

# **Economic Classification Policy Committee**

## **Issues Papers**

### **Issues Paper No. 4 Criteria for Determining Industries**

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Note to reader: This is the fourth in the series of Economic Classification Policy Committee issues papers. The first two, Issues Paper No. 1, "Conceptual Issues," and Issues Paper No. 2, "Aggregation Structures and Hierarchies," were published in the Federal Register, March 31, 1993, pp. 16990-17004. Copies are available by writing to Brenda M. Erickson, Economic Classification Policy Committee, Bureau of Economic Analysis (BE-42), U.S. Department of Commerce, Washington, D.C. 20230, or by telephone at (202) 606-9620, FAX (202) 606-5311.



# Economic Classification Policy Committee Issues Paper No. 4

## Criteria for Determining Industries

### Introduction

Past revisions of the U.S. Standard Industrial Classification (SIC) system have employed a set of "guidelines," or "technical criteria," for determining when a new 4-digit SIC industry should be established, or an existing industry should be discontinued. An appendix, "Economic Significance and Specialization and Coverage Ratios: Historical Notes and Detailed Examples" (henceforth, "Appendix") provides more information on these technical criteria, as well as information on similar criteria that have been employed in Canada.

Two criteria have been emphasized in past U.S. SIC revisions: (1) the economic significance of the industry, and (2) specialization and coverage ratios. These two criteria are discussed in sections 4.1 and 4.2, below. Other criteria used in previous revisions are summarized in section 4.3. The final section of the paper considers alternative statistical tests for distinguishing industries. These methods might supplement criteria used in the past, and would be appropriate for conceptually-based classification systems, such as those discussed in ECPC Issues Paper No. 1, "Conceptual Issues" [3].

### 4.1 Economic Significance

The U.S. "economic significance" criterion refers to the size of a 4-digit industry, relative to the average size of industries in its particular SIC Division (Manufacturing, for example, is SIC Division D—see 1987 SIC Manual [8], p. 701).

Five size variables are incorporated into the economic significance measure: The number of establishments in the industry, the industry's number of employees, its payroll, its value added, and its value of shipments. A weighted average of the five size variables (with weights 1, 2, 1, 2, and 1, respectively, as described in the Appendix) is constructed. This weighted size measure is expressed relative to a similarly-computed measure of the average size of existing industries in the pertinent SIC Division. A weighted average of 20 for a manufacturing industry, for example, has the interpretation that the industry is 20 percent of the

average size for manufacturing industries, and is described as that industry's measure of *economic significance*. The Appendix presents an example of the calculation of the economic significance measure and discusses the rationale for the procedure.

Past practice in the United States has required that an emerging industry achieve an economic significance, or weighted-size measure, of at least 20 to warrant adoption as a 4-digit SIC industry. An existing SIC industry has been retained so long as it achieved a weighted size measure of at least 10. The differential imparts stability to the classification.

The Appendix also presents criteria adopted by Statistics Canada for determining the economic significance of industries. The Canadian economic significance measure is constructed from gross output, which is similar to value of shipments. In the Canadian system, size measures are used as threshold values for accepting new industries and for retaining existing industries. A manufacturing industry with over \$60 million (Canadian) of output, using 1975 data, was considered to be of sufficient economic significance to be recognized in the 1980 Canadian SIC. Those below \$60 million (Canadian) were reviewed and some were recognized if there were analytic reasons for doing so. For example, the industry might be an emerging, new industry expected to become significant in the future. Ratios to divisional averages are not computed in Canada.

### Discussion

Presumably, some measure of the economic significance of an industry will always play a part in economic classification systems. A government program for publishing industry statistics can hardly ignore the size of the industry for which data are to be collected and published. It may cost nearly as much, for example, for a statistical agency to collect and publish statistics for a tiny industry as for a very large one. ECPC Issues Paper No. 3, "Collectibility of Data" [3], discusses the costs and burdens that are associated with collecting data.

It is not clear, however, that the formula used in past U.S. SIC revisions provides an appropriate measure of "economic significance." The variables

now incorporated into the U.S. economic significance measure (value added, payroll, and so forth), the weighting scheme used in averaging the variables, and the scoring cutoffs (20 percent and 10 percent) might all be questioned. Should the existing set of industry size variables be modified, expanded, or replaced? On what basis can the weights be justified? Should the same set of size variables be used in all sectors of the economy, or are the economic significance variables that are appropriate for services different from those that are appropriate for goods?

Another problem arises because, in the U.S. economic significance measure, an industry's size is expressed relative to the average size for industries within its own SIC Division. This relative size computation creates a bias against forming new industries in nonmanufacturing sectors of the economy.

To illustrate, average employment in 4-digit SIC manufacturing industries in 1990 was just over 40,000; average employment in 4-digit SIC services industries, on the other hand, was 177,000, and in retail trade, over 300,000. The employment figures suggest (in practice, five size variables are used, not just employment) that a new service industry has to be roughly 4 times as large as an emerging industry in the manufacturing sector before it meets the "20 percent rule" of the economic significance test, and a proposed retail trade industry must be 7 times as large as a proposed new 4-digit manufacturing industry.

The relative size formulation thus paradoxically facilitates the creation of new 4-digit industries in the Manufacturing Division, where the SIC system is already highly developed. Conversely, it inhibits their formation in the services and distribution sectors where the fastest economic growth is occurring. The economic significance test biases the whole SIC system against recognizing new industries outside the traditional goods-producing sectors. This is a major defect in a U.S. economy that is increasingly devoting its resources to the production of services.

