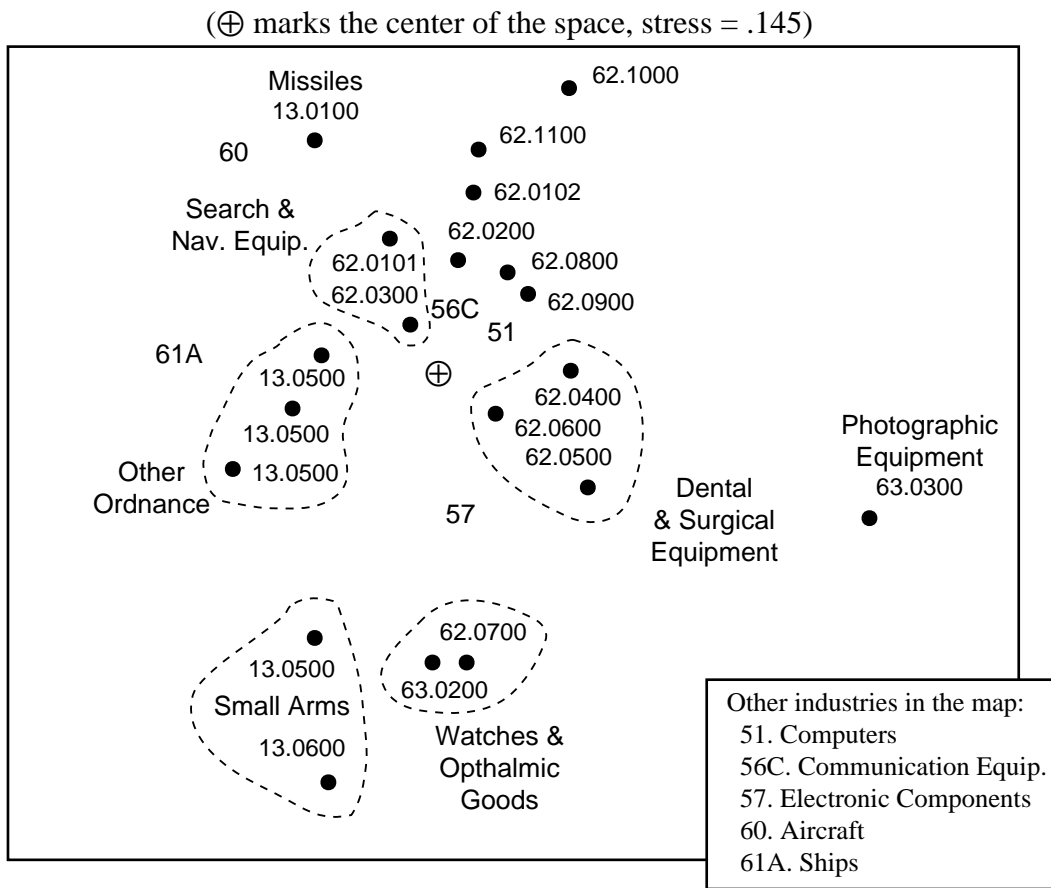


FIGURE A10.

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. Ophthalmic 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 Ophthalmic Goods (74.7%, 74.5%)

