Preview of the Comprehensive Revision of the Annual Industry Accounts

Integrating the Annual Input-Output Accounts and

Gross-Domestic-Product-by-Industry Accounts

By Brian C. Moyer, Mark A. Planting, Mahnaz Fahim-Nader, and Sherlene K. S. Lum

IN JUNE, the Bureau of Economic Analysis (BEA) will release the initial results of its comprehensive revision of the annual industry accounts. The centerpiece of this revision is the integration of the annual input-output (I-O) accounts and the gross-domestic-product-(GDP)-by-industry accounts for 1998–2002. For the first time, the annual I-O accounts and the GDP-by-industry accounts will be released concurrently and will present consistent measures of gross output, intermediate inputs, and value added by industry.

Integration can be achieved through a variety of methods. For example, many countries produce integrated annual I-O accounts and GDP-by-industry accounts by assuming that the industry ratios of intermediate inputs to gross output do not change from the most recent set of benchmark I-O accounts; these ratios are then used to estimate a time series of value added by industry from annual source data on gross output by industry. BEA has taken a different approach in developing an integration methodology because of the richness of the source data that are available in the United States; for example, the Bureau of the Census, the Bureau of Labor Statistics, and the Internal Revenue Service provide data that can be used to estimate value added by industry. However, the quality of these source data varies by data series and by industry; as a result, BEA has developed an integration methodology that ranks the available source data by quality and estimates a balanced set of annual I-O accounts and GDP-by-industry accounts that incorporate a weighted average of these source data on the basis of their relative quality. In this manner, BEA's integrated annual I-O accounts and GDP-by-industry accounts will provide a more consistent and a more accurate set of estimates.

This integration is the most recent improvement in a series of improvements to the industry accounts. As outlined in its strategic plan, BEA continues to make significant improvements to its industry accounts. These improvements include the following: Resuming the publication of the annual I-O accounts; accelerating the release of the annual I-O accounts to within 3 years after the end of the reference year; expanding the GDP-by-industry accounts to include gross output and intermediate inputs for all industries; developing an accelerated set of GDP-by-industry accounts that are available with a lag of just 4 months after the end of the reference year; and continuing to work closely with the Bureau of the Census on new initiatives to improve the quality and the timeliness of the source data used to prepare the industry accounts. With these improvements, general improvements to the quality of industry source data, and improvements to data-processing systems, BEA is now ready to integrate the annual I-O accounts and the GDP-by-industry accounts.[1]

This comprehensive revision undertakes the integration of the annual I-O accounts and the GDP-by-industry accounts, but BEA's long-run goal is the "full" integration of all the industry accounts, including the benchmark I-O accounts, and the integration of the industry accounts with the national income and product accounts (NIPAs).[2] Integration with the NIPAs will allow the industry accounts to provide annual feedback to the NIPAs that could potentially improve the commodity composition of GDP. Full integration is expected in the 2008–2010 timeframe when the neces-

---

1. For a discussion on integrating the industry accounts, see Robert E. Yuskavage, "Priorities for Industry Accounts at BEA" (paper presented at the meeting of the BEA Advisory Committee, Washington, DC, November 17, 2000). The paper is available at BEA's Web site <www.bea.gov>.

2. In addition, it is BEA's long-run goal to integrate the industry accounts and NIPAs with related regional accounts, namely gross state product (GSP) by industry and regional I-O multiplier estimates. Consistency between the annual I-O accounts and the GDP-by-industry accounts will improve the quality of the GSP accounts, and any increase in timeliness of the GDP-by-industry estimates will be reflected in more speedy delivery of the GSP estimates. Consistent and better measures of value added would also potentially strengthen the links between the GSP accounts and the regional I-O multiplier estimates.

sary data on intermediate inputs by industry will be available from the 2002 Economic Census and from the annual surveys that are currently being collected and tabulated by the Bureau of the Census.

This article presents the integration methodology that is being used for 1998–2002 and for future updates. An article in the June issue of the *Survey of Current Business* will describe the results of the comprehensive revision to the annual industry accounts, including the conversion to the 1997 North American Industry Classification System (NAICS) back to 1998 and the release of the accelerated GDP-by-industry estimates for 2003.[3]

Highlights of the integration methodology are as follows.

- It allows BEA to incorporate the most timely and highest quality source data into both the annual I-O accounts and the GDP-by-industry accounts.
- The annual I-O accounts and the GDP-by-industry accounts will be released concurrently for 1998–2002, and for the first time, both sets of accounts will present fully consistent measures of gross output, intermediate inputs, and value added by industry.
- The quality of the annual industry accounts will be improved because the accounts will be prepared within a balanced I-O framework; that is, all the components of the accounts will be in agreement within a balanced row-and-column framework.
- The release of the annual I-O accounts will be accelerated by 2 years in a sequence of two steps that will be completed by the fall of 2004, when they will be released 1 year after the end of the reference year.
- For the first time, the 1998–2002 annual I-O accounts will be a consistent time series; they will be more useful for analyses of trends over time.

This article is presented in two parts. The first part presents the rationale for integration. The second part describes the integration methodology.

The Rationale for Integration

BEA prepares two sets of industry accounts: The I-O accounts, which consists of the benchmark I-O accounts and the annual I-O accounts, and the GDP-by-industry accounts. Both the I-O accounts and the GDP-by-industry accounts present measures of gross output, intermediate inputs, and value added by industry; however, these measures have not been consistent across the two sets of accounts, because of the use of different methodologies and different source data.

The goal of the integration is to eliminate these inconsistencies and to improve the accuracy of both sets of accounts.

In this part, the methodologies used to prepare each set of accounts are reviewed, the relative strengths of each methodology are discussed, and the benefits of integrating the annual I-O accounts and the GDP-by-industry accounts are described.

I-O accounts methodology

The benchmark I-O accounts are prepared every 5 years and are based on data from the quinquennial economic censuses. These accounts present a detailed picture of how industries interact to provide inputs to, and use output from, each other to produce the Nation's GDP.[4] The annual I-O accounts update the most recent benchmark I-O accounts. The annual I-O accounts are more timely than the benchmark I-O accounts, but they are generally less detailed because they rely on annual survey data.[5] At present, the I-O accounts are prepared only in current dollars.[6]

Both the benchmark and the annual I-O accounts are prepared within a balanced row-and-column framework that is presented in two tables: A "make" table and a "use" table. The make table shows the commodities that are produced by each industry, and the use table shows the commodities that are used in industry production and that are consumed by final users. In the use table, the columns consist of industries and final uses (chart 1). The column total for an industry is its gross output (consisting of sales or receipts, other operating income, commodity taxes, and inventory change). The rows in the use table consist of commodities and value added. The commodities are the goods and services that are produced by industries or imported and that are consumed either by industries in the production process or by final users. The commodities consumed by industries in the production process are referred to as intermediate inputs (consisting of energy, materials, and purchased services). Value added in the I-O accounts is computed as a residual—that is, as gross output less intermediate inputs by industry. In concept, this residual, which represents the sum of the costs incurred and the incomes earned in production, consists of compensation

---

3. The June release of the comprehensive revision will not include accelerated annual I-O accounts for 2003.

4. For more information, see Ann M. Lawson, Kurt S. Bersani, Mahnaz Fahim-Nader, and Jiemin Guo, "Benchmark Input-Output Accounts of the United States, 1997," Survey of Current Business 82 (December 2002): 19–109.