The Canadian size criterion, described above, does not contain a bias toward establishing new manufacturing industries, since the size cut-off rule (\$60 million, Canadian) applies across all sectors. One might also define a size rule as some fraction of gross domestic product, or total employment.

A related issue is whether the economic significance criterion should be applied nationally or on some subnational basis. All statistical agencies operate under disclosure restrictions. Publication disclosure rules that are satisfied nationally may be violated at subnational levels. If industry size is to be a criterion for a future classification system, should that size criterion be imposed so as to assure the availability of regional or state industry data? If so, disclosure rules would require that new industries meet a larger national size standard than might otherwise be the case.

Finally, is the size of an industry an adequate way of representing its economic significance? A small industry may have an economic significance out of proportion to its value of shipments, employment, payroll, and so forth. An "objective" application of an economic-size criterion might eliminate information on a small industry that is important for the understanding of productivity, technical change, and U.S. international competitiveness.

### The Committee's Position

If economic significance is a technical criterion for establishing 4-digit industries, then it is necessary to demonstrate that the present economic significance measure results in appropriate industries, or that modifications to it create a more nearly appropriate set of industries. The economic significance measure should be evaluated by the concepts that are to underlie the classification system, and the results from its application should be evaluated according to the intended uses of industrial statistics (ECPC Issues Paper No. 1 discusses concepts for industry classification systems). It is not clear that the size measure of economic significance used in the past provides an adequate *technical* criterion for recognizing and delimiting 4-digit industries.

If size is strictly a *pragmatic* consideration, on the other hand, as it is in the Canadian SIC, one may not need a complex formula. Industry size would merely place a common-sense limit on the amount of industrial data that can be collected and published.

### Request for Comment

The Committee welcomes comments on all aspects of the existing economic significance criterion

for defining industries.

- Are the size variables (number of establishments, value of shipments, value added, employees, payroll) appropriate, or should they be supplemented or replaced by other measures?
- Should different size variables be used in different sectors of the economy? Should the appropriate size variables for services, distributive and network industries, and other nongoods producing industries be the same as those traditionally used for the manufacturing and other goods producing sectors?
- Should weighting of the size variables be dropped or modified? Should the relative size, ratio form calculation (expressing the industry's size relative to the average industry size in its own SIC Division) be dropped or modified?
- Should the historical thresholds (the weighted size measure of 20 percent for forming new industries and 10 percent for retaining old industries, both measured relative to the size of the average 4-digit industry within major divisions) be retained, or should some other approach be followed?
- Should the United States adopt a size criterion similar to or adapted from the Canadian method? That is, should industry size be a pragmatic, flexible rule for limiting collection costs, rather than a major principle employed in developing and maintaining the system?
- Should the classification system place more emphasis on reacting quickly to new and emerging industries, and place less emphasis on a mechanical size rule, with the inertia that it implies for recognizing new and emerging industries? If so, what criterion should be used?

Recommendations regarding alternative criteria of economic significance that address the concerns with existing practices are also sought.

#### 4.2 Specialization and Coverage Ratios

Specialization and coverage ratios, taken together, are the second major criterion used in past SIC revisions. Specialization and coverage ratios are descriptive statistics that have served in the past as measures of homogeneity in industrial classification.

These ratios in the United States are calculated only for manufacturing industries, because the necessary data have not been available for nonmanufacturing sectors.

The *specialization ratio* measures the degree to which the establishments in a given industry concentrate on the primary products that define that industry (the SIC Manual [8] lists each 4-digit industry's primary products, though these are not always complete listings). The numerator of an industry's specialization ratio states the value of shipments of the industry's primary products by establishments classified in the industry; the denominator states the value of such shipments for the industry's primary and secondary products combined. For example, the Steel Works, Blast Furnaces (Including Coke), and Rolling Mills industry (SIC 3312) has a specialization ratio of 98 percent. This means that for establishments classified in the steel works, blast furnaces, and rolling mills industry, 98 percent of their value of shipments derives from the primary products of this industry. Only 2 percent of this industry's shipments consist of secondary products, that is, products that are produced by establishments in SIC 3312 but are primary products in other 4-digit SIC industries.

The *coverage ratio* measures whether the establishments classified in an industry account for a high proportion of the economy's shipments of the primary products on which the industry is defined. The numerator of an industry's coverage ratio states the value of shipments for the industry's primary products (same as the numerator for the specialization ratio); the denominator of the coverage ratio states the total value of shipments of those same primary products, wherever those products are made within the Manufacturing Division (any production of these products outside the Manufacturing Division is not used in the calculation). For example, the coverage ratio for SIC industry 2515, Mattresses, Foundations, and Convertible Beds, is 83 percent. This means that 83 percent of the Manufacturing Division's total shipments of the mattress and bedspring products that are primary to SIC industry 2515 are actually produced in SIC 2515. The remaining 17 percent of these products are produced as secondary products in other manufacturing industries.

Specialization and coverage ratios are used as measures of the appropriateness of an industry

definition. In the United States, an industry is recognized only if the specialization ratio is at least 80 percent and, in general, the coverage ratio is at least 70 percent. However, as explained in the Appendix, the threshold value for the coverage ratio differs according to whether the products are made for commercial sale, for consumption within the same establishment, or are made from purchased materials.

