

An Alternative Framework for Analyzing Industrial Output

By Joel Popkin

In this article, the author, a private economic consultant, builds on a paper that he presented at a conference on economic classification that was held in Williamsburg, Virginia, in November 1991. The views expressed do not necessarily represent those of BEA.

Kathryn L. Kobe, Vice President of Joel Popkin and Company, prepared the data set and contributed to its analysis.

THIS ARTICLE will present and analyze national economic data aggregated to broad industry totals using a classification framework that focuses on end-user markets. Such a classification system is characterized as demand-based because the underlying theory is to group goods and services by their similarity in use.¹ This classification system could be considered as one alternative to the present Standard Industrial Classification (SIC). The present SIC is not predicated on any such underlying theory or approach to classification, a shortcoming that has prompted an effort to revise it thoroughly.² This article serves to present a methodology for restructuring aggregative U.S. industry data and to examine the results of doing so.³ The time periods for which the data are classified are the years 1977, 1982, and 1987.

The present SIC defines industries and assigns them four-digit numerical identifiers. The system is hierarchical in that four-digit industries can be combined into three-digit industry groups, then into two-digit major groups, and finally into 10 highly aggregated divisions. In the national income and product accounts (NIPA's), the tables that present estimates by industries are gener-

ally at the SIC division or major group levels of aggregation.⁴

An Alternative SIC

Table 1 compares the structure of the existing SIC system with that of the alternative system. The existing system has 10 divisions, the same 10 that were in the first SIC developed at the end of World War II. The alternative system has nine divisions, a number that reflects the combination of some existing divisions that more than offsets the creation of some new ones. The alternative system differs from the existing SIC in three significant ways. First, each division is disaggregated primarily according to the end-user market it serves—consumer or producer. Second, the services provided by distribution networks, such as trade and transportation, are put in one newly created division; in the existing SIC, they are in three separate divisions. Third, three new divisions are created for the rapidly growing services sector: Two for services privately produced—one for services purchased by producers, the other for services purchased by consumers—and one for services publicly produced, mostly for households.⁵

The subdivisions in the alternative classification system reflect the end-user market in which the goods or services are sold. Thus, while the conventional hierarchy groups manufactured goods by durability regardless of who buys them, the alternative system groups manufactured goods according to whether they are sold as finished goods to producers or to consumers

1. Another conceptual approach would be to classify goods and services by how they are produced. For a description and analysis of theories of economic classification, see Jack E. Triplett, "The Theory of Industrial and Occupational Classification and Related Phenomena," in *1990 Annual Research Conference Proceedings in Arlington, Virginia, March 18-21, 1990* by the Bureau of the Census (Washington, DC: U.S. Government Printing Office, 1990).

2. BEA chairs an interagency committee charged with directing a comprehensive SIC revision. An article reporting on the progress of the committee appears on pages 45-49 in this issue.

3. The methodology and its rationale were first presented and are explained in greater detail in Joel Popkin, "Recommendations and Description of the Principles upon which a Revised Industrial Classification System Should Be Built," in *1991 International Conference of the Classification of Economic Activity Proceedings in Williamsburg, Virginia, November 6-8, 1991*. The *Proceedings* are available from Carole Ambler, the Bureau of the Census, Room 2069-3, Washington, DC 20233.

4. Most industry information is contained in the tables of section 6—"Income, Employment, and Product by Industry." Most of the NIPA industry breakdowns are for components of national income, such as profits, labor compensation, employment, and self-employment. Because the dollar figures in the tables are for income components, none are deflated. However, annual inflation-adjusted estimates of gross product originating by industry—the industry-level equivalent of gross domestic product—are published separately from, and on a less frequent basis than, the rest of the NIPA's. These measures are published for about 60 detailed industries.

5. In this article, the word "services" refers only to these three kinds of services. The other industries traditionally referred to as "services" are referred to as "distribution networks." Hopefully, a more readily communicable nomenclature will be developed to capture this distinction.

or as unfinished goods to producers for further processing.