5. For more information, see Mark A. Planting and Peter D. Kuhbach, "Annual Input-Output Accounts of the U.S. Economy, 1998," Survey 81 (December 2001): 41–70.

6. BEA is beginning research to explore the feasibility of preparing real (inflation-adjusted) I-O accounts.

Chart 1. Use Table: Commodities Used by Industries and Final Uses

	Industries																							Final Uses						Total Commodity Output
	Agriculture, forestry, fishing, and hunting	Mining	Utilities	Construction	Manufacturing	Wholesale trade	Retail trade	Transportation and warehousing	Information	Finance and insurance	Real estate and rental and leasing	Professional, scientific, and technical services	Management of companies and enterprises	Administrative and waste management services	Educational services	Health care and social assistance	Arts, entertainment, and recreation	Accommodation and food services	Other services, except government	Government	Total intermediate use		Personal consumption expenditures	Private fixed investment	Change in business inventories	Exports of goods and services	Imports of goods and services	Government consumption expenditures and gross investment	GDP	

Commodities
- Agriculture, forestry, fishing, and hunting
- Mining
- Utilities
- Construction
- Manufactured products
- Wholesale trade
- Retail trade
- Transportation and warehousing
- Information
- Finance and insurance
- Real estate and rental and leasing
- Professional, scientific, and technical services
- Management of companies and enterprises
- Administrative and waste management services
- Educational services
- Health care and social assistance
- Arts, entertainment, and recreation
- Accommodation and food services
- Other services, except government
- Government
- Other inputs /1/
- Total intermediate inputs

Value Added
- Compensation of employees
- Taxes on production and imports, less subsidies
- Gross operating surplus
- Total

Total Industry Output

■ Total commodity output

□ Total industry output

1. Includes noncomparable imports, scrap, used goods, inventory valuation adjustment, and rest-of-the-world adjustment.

GDP Gross domestic product

U.S. Bureau of Economic Analysis

of employees, gross operating surplus, and taxes on production and imports, less subsidies.[7] GDP equals valued added summed over all industries, and it also equals final uses summed over all commodities.

At BEA, the I-O accounts have traditionally served two major purposes, both of which have focused on information about the use of commodities. First, the accounts provide the NIPAs with best-level estimates for the commodities that compose GDP in a benchmark year. Second, they provide the NIPAs with information on the split between intermediate inputs and final uses of commodities for the years after a benchmark year, which is critical for GDP determination. GDP measures final uses, while most source data commingle intermediate-use and final-use information. Because of their importance in determining the levels of GDP in the NIPAs, the I-O accounts have traditionally focused more on the commodity composition of the economy and less on the measures of value added by industry.

GDP-by-industry accounts methodology

In contrast to the I-O accounts, the GDP-by-industry accounts have traditionally focused on the industry composition of the economy and the measures of value added by industry; therefore, the GDP-by-industry accounts are ideally suited for analysis of industry shares of GDP and contributions to GDP growth. The GDP-by-industry accounts provide time series estimates of gross output, of intermediate inputs, and of value added by industry and the corresponding price and quantity indexes.[8] Gross output by industry in these accounts is computed by taking best-level estimates from the most recent set of benchmark I-O accounts and by using the annual survey data as extrapolators.

The measures of value added by industry are derived from the industry distributions of the components of gross domestic income (GDI) from the NIPAs. The GDI-based measures of value added by industry represent the sum of the costs incurred and the in-

comes earned in production and are estimated as the sum of the industry distributions of compensation of employees, gross operating surplus, and taxes on production and imports, less subsidies. These industry distributions incorporate additional annual survey data and source data from annual tax returns and administrative records. In the GDP-by-industry accounts, intermediate inputs by industry are measured as a residual—that is, gross output less value added by industry. Finally, gross output and intermediate inputs by industry are deflated using detailed price indexes to produce price indexes and quantity indexes of gross output, of intermediate inputs, and of value added by industry.

Relative strengths of each methodology

The primary strength of the I-O accounts methodology is the balanced row-and-column framework in which the detailed estimates of gross output and intermediate inputs by industry are prepared; this framework allows for a simultaneous look at both the industry composition and the commodity composition of the economy. The primary strength of the GDP-by-industry accounts methodology is the direct approach to estimating a time series of value added by industry from high quality source data.

The strength of a balanced framework is demonstrated in chart 1. A balanced use table ensures that the industry estimates of the I-O accounts (the column totals) are in balance with the commodity estimates of the I-O accounts (the row totals). This framework tracks all of the detailed input and output flows in the economy and guarantees that each commodity that is produced is either consumed by industries as an intermediate input or is consumed by final users. An imbalance in the use table—for example, too little, or too much, supply of a commodity after intermediate inputs by industry and final uses have been accounted for—may indicate a problem with the measures of gross output or intermediate inputs by industry, so a balanced framework provides a "consistency check" for the data in the use table. The I-O accounts are prepared within a balanced framework, but currently, there is no comparable procedure to balance industries and commodities in the GDP-by-industry accounts.

The strength of the GDP-by-industry methodology is that the estimates of value added by industry are derived directly from high quality source data, so these measures generally provide better estimates of value added for industries for which the I-O estimates of value added are considered weak. Several factors affect the quality of the GDP-by-industry estimates on an industry-by-industry basis. For example, gross operating

---

7. Previously, these costs and incomes were classified as either compensation of employees, property-type income, or indirect business tax and nontax liability. These new classifications are consistent with the aggregations introduced as part of the comprehensive NIPA revision; see Brent R. Moulton and Eugene P. Seskin, "Preview of the 2003 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Classifications," SURVEY 83 (June 2003): 17–34. Specifically, all the nontax liabilities except special assessments are removed from indirect business tax and nontax liability, and the remainder of this category is renamed taxes on production and imports; the nontax liabilities except special assessments are added to property-type income; subsidies are removed from property-type income, and the remainder of this category is renamed gross operating surplus; and subsidies are netted against the value of taxes on production and imports.

8. For more information, see Sherlene K.S. Lum, Brian C. Moyer, and Robert E. Yuskavage, "Improved Estimates of Gross Product by Industry for 1947–98," SURVEY 80 (June 2000): 24–54.

surplus, one component of value added by industry, includes several items—such as corporate profits before tax, corporate net interest, and corporate capital consumption allowances—that are based on corporate tax return data from the Internal Revenue Service (IRS). Because the consolidated tax return data of an enterprise may account for activities in several industries, BEA must convert these enterprise-based, or company-based, data to an establishment, or plant, basis. The conversion can introduce errors because it is based on the employment of establishments that is cross-classified by enterprises and because it is based on relationships from an economic census year that are likely to change over time.

In addition, proprietors' income, another component of gross operating surplus, can introduce errors because the industry distributions of proprietors' income are based on incomplete source data. Industries with large shares of value added that are accounted for by proprietors' income are regarded as having estimates of value-added that are of lower quality.[9]

The GDP-by-industry value-added measures may be of a higher or lower quality than the value-added measure in the benchmark I-O accounts, depending on industry-specific information. For an industry with high quality data on gross output and intermediate inputs, the measure of value added in the benchmark I-O accounts may be better than the GDP-by-industry measure, particularly when the amount of enterprise-establishment adjustment for the industry is significant or when the share of proprietors' income in the industry is significant. Alternatively, for an industry with little enterprise-establishment adjustment and a small share of proprietors' income, the GDP-by-industry measure may be considerably better than the benchmark I-O measure, particularly if the coverage of gross output and intermediate inputs in the quinquennial economic census is low. For the 1997 benchmark I-O accounts, less than half of the economy-wide intermediate inputs were covered by the economic census; for many industries, this low coverage results in a lower quality measure of value added in the benchmark I-O accounts.