In the United States, only the census of manufactures collects the extensive product information needed to calculate specialization and coverage ratios. Comparable product or services data are not collected in the economic censuses for the nonmanufacturing sectors, i.e., only primary product information is collected. For this reason, specialization and coverage ratios are available only for manufacturing industries. Moreover, the ratios are calculated only for establishments that have payrolls. In some industries, though probably not many manufacturing ones, sales from sole-proprietor, nonemployer firms may be substantial. Finally, miscellaneous receipts derived from other than primary or secondary products are not used in the calculation of the specialization ratio.

Canada also calculates specialization and coverage ratios, generally using the same methods as the United States. In some instances, however, the Canadians calculate specialization and coverage on an "economy-wide" basis, in contrast to the United States, where the calculations are made only within the Manufacturing Division. Canada requires that the specialization ratio be at least 70 percent, and the coverage ratio be at least 75 percent for 4-digit industry status. In addition, the Canadians use the coverage ratio at the 3-digit, 2-digit, and divisional levels as a rationale for assigning certain activities within the classification, e.g., tire retreading is placed in the Canadian wholesale trade in tires industry because the latter in Canada is the major producer of retreads.

## Discussion

Specialization and coverage ratios are useful, but have limitations.

### (a) Primary and secondary product definitions

Ambiguity arises because specialization and coverage ratios are each a function of the way the industry's primary products are defined. This matter is somewhat complex and may be illustrated with a hypothetical example.

Suppose that two new industries are being considered, for which specialization and coverage ratios are to be computed. The two industries produce six distinct goods and services, designated as A, B, C, D, E, and F. The two industries under consideration contain only establishments that produce goods A, B, C, and D, but the products E and F are primary to other 4-digit industries. Hypothetical data are presented in Table 1.

In Table 1, products A and B are defined as primary products in industry 1. Establishments in industry 1 also produce as secondary products C and E (secondary products are products that are primary to another industry). Products C and D are primary to establishments in industry 2, with products A and F being secondary to this industry.

The specialization ratio for industry 1, as calculated from data in Table 1, is 73,  $[(A+B)/(\text{total production in industry 1})=(48+25)/100]$ ; for industry 2, the specialization ratio is 75,  $[(C+D)/(\text{total production in industry 2})=(30+45)/100]$ . In this example, neither set of establishments achieves the required specialization ratio (80 or above) for designation as a 4-digit industry.

The coverage ratios for industries 1 and 2 are 94,  $[(25+48)/(25+48+5)]$ , and 91,  $[(30+45)/(30+45+7)]$ , respectively. Note that the coverage ratio is high for industry 1 because product C does not appear in the denominator of industry 1's coverage ratio (product C is defined as a secondary product in industry 1).

One can increase an industry's specialization ratio by redefining its secondary products as primary. This is depicted in Table 2. The two sets of establishments produce exactly the same products as in Table 1. However, product C, a product that is made in both industries, is now designated as primary to both industries.

Assume that no new establishments are moved into industry 1 as the result of the change in industry definition, so the data in Table 1 remain unchanged. With product C now being primary to industry 1, the

**TABLE 1**

	Primary products				Secondary products				Total production
	A	B	C	D	A	C	E	F	
Industry 1	25	48				7	20		100
Industry 2			30	45	5			20	100

**TABLE 2**

	Primary products				Secondary products			Total production
	A	B	C	D	A	E	F	
Industry 1	25	48	7			20		100
Industry 2			30	45	5		20	100

specialization ratio of industry 1 increases to 80,  $[(25 + 48 + 7)/100]$ , because the output of product C is added to the numerator of the ratio (the denominator remains unchanged). The specialization ratio of industry 2 is unchanged from the first example, because product C was already among this industry's primary products in Table 1.

The same change reduces the coverage ratio for industry 1. In Table 2, industry 1's coverage ratio declines to 70,  $[(25 + 48 + 7)/(25 + 48 + 7 + 30 + 5)]$ . This change occurs because product C is now defined among industry 1's primary products. Generally, the coverage ratio is computed on a wherever made basis, so the total output of product C (7 in industry 1 and 30 in industry 2) is added to industry 1's denominator. For industry 2, the coverage ratio remains the same, again because product C was already included in its list of primary products.

In this instance, industry 1 qualifies for 4-digit industry status because both specialization and coverage ratios meet the minimum values. Industry 2 still does not qualify as a 4-digit industry because its specialization ratio remains below 80.

If, in a third example, product A is also defined as being primary for both industries, the specialization and coverage ratios would change for industry 2, analogously to the example already given for industry 1. With this further change in definitions, each industry has specialization and coverage ratios that meet or exceed the thresholds,

and both qualify for designation as a separate 4-digit SIC industry.

Table 3 presents the specialization and coverage ratios for each of the three examples discussed above.

Products may be primary to more than one industry in the present system for several reasons. An explicit example in the SIC is a product made from produced versus one made from acquired (transferred or purchased) inputs, e.g., iron and steel forgings. Forgings are made in integrated steel works (SIC 3312), establishments that manufacture pig iron and steel intermediate products from raw material inputs. Integrated steel works can produce semi-finished and finished products from those intermediate products. Forgings are also made in forging establishments (SIC 3462), establishments that manufacture semi-finished and finished iron and steel products only from intermediate iron and steel product inputs. The SIC definition of these primary products includes an "industry-of-origin" qualifier.

In addition, in the SIC identical primary products occur in different 4-digit industries implicitly, without an "industry-of-origin" qualifier. This occurs whenever products are made in different SIC divisions. For example, microcomputers are produced in establishments in the Manufacturing Division, and are also assembled in the Wholesale Trade and in the Retail Trade Divisions.