The “distribution network” division represents the most significant combination of SIC divisions in the alternative hierarchy; the new division combines wholesale and retail trade with transportation, communications, and the distribution

portion of gas, electric, and other public utilities. The division was created for three reasons:

(1) It combines all industries that form a bridge between the production of goods and services and their purchase by users, largely households or businesses. The economic behavior of these distribution networks may differ in some re-

Table 1.—Present and Alternative SIC Hierarchy

1987 SIC	Alternative SIC
A. Agriculture, forestry and fishing	I. Agricultural products and services A. For consumers directly B. For further processing C. For farm use
B. Mining	II. Mineral products
C. Construction	III. Construction A. Residential B. Commercial and industrial C. Governmental
D. Manufacturing	IV. Manufacturing A. First-stage manufactures B. Semifinished manufactures C. Finished manufactures 1. For consumers a. Food b. Nonfood 2. For producers a. Capital equipment b. Other
E. Transportation, communications, electric, gas, and sanitary services	V. Distribution networks A. Transportation 1. For consumers 2. For producers B. Communications 1. For consumers 2. For producers C. Gas, electric, and other public utilities distribution systems ¹ 1. For consumers 2. For producers D. Wholesale trade 1. For consumers 2. For producers E. Retail trade
F. Wholesale trade	
G. Retail trade	
H. Finance, insurance, and real estate	VI. Producer services A. Marketing B. Insurance C. Real estate D. Information E. Finance F. Other
I. Services	VII. Consumer services, privately supplied ² A. Personal B. Health C. Education D. Information E. Entertainment and amusement F. Hotels, bars, and restaurants G. Real estate H. Finance
	VIII. Social services, publicly supplied ³ A. Government B. Health C. Education D. Information E. Other
J. Public administration	IX. Public administration

1. The production of gas, electricity, and potable water would fall under first-stage manufactures (IV.A).

2. This group will include many nonprofit institutions; it would be useful to have subcategories that disaggregate profit and nonprofit organizations.

3. Establishments in this division are excluded from tabulations that represent private sector activity; they are aggregated with SIC division J when government activity is tabulated.

SIC Standard Industrial Classification

spects from the industries that produce the goods and services. Distribution networks are, for example, industries in which returns to scale are important, and some of them have been, or still are, subject to regulation in many of the markets they serve. In addition, distribution network industries would not exist were it not for the needs of producers of goods and

more fundamental services to get those items to markets.⁶

(2) Many analysts are prone to aggregate these distribution industries along with those that produce other services, like medical care and accounting. Such an aggregation forms the basis for statements like “the services sector accounts for about 70 percent of national output.” However, these service-producing industries are so diverse as to render that statement meaningless. The alternative classification seeks to present the traditionally defined services in a more useful way.

(3) The network industries are, for the most part, treated differently in the NIPA’s. Their gross output is measured by gross margin. For example, the output of the retail industry is not its sales, but rather its sales minus the goods it purchases for resale. Transportation gross output, similarly, does not include the value of the goods moved, nor communications output, the value of the services being transmitted.

The role of distribution networks is illuminated in [chart 1](#). It shows producing sectors distributing their outputs to end users through distribution networks. Obviously, not all purchases by end users are part of final demand. In particular, profit and nonprofit businesses use

6. This assumes that the household production required for a personal communication, like a telephone call to a friend, uses economic resources.