In contrast to the benchmark I-O measures, the GDP-by-industry value-added measures are always preferred to the annual I-O measures. The annual I-O estimates of intermediate inputs by industry are currently sparse and unable to yield high quality measures

of value added by industry.[10]

Benefits of the integration methodology

The integration methodology incorporates the relative strengths from both the I-O accounts and the GDP-by-industry accounts. It yields a set of annual I-O accounts and GDP-by-industry accounts that are prepared within a balanced framework and that incorporate the most timely and best source data, including the GDI-based measures of value added from the GDP-by-industry accounts. It ensures the consistency of the estimates of gross output, of intermediate inputs, and of value added by industry in both the annual I-O accounts and the GDP-by-industry accounts.

The benefits of integration, however, go beyond consistency and the use of the best available source data. Because the annual I-O accounts will be estimated concurrently with the GDP-by-industry accounts, they will be released on an accelerated schedule. The 2002 annual I-O table, scheduled for release in June 2004, will be released 18 months rather than 36 months after the end of the reference year. In addition, beginning in the fall of 2004, the annual I-O accounts will adopt the revision schedule of the NIPAs; the revised tables for 2001 and 2002 and new tables for 2003 will be released. The revised I-O estimates that are consistent with the annually revised NIPA estimates provide users with yet another level of consistency. Finally, the integration methodology will impose a time series consistency on the annual I-O tables, making the tables more useful for analyses of trends over time.

A further benefit of the integration methodology is a "feedback loop" to the NIPAs that is demonstrated by examining the relationships among the national accounts (chart 2). Before the integration of the annual I-O accounts and the GDP-by-industry accounts, the benchmark I-O accounts provided the following: A starting point for updating the annual I-O accounts (arrow 1), the best-level estimates of gross output to the GDP-by-industry accounts (arrow 2), and the best-level estimates and commodity splits of GDP to the NIPAs (arrow 3). The NIPAs provided estimates of GDI by industry to the GDP-by-industry accounts (arrow 4) and information on the annual composition of GDP to the annual I-O accounts (arrow 5). The integration results in an exchange of information between the annual I-O accounts and the GDP-by-industry accounts (arrow 6), and it also provides a feedback loop to the NIPAs (arrow 7). Because the integrated indus-

---

9. Proprietors' income is defined here to equal the sum of NIPA estimates for proprietors' income without inventory valuation adjustment (IVA) and capital consumption adjustment (CCAdj), proprietors' net interest, proprietors' capital consumption allowance, and proprietors' IVA. The NIPA adjustment to nonfarm proprietors' income without IVA and CCAdj for misreporting on income tax returns will be shown in NIPA table 7.14 "Relation of Nonfarm Proprietors' Income in the National Income and Product Accounts to Corresponding Measures as Published by the Internal Revenue Service."

10. The Bureau of the Census has recently undertaken initiatives to improve the coverage of intermediate inputs by industry in several of its annual surveys. For example, the Annual Survey of Manufactures has expanded its coverage to include purchased services by industry and the Service Annual Survey has initiated the collection of information on expenses by industry.

try accounts will be prepared within a balanced framework, they will provide annual estimates of the commodity composition of GDP that could potentially be used to improve the NIPA measures of GDP.

Finally, integration of the annual I-O accounts and the GDP-by-industry accounts is the first step towards BEA's long-run goal of the full integration across all of the industry accounts, including the benchmark I-O accounts, and integration of the industry accounts with the NIPAs. The framework used to integrate the annual I-O accounts and the GDP-by-industry accounts could be extended to accommodate the integration of the benchmark I-O accounts and the NIPAs. Under full integration, the benchmark I-O accounts would provide the best measures of value added by industry because they would incorporate the most comprehensive and highest quality information on gross output and intermediate inputs by industry. In addition, the annual I-O accounts and the GDP-by-industry accounts would incorporate annual data on intermediate inputs by industry, so that the annual measures of value added by industry would be independent of the NIPA measures of GDI and would therefore enhance the feedback loop to the NIPAs. Full integration is expected in the 2008–2010 timeframe when the necessary data on intermediate inputs by industry will be available from the 2002 Economic Census and from the annual surveys that are currently being collected and tabulated by the Bureau of the Census. As part of additional data-sharing initiatives, the sources of the differences in data from other Federal statistical agencies will become more apparent, and BEA will be able to further enhance the consis-

tency and quality of its fully integrated accounts.

Integration Methodology

The methodology, including the source data and the estimating procedures that will be used to integrate the annual I-O accounts and the GDP-by-industry accounts is discussed in this section. The methodology is described in a sequence of five steps: (1) Establishing a level of detail for both industries and commodities; (2) revising the previously published 1997 benchmark I-O accounts that will serve as a reference point for the integrated accounts; (3) developing a time series for the annual estimates of value added by industry for 1998–2002; (4) updating and balancing the annual I-O accounts for 1998–2002 on the basis of the revised 1997 benchmark I-O accounts and on the 1998–2002 estimates of value added by industry; and (5) preparing price and quantity indexes for the GDP-by-industry accounts for 1998–2002.

Level of industry and commodity detail

The first step in integrating the annual I-O accounts and the GDP-by-industry accounts is to establish the level of detail that can be used for both sets of accounts. Table A shows this detail and the corresponding 1997 NAICS industry codes.[11] For the annual I-O accounts, the level of detail applies to both industries

---

11. Table A omits the statistical discrepancy that has traditionally appeared as an industry in the GDP-by-industry accounts. This omission in the integrated accounts reflects the use of a balanced framework in which the statistical discrepancy is implicitly spread among industries. In addition, table A does not include an industry for the IVA, which has traditionally been shown in the I-O accounts. The IVA is included as a secondary product in industry gross output and as a separate commodity in final uses.