**TABLE 3**

	Example 1		Example 2		Example 3	
	Industry		Industry		Industry	
Ratio	1	2	1	2	1	2
Specialization	73	75	<b>80</b>	75	<b>80</b>	<b>80</b>
Coverage	94	91	<b>70</b>	91	<b>70</b>	71
Status	fails	fails	<b>qualifies</b>	fails	<b>qualifies</b>	<b>qualifies</b>

Auxiliary establishments are another example where implicit reporting of a product as primary to two or more industries may occur. The data for auxiliary establishments are reported at the 4-, 3-, or 2-digit level along with the data on the establishment, or of the company or enterprise, for which the auxiliary performed its support services. The same type of activity can appear in the services division as well, as for example, a business services industry. Each of these three examples of a product primary to more than one 4-digit industry, poses problems in the calculation and in the interpretation of specialization and coverage ratios.

In summary, both specialization and coverage ratios depend to an extent on the way that primary and secondary products are defined. This dependence on the definition of primary products limits the usefulness of specialization and coverage ratios as a criterion for defining 4-digit industries.

In Canada, the specialization and coverage ratios are only viewed as measures of homogeneity that are necessary, but not sufficient, for the existence or creation of industries within the classification. They are regarded as useful tools, rather than as statistical tests of industry definition.

**(b) Other considerations**

In certain cases in the United States classification system, the determination of the coverage ratio's denominator differs from the calculations presented in the above tables.

To take an example that is already familiar from earlier ECPC issues papers, the coverage ratio for SIC 2061 (cane sugar products made from sugarcane) is 100 percent, because in this case the coverage ratio is defined on cane sugar products; only SIC 2061 establishments make cane sugar products from

sugarcane. If instead the coverage ratio were defined on sugar products, wherever made, without distinguishing the raw material or production process used, the coverage ratio for SIC 2061 would be far lower (22 percent), because establishments in SIC 2061 produce only a fraction of U.S. sugar production.

Generally, production outside of the Manufacturing Division is not used in the coverage ratio, even when data are available. The bread, cake, and related products industry, SIC 2051, has a reported coverage ratio of 99 percent. Bakery products are also made in grocery stores, SIC 5411, and in retail bakeries, SIC 5461, which are industries in the SIC Retail Trade Division. Inclusion of bakery production now in the Retail Trade Division would decrease the coverage ratio of SIC 2051 to 66 percent. In this case, the class of purchaser of the bread is distinguished in the computation of the coverage ratio (manufacturing bakeries sell to retail stores, rather than to the final consumer).

If a demand-based, market-oriented industry classification were adopted, then an industry's specialization ratio would probably be low, though its coverage ratio could be high. For example, a "food-wrapping" industry might include waxed paper, oiled paper, greaseproof wrapping paper, aluminum foil, frozen food bags, and glassine bags (all of which are now in different 4-digit SIC industries). The specialization ratio would be low for the proposed food-wrapping industry because the establishments that make food wrappings also make items such as plastic films, printing paper, building paper, aluminum sheets and coils, trash bags, and grocer's bags, among other products. None of these products would be considered as primary products in a food-wrapping industry.

These examples suggest that the economic concept embodied in the coverage ratio, especially, is not well specified. In many cases, the denominator of the coverage ratio reflects the extent of the market. Iron and steel forgings with similar uses are close substitutes whether or not they are made in steel mills (SIC 3312) or elsewhere (SIC 3462); the coverage ratio includes both sets of products and so is calculated on an extent-of-the-market basis. Yet, cane and beet sugar are also good substitutes, and in these cases the coverage ratio does not extend to the limits of the market for sugar. And though a retail bakery (SIC 5461) may often produce a different line of bakery products from a manufacturing bakery (SIC 2051), in other cases it is not clear whether the coverage ratio now computed for SIC 2051 is broad enough to capture the extent of the market for bakery products.

Section 4.4 has a more extended discussion of economic concepts in relation to specialization and coverage ratios.

### 4.3 Other Criteria

Other criteria have been employed in past revisions of the SIC system. These "statistical and administrative criteria" are in the SIC Manual ([8], pp. 702-3), and include the following:

- Most past revisions to the SIC have focused on changes at the 4-digit level, and have followed the principle that disruptions to the existing hierarchical, 3- and 2-digit industry group configurations be minimized. "Changes to the basic two- or three-digit structure require exceptionally strong justification showing that they reflect changes in the economy and not simply a different view of what the basic structure should be" ([8], p. 700).

Though the economy has changed greatly in the past 50 years, the overall hierarchical structure of the system retains essentially the structure that was laid down when the SIC was established in the 1930's and 1940's. Such long-term stability in the hierarchical structure has often been criticized for ignoring major changes in the production and delivery of goods and services. Those who feel that the hierarchical structure should be changed obviously urge abandoning the criterion that minimizes hierarchical disruptions to it. The

hierarchical structure of classifications is the topic of ECPC Issues Paper No. 2, "Aggregation Structures and Hierarchies" [3].

- Collectibility is one limitation on past revisions to SIC industries. Proposed changes to the classification are inevitably constrained by the availability of data. If the required data cannot be obtained, then the changes cannot be implemented. ECPC Issues Paper No. 3, "Collectibility of Data" [3], discusses these constraints on the classifications.
- A criterion of historical continuity has served to preserve, so far as possible, consistent time series in the 4-digit SIC industries. ECPC Issues Paper No. 5, "The Impact of Classification Revisions on Time Series," discusses time series continuity.
- Particular attention was given in the 1987 SIC revision to proposals that identified new, emerging, or growing industries and to proposals that were likely to increase international comparability. International comparability is the subject of ECPC Issues Paper No. 7, "International Comparability" (forthcoming).
- Potential industries were evaluated to assure that the classification of individual establishments coded to an industry would remain relatively stable over time.