CHART 1

Role of Distribution Networks in the Alternative Framework

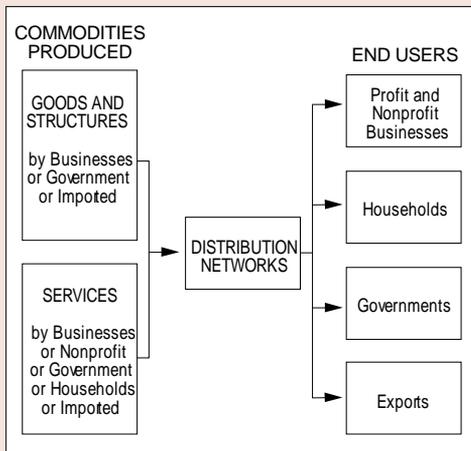
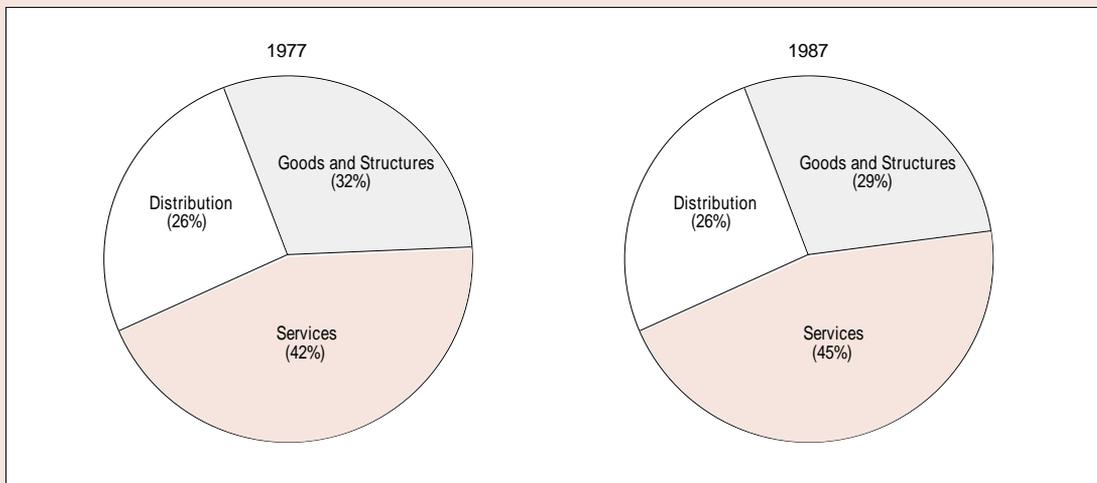


CHART 2

Current-Dollar Shares of Gross Product Originating by Industry, 1977 and 1987



most of their purchases as intermediate inputs to other products and services. The part of their purchases that is not resold consists largely of structures, equipment, and, in the case of non-profit organizations, the services they provide primarily to consumers (households).⁷

Chart 2 shows the distribution of current-dollar output in 1977 and 1987 among three major sectors based on an approximation of the alternative SIC.⁸ It shows a different picture than is reflected by analyses that characterize the economy as 70 percent services. The alternative classification shows that in 1987, 45 percent of the economy produced services, 29 percent produced goods and structures, and 26 percent was engaged in distributing both kinds of production. From 1977 to 1987, the share of current-dollar gross product originating (GPO) in the industries that produce finance, insurance, real estate, and personal and business services rose 3 percentage points, while the share for industries that produce goods and structures fell by 3 percentage points. The share produced by network industries that distribute both goods and services output was unchanged.

Growth Rates Under the Alternative SIC

Because the data in chart 2 are in current dollars, the changes in shares do not reflect growth rates. To measure growth rates, current-dollar data for the commodity groups that compose each of the major sectors of the alternative classification were deflated by available price indexes to derive commodity output in constant dollars.⁹ Growth rates calculated from these constant-dollar estimates

7. Notwithstanding that not all purchases by end users are part of final demand in this system, the system may nonetheless provide an improved framework for measuring industry productivity for broad sectors of the economy. That is because the gross output of each of the three main sectors—goods and structures, services, and distribution networks—can be linked to inputs with a minimum of arbitrariness with respect to how price indexes distribute productivity among industries. This would follow the approach suggested by Edward F. Denison—that final demand end-use categories be the focus of measuring industry productivity; see Edward F. Denison, *Estimates of Productivity Change by Industry: An Evaluation and An Alternative* (Washington, DC: The Brookings Institution, 1989). The hierarchical structure presented here also facilitates the calculation of “ring fence” price indexes proposed by Deborah Paige and Gottfried Bombach in *A Comparison of National Output and Productivity of the United Kingdom and the United States* (Paris: Organisation for European Economic Co-operation, 1959).

8. Since some of the output of goods and services sold to businesses is resold to consumers, the data in chart 2 are based on gross product originating by industry to avoid double counting. For some time now, BEA has presented wage and salary disbursement data in detail that parallels the three sectors shown in chart 2 (see table 2.1 in the section “Selected NIPA Tables” in this issue).