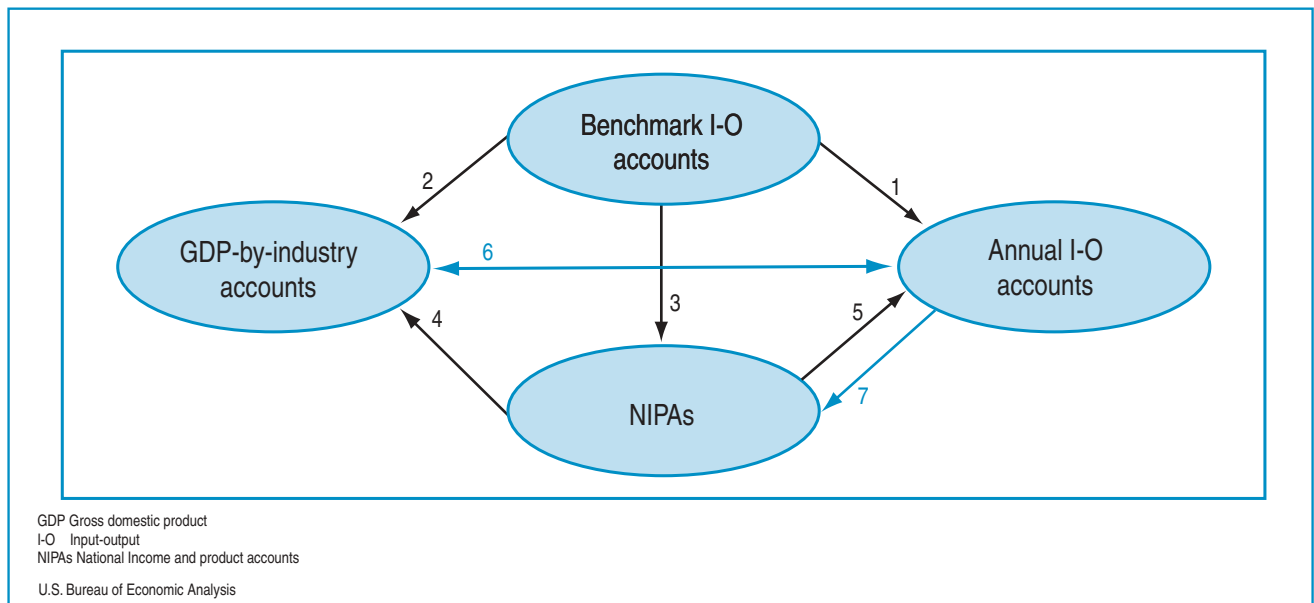## Chart 2. Relationships Among National Economic Accounts

GDP Gross domestic product
I-O Input-output
NIPAs National Income and product accounts

U.S. Bureau of Economic Analysis

Table A. Industries and Commodities in the Integrated Accounts

1997 NAICS industries	1997 NAICS codes
All industries	
Private industries	
Agriculture, forestry, fishing, and hunting	11
Farms	111, 112
Forestry, fishing, and related activities	113, 114, 115
Mining	21
Oil and gas extraction	211
Mining, except oil and gas	212
Support activities for mining	213
Utilities	22
Construction	23
Manufacturing	31, 32, 33
Durable goods	33, 321, 327
Wood products	321
Nonmetallic mineral products	327
Primary metals	331
Fabricated metal products	332
Machinery	333
Computer and electronic products	334
Electrical equipment, appliances, and components	335
Motor vehicles, bodies and trailers, and parts	3361, 3362, 3363
Other transportation equipment	3364, 3365, 3366, 3369
Furniture and related products	337
Miscellaneous manufacturing	339
Nondurable goods	31, 32 (except 321 and 327)
Food and beverage and tobacco products	311, 312
Textile mills and textile product mills	313, 314
Apparel and leather and allied products	315, 316
Paper products	322
Printing and related support activities	323
Petroleum and coal products	324
Chemical products	325
Plastics and rubber products	326
Wholesale trade	42
Retail trade	44, 45
Transportation and warehousing	48, 49
Air transportation	481
Rail transportation	482
Water transportation	483
Truck transportation	484
Transit and ground passenger transportation	485
Pipeline transportation	486
Other transportation and support activities	487, 488, 492
Warehousing and storage	493
Information	51
Publishing industries (includes software)	511
Motion picture and sound recording industries	512
Broadcasting and telecommunications	513
Information and data processing services	514
Finance and insurance	52
Federal Reserve banks, credit intermediation, and related activities	521, 522
Securities, commodity contracts, and investments	523
Insurance carriers and related activities	524
Funds, trusts, and other financial vehicles	525
Real estate and rental and leasing	53
Real estate	531
Rental and leasing services and lessors of intangible assets	532, 533
Professional, scientific, and technical services	54
Legal services	5411
Computer systems design and related services	5415
Miscellaneous professional, scientific, and technical services	5412–5414, 5416–5419
Management of companies and enterprises	55
Administrative and waste management services	56
Administrative and support services	561
Waste management and remediation services	562
Educational services	61
Health care and social assistance	62
Ambulatory health care services	621
Hospitals and nursing and residential care facilities	622, 623
Social assistance	624
Arts, entertainment, and recreation	71
Performing arts, spectator sports, museums, and related activities	711, 712
Amusements, gambling, and recreation industries	713
Accommodation and food services	72
Accommodation	721
Food services and drinking places	722
Other services, except government	81
Government	92
Federal	n.a.
General government	n.a.
Government enterprises	n.a.
State and local	n.a.
General government	n.a.
Government enterprises	n.a.

n.a. Not applicable.

and commodities. The integrated industry accounts will be published at the level shown in table A; but the estimation procedures for most of the other steps are applied at a finer level of industry and commodity detail in order to ensure the best aggregate estimates.

Revised 1997 benchmark I-O accounts

The second step in the integration process is to revise the previously published 1997 benchmark I-O accounts, because the integrated annual I-O accounts and GDP-by-industry accounts will be based on the relationships and levels set by the revised accounts. The revisions are from two sources.

First, the 1997 benchmark I-O accounts are modified to incorporate the definitional, methodological, and statistical changes from the 2003 comprehensive NIPA revision. Incorporating these changes ensures that the integrated accounts for 1998–2002 are consistent with the levels of GDP in the NIPAs. The major NIPA changes and their effects on the 1997 benchmark I-O accounts are summarized in table B.

Second, after the NIPA revisions are incorporated, the level and the composition of value added for each industry are further modified on the basis of information from both the I-O accounts and the GDP-by-industry accounts.[12] As discussed above, value added by industry in the I-O accounts is computed as the difference between gross output and intermediate inputs by industry, and value added by industry in the GDP-by-

---

12. The GDP-by-industry value added that is based on the NIPA GDI estimates will also incorporate the results from the 2003 comprehensive NIPA revision.

Table B. NIPA Changes Incorporated into the 1997 Benchmark Input-Output (I-O) Accounts

NIPA changes [1]	I-O components affected
Recognize the implicit services provided by property and casualty insurance companies and provide a more appropriate treatment of insured losses.	Industry and commodity gross output for insurance carriers and related activities; intermediate inputs and gross operating surplus for all industries; final uses.
Allocate a portion of the implicit services of commercial banks to borrowers.	Industry and commodity gross output for Federal Reserve banks, credit intermediation and related activities; intermediate inputs and gross operating surplus for all industries; final uses.
Redefine change in private farm inventories to include farm materials and supplies.	Intermediate inputs and gross operating surplus for the farms industry; change in private inventories.
Reclassify Indian tribal government activities from the private sector to the state and local government sector.	Gross output, intermediate inputs, and value added for the amusements, gambling, and recreation; accommodation; and state and local government enterprises industries; state and local general government.
Reclassify military grants-in-kind as exports.	Federal general government; exports.
Recognize explicitly the services produced by general government and treat government purchases of goods and services as intermediate inputs.	Gross output and intermediate inputs for the state and local general government and Federal general government industries.
Reclassify business nontax liability as current transfer payments to government and as rent and royalties to government.	Taxes on production and imports, less subsidies and gross operating surplus for all industries; gross output for the rental and leasing services and lessors of intangible assets industry; purchases of the rental and leasing services and lessors of intangible assets commodity by selected industries.

1. For details, see Brent R. Moulton and Eugene P. Seskin, "Preview of the 2003 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Classifications," SURVEY OF CURRENT BUSINESS 83 (June 2003): 20.