The final criterion listed above, the stability requirement, is intended to minimize switching of establishments from one industry to another when very little change in their basic economic activities has occurred. In practice, the evaluation of stability draws upon the experiences of statistical agencies in the coding of establishments to industries.

### Request for Comment

The Committee recognizes that comments on the first three of the criteria discussed in section 4.3 substantially duplicate comments on ECPC Issues Paper Nos. 2 and 5. Nevertheless, the Committee welcomes all comments on previous SIC criteria, and it also seeks proposals for new criteria for accepting changes in the definition of industries. Insights are sought regarding benefits

provided by historical continuity in the SIC hierarchy and historical continuity in 4-digit industries versus the costs imposed by ignoring changes in the economy over time.

#### 4.4 Alternative Criteria for Determining Industries

Classification systems are developed to group "like" activities together. Every classification system needs a rule or rules for determining which activities are "like," rules for defining homogeneity. Additionally, the groupings on "industries" that result from application of the system's homogeneity rules should be capable of evaluation by some statistic or statistical test, at least in principle.

##### (a) Homogeneity measures and conceptually-based classification systems

For a conceptually-based system, the definition of homogeneity depends on the concept that underlies the classification. For a production-oriented (supply-based) concept, an industry would be considered homogeneous if it contains only establishments that utilize similar production processes (see the discussion of economic concepts for classifications in ECPC Issues Paper No. 1, section 1.2). For a supply-based industry, an appropriate statistical test is one that distinguishes whether establishments have similar production processes (similar production functions).

For classifications erected on a market-oriented (demand-based) concept, homogeneity requires that the products within the grouping compete in the same market, or that the products within the grouping be close substitutes or are products that are used or distributed together. For a demand-based grouping, appropriate statistical tests are those that distinguish the extent of markets, the extent or degree of substitution among products, or that distinguish whether products belong together in a grouping according to use.

##### (b) Conceptually-based systems and specialization and coverage ratios

As noted in section 4.2, in past U.S. SIC revisions, specialization and coverage ratios have been used to determine homogeneity for 4-digit industrial classifications. One might interpret, in a

rough and ready sense at least, specialization and coverage ratios within a conceptual rationale.

A production-oriented grouping of establishments would probably exhibit a high specialization ratio, since similar production processes likely produce similar products. For example, SIC 2211, Broadwoven Fabric Mills, Cotton, probably represents a grouping of establishments having very similar production processes, and this industry has a specialization ratio of 87 percent.

The coverage ratio for supply-based groupings, however, might be low because other production processes could produce products that are close substitutes. For example, the Broadwoven Fabric Mills, Manmade Fiber and Silk industry (SIC 2221) produces fabrics that are substitutes for cotton fabrics in many uses. Accordingly, the coverage ratio for cotton fabric mills would be low if the coverage ratio were defined on the market for fabrics (rather than on just cotton fabrics).

In contrast, an appropriately defined market-oriented grouping of commodities might exhibit a low specialization ratio and a high coverage ratio. A "food wrapping" industry, for example, would group producers who do not necessarily specialize in food wrappings because their products have other uses. But the food wrapping industry could be defined to have a high coverage ratio.

An "ideal industry" is a grouping of establishments and products that meets both production and market-oriented concepts. One would expect an ideal industry to have both high specialization and high coverage ratios. Malt Beverages (SIC 2082) has a coverage ratio of 100 percent and a specialization ratio of 99 percent.

This rationale for specialization and coverage ratios does not explicitly appear in previous SIC revision materials. The rationale suggests that specialization and coverage ratios could have value, even in a conceptually-based classification system. It also suggests that when specialization and coverage ratios were developed the guidelines the developers were using might have connections with the economic framework developed in ECPC Issues Paper No. 1.

Nevertheless, section 4.2 identified ambiguities in specialization and coverage ratios, including their dependence on the way an industry's primary and secondary products are defined. They clearly are

not adequate, used by themselves, to determine conceptually-based economic classifications. In Statistics Canada's usage, specialization and coverage ratios are not used to identify the appropriate groupings; they are pragmatic measures used to verify industry coding of data, and serve as editing devices once a classification is defined and the appropriate groupings have been constructed.

### (c) New statistical methods for economic classifications

Other statistics, and statistical tests, apply to classification systems that are erected on economic concepts. For evaluating supply-based industries, several recently-developed statistical techniques appear promising.

For an economic classification based on a production-oriented concept, the criterion for grouping is similarity of production functions among establishments, as noted above and described in ECPC Issues Paper No. 1. Production functions are mathematical descriptions of production activities. In the Cobb-Douglas production function, inputs--raw materials, labor, capital equipment and buildings, and energy--adapt to changes in the relative prices of those inputs in such a way that the value-shares of the inputs remain constant (the value-share of labor, for example, is the total labor cost divided by the total cost of all of the inputs). Input value-shares can also be computed for more detailed definitions of inputs, distinguishing different labor categories, types of capital equipment, or forms of energy. Input value-shares can approximate more complex production functions, such as the translog (Christensen, Jorgenson, and Lau [2]), under some conditions.

As Gollop (Williamsburg Conference [5], p. 498) put it: "Assuming producers face identical input prices, differences in factor shares among establishments [imply] different production functions. In short, as a first approximation, differences in input cost shares among establishments assigned to an industry identify the extent of technical heterogeneity within that industry."