9. The lack of comprehensive data classified by commodity—particularly in service industries, where commodities tend to be defined by the four-digit SIC industries in which they are produced—limited the precision with which these data series could be estimated. For example, it was not possible to clearly separate and deflate personal checking services available to consumers from the kinds of checking services available to businesses.

are presented in tables 2 and 3.¹⁰ As measures of the change in gross commodity output in each industry, these growth rates differ from growth rates of GPO, which are measured by industry gross output less purchased materials and outside services, both in constant dollars.

Tables 2 and 3 contain growth rates for industries in the alternative classification scheme for two periods—1977–82 and 1982–87.¹¹ The beginning and ending points for each period reflect the years in which economic censuses were taken; economic census years provide the most detailed data available, including benchmark input-output tables for accomplishing the reclassification.

The summary data shown in table 2 support three relevant observations. The first is that the acceleration in economywide growth between 1977–82 and 1982–87 would be noticeable regardless of which classification structure is used. The two recessions during 1977–82 pulled down the overall growth rate for the period to an annual average of 1–2 percent. The 1982–87 period, on the other hand, was part of a prolonged period of expansion and showed an average annual growth rate of almost 4 percent. Growth clearly accelerated. However, the alternative SIC structure makes it possible to identify and quantify the sources of demand that gave rise to the acceleration. Thus, the second observation that can be made is that while demand accelerated in all sectors during 1982–87, consumer demand for goods and structures accelerated more than producer demand.

10. The appendix at the end of this article explains the derivation of the numbers in these tables.

11. The growth rate for the entire 1977–87 period is not shown, because the reclassification could not be accomplished to the same degree in each of the individual 5-year periods.

Table 2.—Average Annual Rates of Change in Gross Output for Major End-User Categories

[Average annual percent change]

	1977–82	1982–87	Acceleration
Goods, structures, and services	1.10	3.86	2.76
Goods:			
For consumers	-.91	3.82	4.73
For producers .....	.02	3.37	3.35
Structures:			
For consumers	-7.98	13.87	21.85
For producers	4.98	.89	-4.09
Services:			
For consumers	2.40	3.44	1.04
For producers	3.98	5.15	1.17
Distribution networks	1.83	4.58	2.75

NOTE.—The appendix to the article explains the derivation of the numbers in this table.

A third observation from [table 2](#) is that the acceleration in distribution network activity was strikingly close to that in goods, structures, and services combined; further, it was closer to the combined acceleration than to the acceleration in any one sector. A surge in demand for goods and services should give rise to a parallel surge in distribution activity, as shown in these data. By comparison, the growth rates for the two periods differ between the distribution networks and the things they distribute. This difference could reflect a change in the mix of distribution networks being used or a change in the productivity of distribution networks. It could also reflect the impact of the distribution of imports: [Table 2](#) is based on the gross output of domestic producers and does not directly measure imports; however, import growth will implicitly show up in many of the distributive industries as domestic businesses transport and sell imported goods.

Growth rates for 1977–82

[Table 3](#) provides more detailed end-user data on growth rates for the two 5-year periods. The first 5-year period, 1977–82, encompassed two recessions, one in 1980–81 and one in 1981–82; thus, growth was slowed in the middle of the period as well as at the end. The data in [table 2](#) already showed that the recessions' effect was greatest on the consumer sector; [table 3](#) shows that in more detail. Output of consumer structures, largely new houses, was hard hit; it fell at an 8 percent annual rate. Domestic output of consumer finished goods, including processed food, also fell, declining at an annual rate of 1.0 percent. That affected the growth rates for the distribution services generated by consumer goods sales—those provided by retail trade outlets and by transportation industries that ship those goods to markets. The latter, which make up the bulk of the producer transportation sector, rose at only a 0.2-percent annual rate. Consumers also cut their purchases of gas, electric, and water distribution services, but that may have been largely a result of the rise in energy prices in 1979 and 1980 rather than the effect of the recession. Consumer purchases of transportation were virtually unchanged; however, more detailed data show that their use of air transportation increased, while their use of land-based mass transport declined.