NIPA National income and product account

industry accounts is computed from the industry distributions of GDI from the NIPAs. In general, these two measures of value added for an industry will differ. Because a major benefit of integrating the two sets of accounts is to incorporate the best available information from each, a "combined" value added by industry is computed and incorporated into the 1997 benchmark I-O accounts.[13]

The combined value added by industry is an average with weights determined by criteria that indicate the relative quality of the benchmark I-O measure of value added and the GDP-by-industry measure of value added. In general, these criteria are based on the quality of the source data used for each set of accounts. The criteria for the benchmark I-O accounts include the following:

- The percent of intermediate inputs by industry that are covered by source data from the quinquennial economic census, and
- The percent of an industry's total gross output that is accounted for by the quinquennial economic census.

The criteria for the GDP-by-industry accounts include the following:

- The quality and the percent of adjustments that are made to convert the enterprise-based, profit-type income data to an establishment basis, and
- The percent of an industry's value added that is accounted for by proprietors' income.

For both the benchmark I-O accounts and the GDP-by-industry accounts, these criteria, along with expert analyst judgment, are applied at the industry level shown in table A in order to identify point estimates and estimates of variance for each industry's measure of value added.[14] For each industry, these point estimates and estimates of variance are used to develop probability distributions of value added by industry for each set of accounts. Each probability distribution represents a measure of the likelihood that the "true" value added takes on a particular value, given the available source data. The distributions are then combined to produce a combined measure of value added by industry. Essentially, the combined measure is an average of the two point estimates; the weights are determined by the relative variances—a point estimate with a

smaller variance receives a larger weight.

Chart 3 provides an example of the process used for the educational services industry. The point estimate of value added is $63.4 billion from the revised 1997 benchmark I-O accounts and $61.3 billion from the GDP-by-industry accounts. The related probability distribution for each point estimate is shown in chart 3. Note that the GDP-by-industry distribution is more peaked—that is, it has a smaller variance—than the distribution from the I-O accounts. The smaller variance indicates a relatively better GDP-by-industry estimate, which is the result of the small amount of enterprise-establishment adjustments made to the GDI data for this industry. In contrast, the larger variance of the probability distribution of the point estimate for the benchmark I-O accounts is the result of the limited coverage of this industry's gross output and intermediate inputs in the quinquennial economic census. As expected, the combined estimate of $62.1 billion is closer to the GDP-by-industry estimate than to the I-O estimate. Because more information is used to make this combined estimate, its overall quality is higher than that for either of the individual estimates, as shown by their distributions in chart 3.

After the two sets of revisions have been made to the 1997 benchmark I-O accounts, it is then balanced. For this balancing, each industry's new measure of value added is fixed, and total intermediate inputs is estimated. Balancing ensures that the use of commodities equals the supply of commodities, the sum of value added and intermediate inputs by industry equals gross output by industry, and the sum of final uses equals published GDP for 1997. The revised 1997

Chart 3. Probability Distributions of Value Added for Educational Services

U.S. Bureau of Economic Analysis

---
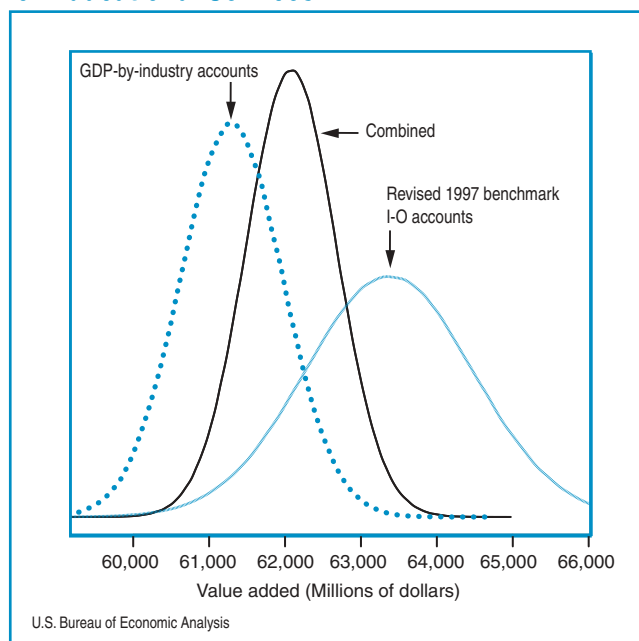
13. The estimates of "compensation of employees" and "taxes on production and imports, less subsidies" in the revised 1997 benchmark I-O accounts are consistent with those published in the NIPAs. For census-covered industries, the compensation in the previously published 1997 benchmark I-O accounts was based on the 1997 Economic Census. See Lawson, et al., 31.

14. The estimates are prepared at this level of detail because the industry distributions of GDI are available at this level. These estimates are allocated to more detailed industries when the revised benchmark I-O table is balanced. Source data for 1997 were not available on a 1997 NAICS basis for all of the components of GDI. For selected components, BEA converted data from the 1987 Standard Industrial Classification basis to the 1997 NAICS basis.

benchmark I-O accounts then provide a starting point for preparing the annual I-O accounts for 1998–2002.

A time series of value added for 1998–2002

A time series of value added by industry is prepared by extrapolating the revised 1997 benchmark I-O estimates of value added by industry forward to 1998–2002 using the GDI-based measure of value added by industry. The components of GDI that compose value added by industry and information on the major source data and on the industrial distribution for each component are shown in table C.

As discussed above, the quality of the GDI-based value-added measures depends on a number of factors, including the adjustments to convert enterprise-based, profit-type GDI data to an establishment basis. Nevertheless, these measures provide preferred indicators of value-added growth when compared with the annual I-O residual methodology primarily because the annual I-O source data on intermediate inputs by indus-