Gollop [4] proposed a diversification index as a statistical test of the heterogeneity in a production-based grouping of establishments; this test was explored in Gollop and Monahan [6]. Establishment homogeneity, in the Gollop and Monahan sense, is based upon the hypothesis that establishments that

employ similar production processes will exhibit similarities in their mixes of inputs. The test evaluates the value-shares of inputs among establishments as the means of determining which establishments should be included in a particular industry, and permits quantifying the "extent of technical diversity" among those establishments ([4], p. 366).

The Gollop-Monahan diversification index equals zero if input-cost shares are identical among all the establishments. The greater is the heterogeneity among a proposed grouping of establishments, the larger is the diversification index, and the less appropriate is the proposed industry.

The Gollop-Monahan diversification index could also be used in another way: Suppose we identify an industry, such as Farm Machinery and Equipment, SIC 3523, that groups establishments together because their products serve similar users (in this case, farmers). This is, then, a demand-based industry (see ECPC Issues Paper No. 1). The diversification index could be used to answer the question: How far is this market-oriented industry from meeting the test for a production-oriented, or supply-based, industry? The answer would help to determine when compromises or departures from the conceptual framework might be acceptable because they are, in a quantifiable sense, "small."

Abbott and Andrews [1] and Walter and Rives [9] use somewhat different assumptions about production functions to test for similarity of production processes among 4-digit industries. The authors assume that a homogeneous good is produced with fixed input proportions and evaluate observed differences in input proportions over time. Their test criterion is the presence of constant input proportions, rather than constant value-shares of inputs, as in the Gollop-Monahan test.

A demand-based classification system should employ statistical tests of homogeneity that are appropriate for the demand-based concept, and of course these statistical tests would differ from those used for testing supply-based industries for homogeneity. A demand-based industry can arise in several forms, and each form implies a different statistical test.

The most complex version of demand-based grouping, functional aggregation, implies statistical

tests for what is known as "functional separability" (see Issues Paper No. 1, section 1.2). Separability tests are difficult to carry out and require estimating demand functions for large sets of products. Such tests are in principle feasible, however, and might have applicability in some sectors of a demand-based system.

A second demand-based aggregation rule, grouping of close substitutes, requires estimates of substitution elasticities among a large set of products. Statistical data on the degree of substitution among commodities, wherever such information exists, would be useful in constructing a demand-based system, and might provide useful guidance for some sectors of a demand-based aggregation system.

Finally, ECPC Issues Paper No. 1 notes the application of "Hicksian aggregation" principles to a demand-based or market-oriented grouping system. In this case, products included in the grouping are taken as homogeneous if their prices move together. Jaditz [7] tests 4-digit SIC industries for Hicksian aggregation by examining product price movements, using detailed U.S. producer price index (PPI) information, to determine the degree of similarity among the price histories of goods. Jaditz finds "less coherence in prices over time" in the 4-digit SIC's than would be expected of market aggregates and, also, that "classification schemes based on similarities in price histories bear little resemblance to the SIC classification scheme" ([ibid.], Abstract).

With the exception of tests for Hicksian aggregation, available demand-based tests are more difficult to apply than supply-based tests such as the Gollop-Monahan diversification index.

### The Committee's Position

The Committee believes that statistical methods for testing the homogeneity of economic groupings should be used if a conceptually-based approach is adopted for the classification system. However, the statistical methods that have been developed cannot be relied on solely at the present time.

For one thing, these methods are all relatively new and will no doubt receive further technical development. For another, they often have rigorous data requirements. For example, the Gollop-Monahan diversification index requires detailed information on production inputs and on establishment expenditures for inputs, which is not available for all

sectors of the economy in the detail required by the test. For a third reason, the tests require relatively intensive work by statistical agency personnel, and only a small portion of the 4-digit industries could be examined statistically in time for the 1997 Economic Censuses. Finally, institutional knowledge about industries, about production processes, markets, and so forth, will always be important in a classification system, because even with statistical tools, institutional knowledge about the industries must be applied to guide the statistical investigation.

Thus, the Committee believes that the recently-developed statistical methods described in this section should receive further development and application to classification purposes. At present, however, they will of necessity supplement, rather than replace, more traditional analyses of industries and groupings.

### Request for Comment

The Committee solicits suggestions that will improve statistical tests for classification purposes, or that will develop new methods for statistical examination of classification issues. The Committee may consider, if funds are available, research proposals for developing such statistical tests.

### References

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# Economic Classification Policy Committee

## APPENDIX Issues Paper No. 4

### Economic Significance and Specialization and Coverage Ratios: Historical Notes and Detailed Examples

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#### Background

For the 1957 Standard Industrial Classification (SIC) revision, the Bureau of the Budget (predecessor of the Office of Management and Budget, or OMB) established the Committee on Criteria for Recognizing an Industry to set guidelines for establishment of an SIC industry. The Committee developed a set of technical "criteria" for evaluating proposals for new SIC industries. At that time, only two technical criteria were promulgated, economic significance, or size of the industry, and specialization and coverage ratios.

According to the 1957 SIC Manual, "To be recognized as an industry, each group of establishments must have significance from the standpoint of number of production workers, value added by manufacture, value of shipments, and number of establishments. Size of an industry is not the sole criterion for its recognition. It is also important that an industry comprise a group of establishments of which the output of products or processes defining the industry (primary products of the industry) account for a relatively high proportion of (a) the total shipments or receipts of the industry (specialization ratio), and (b) the total output by all industries of the products or processes which are primary to the industry (coverage ratio)" ([4], p. 431). The 1972 SIC revision extended the economic significance criterion to the nonmanufacturing sectors of the economy, and added payroll to the measures of economic significance.