Services bought by consumers, both privately and publicly supplied, grew during the period despite the recessions. Among consumer services, output of the finance, insurance, and real estate sector rose more quickly than the "other"

personal services category. Consumer use of communication networks rose at about the same rate as their purchases of services.

Despite the recession-related weakness in the demand for the output of industries that produce and distribute consumer goods, industries supplying producers grew relatively fast. Perhaps reflecting the growth in business usage of communications and other computer-driven inputs, there was a 4.4-percent annual rate of increase in capital equipment purchases. Output of services to businesses rose almost as fast—4.0 percent. But the weakness in demand for consumer goods and for residential construction overwhelmed the strength in capital equipment demand, causing the output of first-stage and of semifinished manufactures to end up lower in 1982 than in 1977. This decline in first-stage manufactures—those receiving their first transformation from raw materials (which includes the generation of power)—and in semifinished manufactures contrasts with an overall rise in finished manufactures; this divergence implies either that the productivity with which materials were used improved or that finished goods pro-

Table 3.—Average Annual Rates of Change in Gross Output
(Average annual percent change)

	1977–82	1982–87
Goods and structures	-0.04	3.72
For consumers	-2.35	5.78
Agriculture for consumer use	1.63	3.70
Residential construction	-7.98	13.87
Consumer finished goods	-1.03	3.82
For producers .....	.72	3.06
Agriculture for farm	-.04	1.74
Agriculture for further processing	3.52	.79
Minerals	-.90	-2.22
Nonresidential construction	4.98	.89
All manufactures excluding finished goods for consumer use	-.14	4.40
First-stage manufactures	-1.66	.78
Semifinished manufactures	-1.28	4.85
Finished manufactures:		
Equipment	4.43	8.67
Nonequipment .....	.82	2.33
Services	2.93	4.06
For consumers	2.40	3.44
Privately supplied	2.48	3.53
Finance, insurance, and real estate	3.13	3.31
Other	2.32	3.58
Publicly supplied	2.01	2.96
For producers	3.98	5.15
Finance, insurance, and real estate	3.66	4.06
Other	4.24	5.99
Distribution networks	1.83	4.58
For consumers	1.48	4.87
Transportation .....	.10	5.53
Communications	2.34	5.43
Utility	-.56	6.85
Wholesale for consumers	4.04	2.95
Retail .....	.58	5.27
For producers	2.23	4.24
Transportation .....	.17	4.87
Communication	7.41	2.89
Utility	-.81	-3.61
Wholesale for producers	3.07	7.43

NOTE.—The appendix to the article explains the derivation of the numbers in this table.

ducers bought an increasing proportion of their materials from foreign suppliers.

Growth rates for 1982–87

Virtually all sectors in the alternative hierarchy grew faster from 1982 to 1987 than from 1977 to 1982. That outcome is of course largely explained by the fact that a recession year, 1982, marked the dividing line between the two periods.

Just as residential construction fell most in the recession-dominated period of 1977–82, it rose fastest—13.9 percent per year—in the prosperous 1982–87 period. Output of consumer finished goods grew at a 3.8-percent annual pace, as consumer purchases of motor vehicles bounced back from recession lows. The retail trade and transportation services needed to get those goods into the hands of consumers grew even faster—5.3 percent and 4.9 percent per year, respectively.

Consumer use of transportation networks grew faster than that of producers; this reflects increased use of air travel and increased reliance on travel-arrangement services. Consumers, enjoying the results of competition in long distance markets, also used communication networks at a faster rate than did producers; this is the exact opposite of the pattern seen in 1977–82, when communications services to businesses expanded much more rapidly than those to consumers. Although consumer purchases of both privately and publicly supplied services accelerated during 1982–87 from the previous, recession-dominated, 5 years, the acceleration was modest, especially in comparison with that in their purchases of goods and structures.

Producers continued to buy finance, insurance, and real estate services at a faster pace than consumers in 1982–87. Their purchase of “other” business services rose even faster, probably reflecting significant outsourcing by manufacturers of operations such as legal services, advertising, and accounting.