Table C. Principal Source Data for Value-Added Extrapolators

Component of gross domestic income	Major source data	Industrial distribution	
		Distribution available in source data	Data or assumption used if distribution by establishment is not available in source data
Compensation of employees, paid			
Wage and salary accruals [1]	BLS tabulations of wages and salaries of employees covered by state UI programs and OPM data on wages and salaries of Federal Government employees.	Establishment.	
Supplements to wages and salaries			
Employer contributions for employee pension and insurance funds	DOL tabulations of IRS data (Form 5500) on pension plans, HHS data from the Medical Expenditure Panel Survey on health insurance, and trade association data for other types.	None. [2]	BLS employer cost index and UI tabulations.
Employer contributions for government social insurance	Federal budget data.	None.	Social Security Administration and BLS tabulations.
Taxes on production and imports, less subsidies			
Taxes on production and imports	Federal budget data and Census Bureau data on state and local governments.	None.	Property taxes are based on BEA capital stock distribution.
Subsidies	Federal budget data and Census Bureau data on state and local governments.	None.	Payments are assigned to the industries being supported.
Gross operating surplus			
Private enterprises			
Net interest and miscellaneous payments, domestic industries			
Corporate	IRS tabulations of data from corporate tax returns (Form 1120 series), FFIEC Call Report data on commercial banks, trade association data on life insurance companies.	Company.	Census Bureau company-establishment employment matrix.
Noncorporate	IRS tabulations of tax return data from sole proprietorships (Form 1040 Schedule C) and partnerships (Form 1065), FRB flow-of-funds-account data on residential mortgages.	Company.	Assumed to be equivalent to an establishment distribution.
Business current transfer payments (net)	IRS tabulations of data from corporate tax returns (Form 1120 series), trade association data for property-casualty insurance net settlements and for other types.	Company.	Industry-specific payments are assigned to those industries; others are based on IRS company industry distribution.
Proprietors' income with IVA and without CCAdj			
Farm	USDA farm income statistics.	Establishment.	
Nonfarm			
Proprietors' income without IVA and CCAdj	IRS tabulations of tax return data from sole proprietorships (Form 1040 Schedule C) and partnerships (Form 1065).	Company.	Assumed to be equivalent to an establishment distribution.
IVA	BLS prices and IRS inventory data.	Establishment.	
Rental income of persons without CCAdj	Census Bureau data on housing units and rents from the American Housing Survey, HMDA data on residential mortgages, and IRS tabulations of data from individual tax returns (Form 1040).	Establishment.	
Corporate profits before tax with IVA and without CCAdj, domestic industries			
Corporate profits before tax without IVA and CCAdj	IRS tabulations of data from corporate tax returns (Form 1120 series) and regulatory agencies and public financial reports data.	Company.	Census Bureau company-establishment employment matrix.
IVA	BLS prices and IRS inventory data.	Establishment.	
Capital consumption allowances			
Corporate	IRS tabulations of data from corporate tax returns (Form 1120 series).	Company.	Census Bureau company-establishment employment matrix.
Noncorporate	IRS tabulations of tax return data from sole proprietorships (Form 1040 Schedule C) and partnerships (Form 1065).	Company.	Assumed to be equivalent to an establishment distribution.
Current surplus of government enterprises	Federal budget data and Census Bureau data on state and local governments.	Establishment.	
Consumption of fixed capital			
Households and institutions [3]	BEA capital stock estimates.	Establishment.	
Government	BEA capital stock estimates.	Type of agency.	

1. Includes wage and salary disbursements to the rest of the world and excludes wages and salaries received from the rest of the world.
2. A company-based industrial distribution for pension plans is available in the source data.
3. Consists of owner-occupied housing and nonprofit institutions primarily serving households.

BEA   Bureau of Economic Analysis
BLS   Bureau of Labor Statistics
CCAdj Capital consumption adjustment
DOL   Department of Labor
FFIEC Federal Financial Institutions Examination Council

FRB   Federal Reserve Board of Governors
HCFA Health Care Financing Administration
HHS   Department of Health and Human Services
HMDA Home Mortgage Disclosure Act
IRS   Internal Revenue Service
IVA   Inventory valuation adjustment
OPM Office of Personnel Management
UI   Unemployment insurance
USDA U.S. Department of Agriculture

try are currently too sparse to yield high quality measures of value added by industry.

Updated and balanced annual I-O accounts for 1998–2002

Updating and balancing the annual I-O accounts requires completing five tasks for each annual I-O table for 1998–2002. Each task provides essential inputs for the next task. These tasks include (1) calculating industry and commodity gross output; (2) estimating the commodity composition of intermediate inputs for each industry; (3) estimating the domestic supply of each commodity; (4) incorporating the commodity compositions of the GDP expenditure components for personal consumption expenditures (PCE), gross private fixed investment, and government consumption and investment expenditures; and (5) balancing the use table.

Industry and commodity gross output. For most industries and commodities, annual source data are available to estimate current-year industry and commodity gross output. For manufacturing, trade, and most service industries, the annual source data are based on surveys from the Bureau of the Census. For agriculture, insurance, and government enterprises and for major parts of transportation, utilities, finance, and real estate, the annual source data are based on other government sources or private sources. For the industries and commodities for which annual source data at the 1997 benchmark I-O level of detail are not available, aggregated source data are used to extrapolate the industry and commodity gross-output estimates. Table D shows the data sources used to update industry and commodity gross output.

Commodity composition of intermediate inputs. The estimates of the composition of intermediate inputs by industry are based on the revised 1997 benchmark I-O relationships and are adjusted for changes in relative prices and other factors.

First, each industry's current-year output is valued in the prices for the previous year and is estimated using an industry price index that is calculated by weighting together—in a Fisher index-number formula—the commodity price indexes that compose the industry's output. Generally, the number of price indexes available for commodities is fewer than the number of commodities; for commodities for which a price index is unavailable, an aggregate price index is applied to multiple commodities. The data sources used to prepare the commodity price indexes are shown in table D.

Second, each industry's output for the current year that is valued in the prices for the previous year is multiplied by the previous year's direct requirements coefficient for the industry to yield current-year intermediate inputs valued in the prices of the previous year.[15] This procedure assumes that in the current year, the composition of an industry's intermediate inputs per dollar of output (valued in the prices of the previous year) is unchanged from the previous year. The results are then reflated to current-year prices using the commodity price indexes.

Finally, commodity taxes, transportation costs, and trade margins for each intermediate input are estimated. Commodity taxes are added to raise the intermediate inputs from a basic price valuation to a producers' price valuation. Transportation costs and trade margins are estimated to provide a purchasers' price valuation of intermediate inputs.[16]

Domestic supply. Domestic supply is the total value of goods and services available for consumption as intermediate inputs by industries or as PCE, private fixed investment, and government consumption and investment expenditures; it is calculated as domestic commodity gross output, plus imports, less exports, less the change in private inventories. The estimates of imports and exports are based on foreign trade statistics from the Bureau of the Census and on BEA's international transactions accounts. For the current year, the change in private inventories by industry are from the NIPAs, and the commodity composition of inventories held by industries are based on the revised 1997 benchmark I-O relationships.

Commodity composition of final uses excluding trade and change in private inventories. The annual estimates of the major expenditure components of final uses for PCE, private fixed investment, and government consumption and investment are obtained from the NIPAs. Initial commodity compositions for these expenditure components are estimated using commodity-flow relationships from the revised 1997 benchmark I-O accounts.

Balancing the use table. The use table is balanced with a biproportional adjustment procedure—that is, with a procedure that sequentially adjusts rows and columns to equal a set of predetermined control totals. In a series of iterations, the adjustments are made (1)

---

15. The direct requirements coefficient is the amount of a commodity required by the industry to produce a dollar of the industry's output.

16. The basic price is the price received by the producer for goods that are sold; it excludes the taxes collected by the producer from purchasers as well as transportation costs and trade margins.

until the use of commodities by industries, PCE, private fixed investment, and government consumption and investment equals the domestic supply of commodities, (2) until the sum of value added by industry and intermediate inputs by industry equals gross output by industry, and (3) until the sum of the commodity composition of PCE, private fixed investment, and government consumption and investment equals the