For the 1987 SIC revision, the guidelines for reviewing proposed changes to the SIC were expanded to include the following additional elements:

- Maintenance of the existing SIC structure;
- Historical continuity;
- Other statistical considerations; and
- Administrative considerations.

Nevertheless, the original two criteria--that is, economic significance and specialization and coverage ratios--were specified as the "major criteria." These major criteria are described in the following sections.

#### Economic Significance

Economic significance is a measure of the size of an industry in relation to the average size of all industries included in its SIC division (manufacturing, retail, etc.). For 1987, the major components necessary to derive economic significance were:

- (1) Number of establishments - An establishment is an economic unit, generally at a single physical location (for example, a farm, mine, factory, or store) from which data on employment, payroll, and volume of business can be gathered.
- (2) Number of employees - Employment includes all full- and part-time employees on the payrolls of the establishments.
- (3) Payroll - Payroll includes the gross earnings of the employees of the establishments, excluding nonwage compensation.
- (4) Value added - Value added, used for manufacturing establishments only, is derived by subtracting the cost of materials, containers, fuel, purchased electricity, and contract work from the value of shipments. The result of that calculation is adjusted by the addition of the difference between sales value and cost of merchandise sold without further manufacturing, processing, or assembly, plus the net change between the beginning and end-of-year finished goods and work-in-process inventories.
- (5) Volume of business (value of shipments or receipts) - Volume of business, depending on the division, includes value of shipments or receipts.

Value added and number of employees were considered the more significant and reliable measures of industry importance. The 1957 SIC Manual explains: "Value of shipments includes the value created in other industries or other economic divisions such as Agriculture, etc., and does not measure value of income produced in the specific manufacturing industry. In some instances, the large duplication of value of shipments within an industry makes publication of the figure meaningless. A count of establishments in each industry is of limited significance as it treats both large and small establishments as of equal importance. In addition, the derivation of an 'average' number of establishments per industry reflects to a large extent, the very numerous plants in a relative few industries" ([4], p. 432).

To measure economic significance of an industry, each of the above five variables is first expressed as a ratio relative to the same variable's average value for the SIC Division (mining, agriculture, manufacturing, services, etc.) into which the industry falls. To provide an example of the calculations, table 1 refers to a proposal (in the 1987 SIC revision) for a new manufacturing industry consisting of establishments primarily engaged in manufacturing potato chips, corn chips, and similar snack foods.

Based on 1982 Census of Manufactures data, the proposed snack food industry's number of establishments--230--was 29 percent of the average number of establishments in industries in this division (column C of the table). Similarly, the 26,700 employees in the snack food industry were 62 percent of average employment for manufacturing industries, the industry's payroll was 52 percent of the average for manufacturing industries, and so forth.

To determine the final economic significance "score" for an industry, the separate ratios, as described above, are then weighted together using the factors listed in column D of the table. These weights were developed in 1972. As noted above, value added and number of employees were considered better measures of size, and they were therefore given double weight when calculating the final score.

When weights are applied to the five relative size measures described above, this results in a "score" for the snack food industry of 413 points (the sum of column E in the table). When this total

is divided by the sum of the weights (7 from column D), it yields a weighted average, or point score, of 59. By the relative size measure, the proposed snack food industry is 59 percent of the size of the average manufacturing industry.

In 1957, the Committee on Criteria for Recognizing an Industry determined that an existing industry is "considered as sizable if it attains a point score of 10 or higher. The point score for a new industry is 20 or higher . . . . The final score is a measure in percent of the size of an industry in relation to an 'average industry'" (ibid.). These scoring cutoffs remain the standard used in the 1987 SIC revision. Thus, the proposed new snack food industry was deemed economically significant by the 1957 criterion.

The test of economic significance for determining industries has provided for gradual changes in the U.S. industrial classification structure. At the same time, it has provided for continuity in the system by assigning a lower average score for the continuance of an existing industry than that needed for the recognition of a new industry.

Economic significance, used as a measurement tool, spotlights the declining/rising industries in the economy during the review and revision process. It also assures that an industry is well established before it is recognized in the SIC, but the concept of economic significance can only be used when data are available. For example, information on a potential snack food industry was available from the census of manufactures because detailed product information was collected for these items. If that detailed product information had not been available, it would have been very difficult to determine if the potential industry met the criterion of economic significance.

### Specialization and Coverage Ratios

The "primary product specialization ratio" and the "coverage ratio" serve as the current industrial homogeneity measures. These criteria relate only to manufacturing.

The specialization ratio measures the degree to which the establishments in a given industry concentrate on activities that define the industry. The specialization ratio is calculated by dividing the value of the primary product shipments of the establishments classified in the industry by the

Factor	Proposed industry	Average industry	Relative size (A/B) (percent)	Weights	Weighted points (CxD)
	(A)	(B)	(C)		(E)
Number of establishments	230	796	29	1	29
Number of employees (thousands)	26.7	43.0	62	2	124
Payroll (million dollars)	301.3	584.0	52	1	52
Value added (million dollars)	934.5	1,295.0	72	2	144
Shipments (million dollars)	1,929.0	3,006.0	64	1	64
Sums (where relevant)				7	413

$$\frac{413}{7} = 59 \text{ percent (Weighted average)}$$

value of all shipments (both primary and secondary, but excluding miscellaneous receipts) for the same establishments. A proposed new 4-digit SIC industry must have a specialization ratio of 80 percent. When an industry has a specialization ratio of 80 percent, the 80 percent of the shipments of establishments classified in that industry consist of products that are primary to that industry (primary products), and 20 percent are secondary products (products that are primary to some other industry).