62.0700	watches, clocks, watchcases, and parts
63.0200	ophthalmic goods

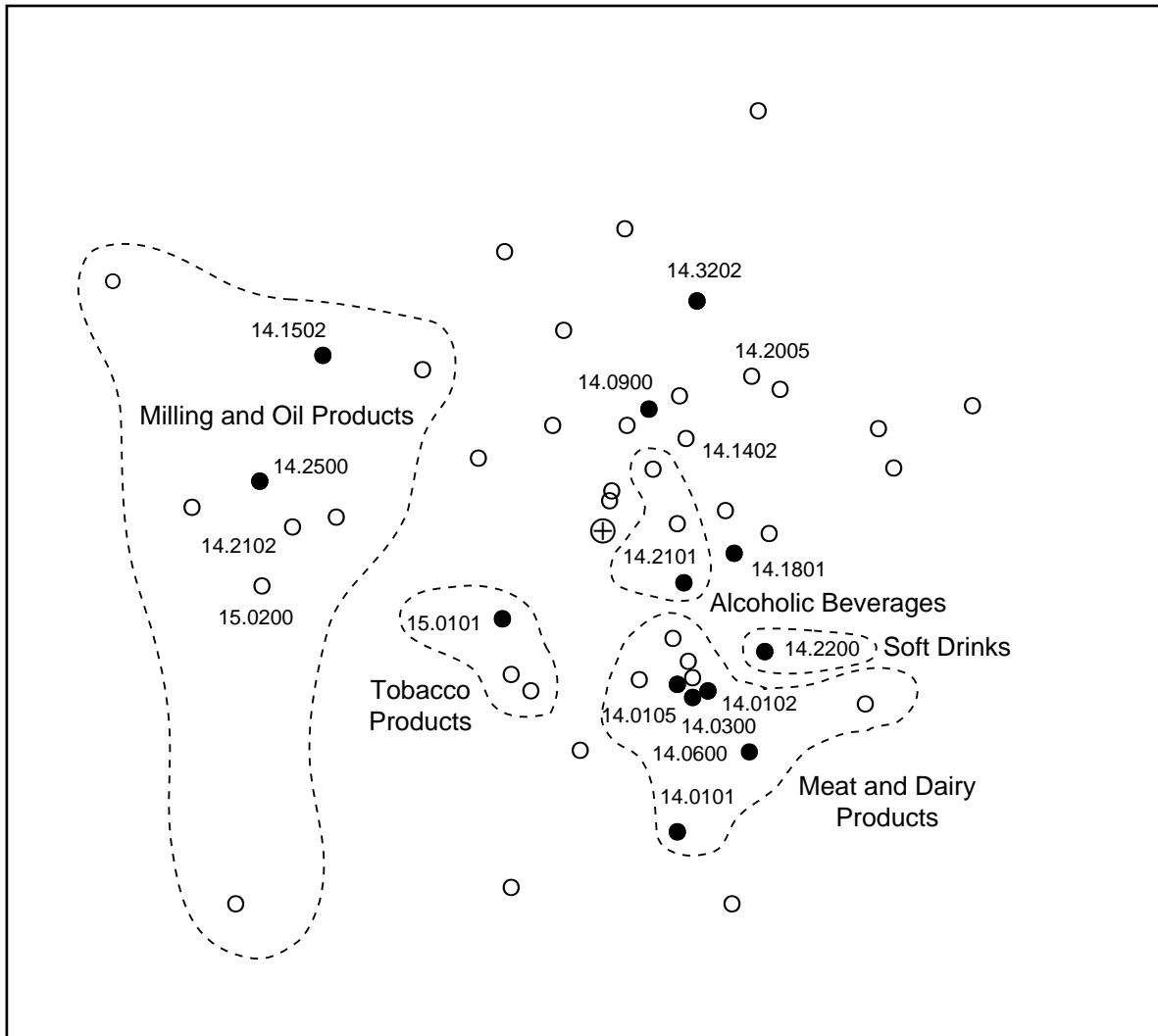
*63B. Photographic Equipment (100%)

63.0300	photographic equipment and supplies
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FIGURE A11. FOOD AND TOBACCO

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

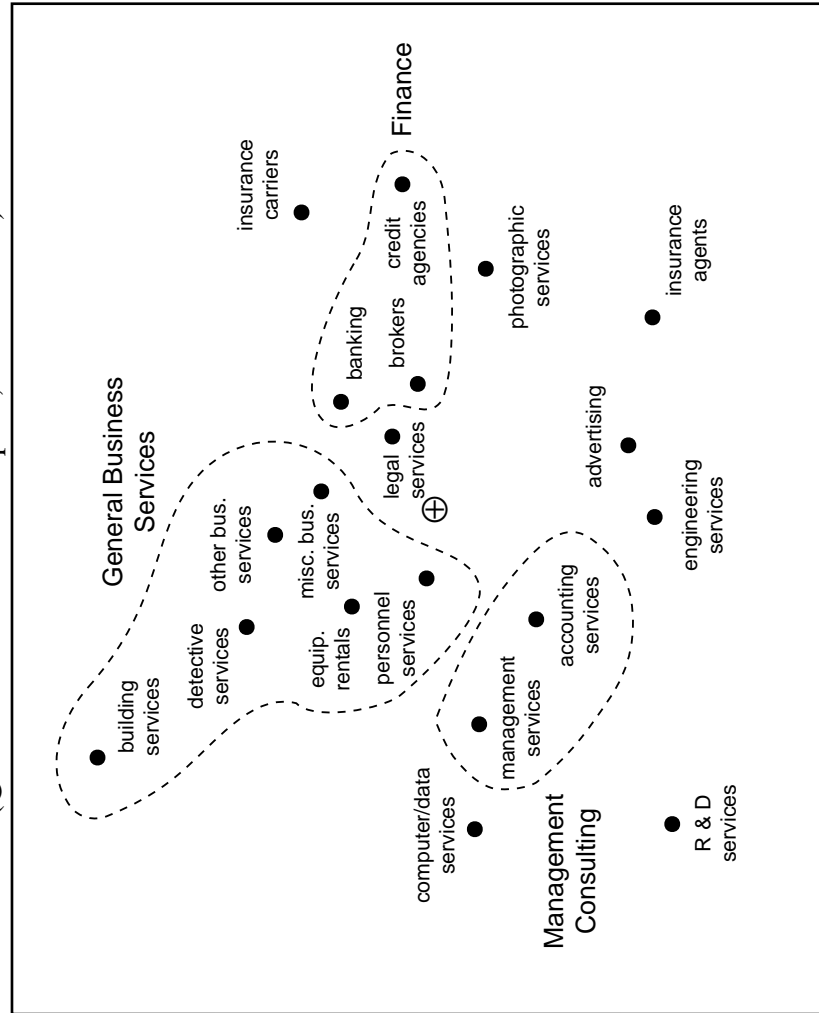
(⊕ marks the center of the space, stress = .177)