Table D. Principal Sources of Data for Industry and Commodity Output and Prices

Industry and commodity	Source data for extrapolator	Source data for price index
Agriculture, forestry, fishing and hunting		
Farms	USDA cash receipts from marketing and inventory change	USDA prices received by farmers; PPI.
Forestry, fishing, and related activities	For forestry, Census Bureau shipments; for fishing, NOAA value of fish landings; for related activities, NIPA estimates	PPI; NOAA; NIPA deflator.
Mining		
Oil and gas extraction	DOE quantity produced and prices.	For crude petroleum and natural gas, IPD from DOE; for natural gas liquids, PPI.
Mining, except oil and gas	DOE quantity produced and average price for uranium and coal; USGS quantity and price data for all others.	IPD from DOE and USGS.
Support activities for mining	DOE, USGS, and trade sources for quantity produced and prices.	IPD from DOE, USGS and trade sources; for exploration, PPI.
Utilities		
Electric utilities	EIA	PPI.
Natural gas	EIA quantity and price data	PPI.
Water, sewage, and other systems	PCE	CPI.
Construction		
For the Department of Defense (DOD)	DOD expenditures data	DOD prices for military construction; cost indexes from trade sources and government agencies for other construction.
For state and local highways	Census Bureau data from the ASGF	Cost indexes from government agencies.
For private electric and gas utilities	Federal regulatory agencies and trade sources expenditures data	Cost indexes from trade sources and government agencies.
For farms, excluding residential	USDA expenditures data	Trade sources cost index; Census Bureau price deflator for new single-family houses under construction.
For other nonresidential	Census Bureau data on value of construction put in place	Trade sources and government agency cost indexes; Census Bureau price index for new single-family houses under construction; BEA quality-adjusted price indexes for factories, office buildings, warehouses, and schools.
For other residential	Census Bureau data on value of construction put in place	Census Bureau price index for new single-family houses under construction; BEA price index for multifamily construction.
Manufacturing	Census Bureau data on shipments and inventory change	PPI; quality adjusted price indexes for computers, photocopying equipment, digital telephone switching equipment, and LAN equipment; BEA price indexes based on DOD prices paid for military equipment.
Wholesale trade	Census Bureau ATS data	Sales price by kind-of-business computed from PPI.
Retail trade	Census Bureau ARTS data	Sales price by kind-of-business computed from CPI.
Transportation and warehousing		
Air transportation	BTS Air Carrier Financial Statistics.	IPD for total passenger-related revenues and passenger miles from DOT; IPD for total freight-, mail-, and express-related revenues and ton miles from DOT; wages and salaries per employee from BLS.
Rail transportation	Amtrak and trade sources	PPI.
Water transportation	Army Corps of Engineers; trade sources	PPI for freight; for passengers, CPI.
Truck transportation	Census Bureau SAS	PPI.
Transit and ground passenger transportation	PCE; BTS	For taxicabs, intercity buses, and other local transit, PCE price index; for school buses, BLS data on wages and salaries per employee.
Pipeline transportation	Trade sources	PPI.
Other transportation and support activities	PCE	For sightseeing, PCE price index; for other transportation and support activities, PCE price indexes and PPI.
Warehousing and storage	Census Bureau SAS	PPI.
Information		
Publishing industries (includes software)	Census Bureau SAS	BEA price indexes for prepackaged and custom software for software publishers; for all other publishing industries, PPI.
Motion picture and sound recording industries	Census Bureau SAS	PCE price indexes.
Broadcasting and telecommunications	Census Bureau SAS	For cable networks, programming, and telecommunications, PPI; for radio and television broadcasting, network receipts, and all other telecommunications, composite price index of PPIs.
Information and data processing services	Census Bureau SAS	For information services, PCE price indexes; for data processing services, PPI.

levels for expenditure components in the NIPAs. After the results have been reviewed and verified, the annual I-O accounts for 1998–2002 are finalized. The measures of gross output, intermediate inputs, and value added by industry are then incorporated into the GDP-by-industry accounts.

Table D. Principal Sources of Data for Industry and Commodity Output and Prices—Continued

Industry and commodity	Source data for extrapolator	Source data for price index
Finance and insurance		
Federal Reserve banks, credit intermediation, and related activities......	FDIC; FRB; NIPA imputed service charges; NCUA; and other private agencies	PCE price indexes; other government data.
Securities, commodity contracts, and investments	SEC FOCUS Report.	PCE price indexes.
Insurance carriers and related activities.................................	Trade sources for insurance carriers; BEA estimates for property and casualty insurance; for all other insurance, PCE; for insurance agents, brokers, and services, IRS tabulations of business tax returns................	For health and life insurance, PCE price indexes; for property and casualty insurance, PPI; for agents, brokers, and services, composite price index based on trade sources data and PCE price indexes.
Funds, trusts, and other financial vehicles	NIPA imputed service charges for other financial institutions; EBSA data on pension funds	IPD from NIPA imputed service charges; composite price index based on PCE price indexes; PPI data; BLS data on wages and salaries per full-time employee.
Real estate and rental and leasing		
Real estate.................................	For residential dwellings and real estate agents and managers, NIPA housing data; for nonresidential dwellings, IRS tabulations of business tax returns; NIPA rental value of buildings owned by nonprofits................	For nonfarm residential dwellings, NIPA price index; for nonresidential dwellings, PPI; for real estate managers and agents, PPI and trade sources; IPD for nonprofit and farm residential dwellings.
Rental and leasing services and lessors of intangible assets.................	For rental and leasing services, Census Bureau SAS; for royalties, IRS tabulations of business tax returns................	For automotive equipment rental, PPI; for other rental services, PCE price indexes; for royalties, PCE price index and IPD from DOE and PPI.
Professional, scientific, and technical services		
Legal services.................................	Census Bureau SAS	PPI.
Computer systems design and related services	Census Bureau SAS	BEA price indexes for prepackaged and custom software.
Miscellaneous professional, scientific, and technical services.................	Census Bureau SAS	PPI; BLS wages and salaries per full-time employee.
Management of companies and enterprises.................................	BLS wages and salaries	BLS wages and salaries per full-time employee.
Administrative and waste management services		
Administrative and support services	Census Bureau SAS	BLS wages and salaries per full- time employee; PCE price indexes; PPI.
Waste management and remediation services.................................	Census Bureau SAS	CPI.
Educational services	PCE.................................	PCE price index based on trade sources.
Health care and social assistance		
Ambulatory health care services.................................	Census Bureau SAS	PPI; PCE price indexes.
Hospitals and nursing and residential care facilities.................................	Census Bureau SAS	PCE price indexes.
Social assistance	Census Bureau SAS	PCE price indexes.
Arts, entertainment, and recreation		
Performing arts, spectator sports, museums, and related activities........	Census Bureau SAS	PCE price indexes.
Amusements, gambling, and recreation industries	Census Bureau SAS	PCE price indexes.
Accommodation and food services		
Accommodation	Census Bureau ARTS.................................	For hotels and motels, PPI; PCE price index.
Food services and drinking places.................................	Census Bureau ARTS.................................	CPI.
Other services, except government	For religious, labor, and political organizations, PCE; for other services, Census Bureau SAS; for private households, BEA compensation of employees	CPI; BLS data on wages and salaries per full-time employee; PCE price indexes.
Government		
Federal		
General government	NIPA estimates.................................	NIPA price indexes.
Government enterprises	USPS receipts; for electric utilities, DOE; other government data	For USPS and electric utilities, PPI; for all others, PCE price index and NIPA price indexes.
State and local		
General government	NIPA estimates.................................	NIPA price indexes.
Government enterprises.................................	For electric utilities, DOE data; for other enterprises, BEA data on revenue by type.................................	PPI.

Price and quantity indexes for the GDP-by-industry accounts

Preparing price and quantity indexes for the GDP-by-industry accounts for 1998–2002 requires completing two tasks. First, price and quantity indexes for gross output and intermediate inputs by industry are prepared. Second, information on gross output and intermediate inputs by industry are combined using the double-deflation procedure to derive price and quantity indexes for value added by industry.