The coverage ratio measures the proportion of products that define an industry that originate from the establishments classified in that industry. In the coverage ratio, the proportion of products defining the industry shipped by establishments classified in the industry is the numerator; total shipments of these products by all manufacturing establishments in the economy is the denominator ([3], p. 701-2).

Required coverage ratios, developed by the 1957 Committee, are in table 2.

The following example illustrates the use of specialization and coverage ratios. In 1987, establishments classified in SIC 3612, Power, Distribution, and Specialty Transformers, shipped

transformers valued at \$3125.0 million. Total shipments of these same establishments (i.e., transformers as well as secondary products that also are produced in SIC 3612) amounted to \$3289.5 million. This means that 95 percent of the shipments of establishments in SIC 3612 comprised the primary products (transformers) that define the industry and only 5 percent are secondary products to SIC 3612.

The coverage ratio for SIC 3612 was 98 percent. Shipments of transformers by all industries totaled \$3188.8 million in 1987, of which \$3125.0 million were transformers shipped by establishments in SIC 3612. This 98 percent coverage ratio indicates that establishments that specialize in transformers and are classified in SIC 3612 account for most of the economy's production of those products.

Taken together, coverage and specialization ratios and the test of economic significance are the major tools that have been used in the United States to determine whether 4-digit industries need to be defined, redefined, expanded, contracted, or eliminated.

Type of industry	Ratio (percent)
For commercial sale (for example, industry 3651, Household Audio and Video Equipment)	70
For industries having significant interplant transfers or consumption for use within the same establishment (for example, industry 3321, Gray and Ductile Iron Foundries)	50
For industries producing from purchased materials which are differentiated by stage of process (for example, industry 2045, Prepared Flour Mixes and Doughs)	33

#### A Comparison Between Guidelines Used for Establishing Industries in the U.S. SIC and the Canadian SIC

In Canada, as in the United States, specialization and coverage ratios and a test for economic significance are used as guidelines to delineate industries. There are some differences, however, in their applications in the two countries.

In Canada's 1980 SIC revision, the economic significance measure comprised only gross output, the equivalent of the U.S. value of shipments. Generally, there were different guidelines in Canada for existing industries and potential new industries. An existing industry with more than \$60 million (Canadian) of output, using 1975 data, was retained. Those industries below the threshold were reviewed and some were recognized if there were analytical reasons for doing so. For example, small but stable existing industries might still be retained. Growing or emerging new industries might be recognized if in future they were expected to become significant. The threshold for recognition was based on a study of the smaller tail of the distribution of industries according to size of gross output. Table 3, provided by the Standards Division of Statistics Canada, presents the Canadian economic significance guidelines.

Canada's calculations of specialization and coverage ratios are similar to the U.S. calculations. An industry in Canada may be recognized if the specialization ratio is 70 percent and the coverage ratio is 75 percent (compared with 80 percent and 70 percent, respectively, in the United States).

There are some differences in the way in which the ratios are computed. The *Concordance Between the Standard Industrial Classifications of the United States and Canada* explains this difference ([2], p. x). "Some manufacturing activity is performed both by units primarily engaged in manufacturing and by units that are primarily engaged in other activities. The U.S. calculations take account only of production by manufacturing establishments. For selected commodities, the Canadian calculations take account both of total production by manufacturing establishments and production as a secondary activity by wholesale establishments."

In Canada, specialization and coverage ratios are regarded as useful tools that are necessary, but not sufficient, for retaining or creating new industries. These measures are regarded as pragmatic, descriptive statistics that are based on easily available data and are therefore easy to calculate, at least for goods. They serve two purposes: (1) a necessary condition to define industries, and (2) a tool for implementing the classification. The specialization ratio in particular can be used to confirm the correct coding of establishments to industries. In Canada, the ratios are used in an automated system, to confirm SIC coding of the establishments covered by the Annual Surveys of Forestry and Manufactures.

In addition to these guidelines used by Statistics Canada to determine industries for their 1980 revision, two other criteria were employed. They are historical comparability and usefulness to applications of the SIC outside Statistics Canada.

Table 3.--Economic Significance Criteria for the 1980 Canadian SIC Revision		
Manufacturing		
Shipments \$ million Canadian in 1975	Existing industries	Proposed new industries
< 40	Delete	Reject
40 - 60	Look at trend	
> 60	Keep	Create

In the paper, "Criteria Used for the 1980 Revision" ([1], p. 1), Statistics Canada notes: "The major factors that determine the classification of industries are the analytical requirements of users on the one hand and the actual activities of establishments on the other . . . . The development of the revised SIC is then an iterative process of comparing analytical needs to actual industry structure. Each analytical requirement is expressed as a proposed set of new industry classes. To the extent permitted by the data, establishments are classified to these new classes and the objective criteria are calculated. If the criteria are not satisfied, the proposal may be abandoned or modified and the calculations repeated. If the criteria are eventually satisfied, the proposed structure is assessed against other proposals, with which it might conflict."

The U.S. published materials on SIC revision contain no comparable explicit statement recognizing analytical requirements of users, and instead present the guidelines as if they were objective criteria derived from economic structure. However, in practice, the committees who are responsible for revising the U.S. SIC codes begin with lists of proposals for new or modified SIC industries that come, for the most part, from public submissions.

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