Proposed Aggregation:
 (* marks revised category)

FIGURE A12. FINANCE AND BUSINESS SERVICES

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



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%)		*14F. Other Flour Products (75.3%, 76.8%)					
16790	0.784	14.1502	prepared feeds, n.e.c.	8974	0.899	14.1402	cereal breakfast foods
10204	0.940	14.2500	soybean oil mills	6053	0.787	14.1401	flour and other grain mill products
6907	0.798	14.1700	wet corn milling	3669	0.926	14.1403	prepared flour mixes and doughs
3572	0.781	15.0200	tobacco stemming and redrying	1360	0.852	14.3100	macaroni, spaghetti, vermicelli, and noodles
1787	0.531	14.2700	animal and marine fats and oils	*14G. Canned and Frozen Food (except fish, 76.5%, 75.0%)			
1593	0.790	14.1600	rice milling	14497	0.940	14.0900	canned fruits, vegetables, preserves, jams, jellies
658	0.846	14.2400	cottonseed oil mills	7513	0.781	14.1302	frozen specialties, n.e.c.
637	0.706	14.2600	vegetable oil mills, n.e.c.	7420	0.949	14.1301	frozen fruits, fruit juices, and vegetables
566	0.800	14.2102	malt	6566	0.847	14.0800	canned specialties
*14B. Meat and Dairy Products (84.5%, 78.6%)		*14H. Candy and Snack Foods (82.3%, 76.4%)		6324	0.840	14.1100	pickles, sauces, and salad dressings
48871	0.939	14.0101	meat packing plants	5083	0.923	14.2800	roasted coffee
24800	0.971	14.0105	poultry slaughtering and processing	2798	0.827	14.1000	dehydrated fruits, vegetables, and soups
19689	0.970	14.0600	fluid milk	*14I. Food Products, n.e.c. (58.1%, 49.8%)			
18670	0.917	14.0102	sausages and other prepared meat products	11898	0.851	14.3202	food preparations, n.e.c.
17720	0.974	14.0300	natural, processed, and imitation cheese	6876	0.721	14.2300	flavoring extracts and flavoring syrups, n.e.c.
7187	0.975	14.0400	dry, condensed, and evaporated dairy products	6176	0.807	14.1501	dog and cat food
6665	0.853	14.1200	prepared fresh or frozen fish and seafoods	4614	0.697	14.2900	edible fats and oils, n.e.c.
4828	0.887	14.0500	ice cream and frozen desserts	355	0.758	14.3000	manufactured ice
1003	0.929	14.0200	creamery butter	*15A. Tobacco Products (92.6%, 96.5%)			
938	0.755	14.0700	canned and cured fish and seafoods	34720	0.956	15.0101	Cigarettes
*14C. Alcoholic Beverages (85.3%, 84.0%)		*14D. Soft Drinks (100%)		1539	0.988	15.0103	Chewing and smoking tobacco and snuff
20593	0.870	14.2101	malt beverages	315	0.941	15.0102	Cigars
6576	0.942	14.2104	distilled and blended liquors	bottled and canned soft drinks			
5089	0.957	14.2103	wines, brandy, and brandy spirits	*14E. Bakery Goods (88.1%, 87.8%)			
*14D. Soft Drinks (100%)		bottled and canned soft drinks		24073	0.929	14.1801	bread, cake, and related products
23756	1.000	14.2200	bottled and canned soft drinks	7604	0.964	14.1802	cookies and crackers
*14E. Bakery Goods (88.1%, 87.8%)		bread, cake, and related products		1653	0.924	14.1803	frozen bakery products, except bread
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				

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

Table A8 (continued)

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.