A notable development was the decline in mineral output and in producer purchases of gas and electricity. The former reflects the cutbacks in domestic oil production and the associated drilling services such production requires. The latter may be partly due to energy conservation by businesses in response to the sharp price boosts during the 1970's.¹²

Though the pace of output of finished consumer goods stepped up in 1982–87 from 1977–82, output of producer goods, particularly capital

goods, rose even faster. The rate of increase for all finished manufactures averaged 5.3 percent per year during 1982–87. U.S. output of semifinished goods used to produce the finished goods, rose almost as fast—4.9 percent. By contrast, output of first-stage manufactures grew nowhere near that quickly.

Conclusions

There are two kinds of distinctions that these experimental data seek to illuminate. The first is the need to find a way to distinguish the many varied industries that are currently characterized as services. The second is to distinguish between producer and consumer demands. While consumer demands are observable in the NIPA's, many producer demands are not. Those missing are so-called intermediate demands, sales from one industry to another. Such demands have intrinsic importance in addition to their importance in measuring productivity by industry.

While the present SIC heightens the distinction between goods and services, the alternative classification underscores the diversity of service industries. Distribution networks exist to transfer goods and services to end users. Many, such as express mail (transportation) and facsimile transmission (communications), compete in the distribution of the same services—for example, legal services. It is meaningful then, in the context of a demand-based approach to classification, to create a sector for distribution networks.

Consumers and producers usually are buyers in different markets. The alternative set of data computed for this article will be useful to analysts who study the structure of U.S. industry by the end markets each industry serves. Because prices are determined in markets, the alternative structure presented here should be useful in studying price behavior. In producing meaningful aggregations of prices, this demand-based classification structure also points to another dimension of the need for price data. For example, the services that the finance, insurance, and real estate industry provides to consumers differ in composition from those they provide to businesses. It is generally the case, certainly outside of manufacturing, that prices paid by consumers are measured more comprehensively and accurately than prices paid by producers. Yet this type of breakdown reveals that services supplied by producers to producers (alternative SIC division VI) represent almost half of all privately supplied services (alternative SIC

¹² This may also reflect a problem with the price deflators that is discussed further in the appendix.

divisions VI and VII) if the imputation for owner-occupied housing is removed. The refinement of the data presented here will focus attention on data gaps and needed data improvements, which, if made, will strengthen the NIPA's generally.

Appendix: Methodology

The reallocation of gross current-dollar output from the present SIC categories to the alternative classification was accomplished by use of the six-digit 1977 and 1982 benchmark input-output tables and the annual input-output table for 1987. The distribution of output of each commodity between producer and consumer purchases was examined. Depending on the distribution, the output of the commodity was allocated totally to a consumer sector, totally to a producer sector or, if the commodity was relatively important to both, was split between both. If a sector was divided, the consumer and producer sectors were each allocated the same relative share of imports and inventory investment. Government final demand and exports were generally considered to be a producer use rather than a consumer use. In some instances, such as when separating generation from distribution in electric utility output, various other sources of data were used to make approximations of what share of output should go to which end-user market. Those sources in-

cluded detailed Census Bureau data, employment data, energy prices, and Internal Revenue Service statistics.

Commodities were allocated to the finished goods subcategories of manufacturing based on the percentage of output going to final demand or going in an unchanged form to industries outside of manufacturing. For example, most office products were allocated to nonequipment producer finished goods. Commodities that were produced in the first processing of raw materials were classified as first-stage manufactures; the generation portion of utility output was included in that group as well. All other manufactured items except those of publishing industries were classified as semifinished manufactures. Publishing, not considered a manufacturing industry under the alternative classification system, was split between consumer and producer services.

The resulting current-dollar series were deflated using existing BEA price series for the most part. When output of a commodity group had to be divided between producers and consumers, the same price index was used for both parts of the output. This was done partly to ensure that the output growth for the total economy derived from the alternative system would approximately match that produced by BEA based on the existing SIC. But even absent that consideration, the lack of end-user-specific price indexes would, in many cases, have precluded separate deflation. 