Indexes for gross output and intermediate inputs by industry. Price and quantity indexes for gross output by industry are derived by separately deflating each commodity produced by an industry and included as part of its gross output. This information is obtained from annual I-O make tables. Price and quantity indexes for intermediate inputs are derived by deflating the commodities that compose an industry's intermediate inputs in the annual I-O use tables. The data sources used to prepare the commodity price indexes for deflation are shown in table D. When a commodity price index is based on more than one detailed price index, a Fisher index-number formula is used to prepare the composite index. The technical note "Computing Chain-Type Price and Quantity Indexes in the GDP-by-Industry Accounts" shows the Fisher index-number formulas that are used to prepare the price and quantity indexes for gross output and intermediate inputs by industry.

Indexes for value added by industry. Price and quantity indexes for value added by industry are calculated using the double-deflation method. In the double-deflation method, the separate estimates of gross output and intermediate inputs by industry are combined in a Fisher index-number formula in order to generate price and quantity indexes for value added by industry. This method is preferred for computing price and quantity indexes for value added by industry because it requires the fewest assumptions about the relationships among gross output by industry and intermediate inputs by industry.

Technical Note
Computing Chain-Type Price and Quantity Indexes in the GDP-by-Industry Accounts

The computation of the chain-type Fisher price and quantity indexes for gross output, intermediate inputs, and value added for an industry or an aggregate is summarized below.

Chain-type price indexes. In the notation, $LP_{t-1,\,t}$ refers to the Laspeyres price relative for the years t–1 and t, $PP_{t-1,\,t}$ refers to the Paasche price relative, $FP_{t-1,\,t}$

refers to the Fisher price relative, and CP_t refers to the Fisher chain-type price index. The superscript GO refers to gross output, II refers to intermediate inputs, and VA refers to value added; p refers to detailed prices, and q refers to quantities.

Laspeyres price relatives for gross output, intermediate inputs, and value added, respectively, are

$$LP_{t-1,\,t}^{GO} = \frac{\sum p_t^{GO} \, q_{t-1}^{GO}}{\sum p_{t-1}^{GO} \, q_{t-1}^{GO}},$$

$$LP_{t-1,\,t}^{II} = \frac{\sum p_t^{II} \, q_{t-1}^{II}}{\sum p_{t-1}^{II} \, q_{t-1}^{II}}, \; and$$

$$LP_{t-1,\,t}^{VA} = \frac{\left(\sum p_t^{GO} \, q_{t-1}^{GO}\right) - \left(\sum p_t^{II} \, q_{t-1}^{II}\right)}{\left(\sum p_{t-1}^{GO} \, q_{t-1}^{GO}\right) - \left(\sum p_{t-1}^{II} \, q_{t-1}^{II}\right)}.$$

Paasche price relatives for gross output, intermediate inputs, and value added are

$$PP_{t-1,\,t}^{GO} = \frac{\sum p_t^{GO} \, q_t^{GO}}{\sum p_{t-1}^{GO} \, q_t^{GO}},$$

$$PP_{t-1,\,t}^{II} = \frac{\sum p_t^{II} \, q_t^{II}}{\sum p_{t-1}^{II} \, q_t^{II}}, \; and$$

$$PP_{t-1,\,t}^{VA} = \frac{\left(\sum p_t^{GO} \, q_t^{GO}\right) - \left(\sum p_t^{II} \, q_t^{II}\right)}{\left(\sum p_{t-1}^{GO} \, q_t^{GO}\right) - \left(\sum p_{t-1}^{II} \, q_t^{II}\right)}.$$

Fisher price relatives for gross output, intermediate inputs, and value added are

$$FP_{t-1,\,t}^{GO} = \sqrt{LP_{t-1,\,t}^{GO} \times PP_{t-1,\,t}^{GO}},$$

$$FP_{t-1,\,t}^{II} = \sqrt{LP_{t-1,\,t}^{II} \times PP_{t-1,\,t}^{II}}, \; and$$

$$FP_{t-1,t}^{VA} = \sqrt{LP_{t-1,t}^{VA} \times PP_{t-1,t}^{VA}} \, .$$

Fisher chain-type price indexes for gross output, intermediate inputs, and value added for years after the reference year are

$$CP_t^{GO} = CP_{t-1}^{GO} \times FP_{t-1,t}^{GO},$$

$$CP_t^{II} = CP_{t-1}^{II} \times FP_{t-1,t}^{II}, \text{ and}$$

$$CP_t^{VA} = CP_{t-1}^{VA} \times FP_{t-1,t}^{VA}.$$

In the reference year (2000 for this comprehensive revision),

$$CP_t^{GO} = CP_t^{II} = CP_t^{VA} = 100.$$

Chain-type quantity indexes. In the notation, $LQ_{t-1,t}$ refers to the Laspeyres quantity relative for the years $t-1$ and t, $PQ_{t-1,t}$ refers to the Paasche quantity relative, $FQ_{t-1,t}$ refers to the Fisher quantity relative, and CQ_t refers to the Fisher chain-type quantity index. The superscript GO refers to gross output, II refers to intermediate inputs, and VA refers to value added; p refers to detailed prices, and q refers to quantities.

Laspeyres quantity relatives for gross output, intermediate inputs, and value added, respectively, are

$$LQ_{t-1,t}^{GO} = \frac{\sum p_{t-1}^{GO} q_t^{GO}}{\sum p_{t-1}^{GO} q_{t-1}^{GO}},$$

$$LQ_{t-1,t}^{II} = \frac{\sum p_{t-1}^{II} q_t^{II}}{\sum p_{t-1}^{II} q_{t-1}^{II}}, \text{ and}$$

$$LQ_{t-1,t}^{VA} = \frac{\left(\sum p_{t-1}^{GO} q_t^{GO}\right) - \left(\sum p_{t-1}^{II} q_t^{II}\right)}{\left(\sum p_{t-1}^{GO} q_{t-1}^{GO}\right) - \left(\sum p_{t-1}^{II} q_{t-1}^{II}\right)}.$$

Paasche quantity relatives for gross output, intermediate inputs, and value added are

$$PQ_{t-1,t}^{GO} = \frac{\sum p_t^{GO} q_t^{GO}}{\sum p_t^{GO} q_{t-1}^{GO}},$$

$$PQ_{t-1,t}^{II} = \frac{\sum p_t^{II} q_t^{II}}{\sum p_t^{II} q_{t-1}^{II}}, \text{ and}$$

$$PQ_{t-1,t}^{VA} = \frac{\left(\sum p_t^{GO} q_t^{GO}\right) - \left(\sum p_t^{II} q_t^{II}\right)}{\left(\sum p_t^{GO} q_{t-1}^{GO}\right) - \left(\sum p_t^{II} q_{t-1}^{II}\right)}.$$

Fisher quantity relatives for gross output, intermediate inputs, and value added are

$$FQ_{t-1,t}^{GO} = \sqrt{LQ_{t-1,t}^{GO} \times PQ_{t-1,t}^{GO}},$$

$$FQ_{t-1,t}^{II} = \sqrt{LQ_{t-1,t}^{II} \times PQ_{t-1,t}^{II}}, \text{ and}$$

$$FQ_{t-1,t}^{VA} = \sqrt{LQ_{t-1,t}^{VA} \times PQ_{t-1,t}^{VA}} \, .$$

Fisher chain-type quantity indexes for gross output, intermediate inputs, and value added for years after the reference year are

$$CQ_t^{GO} = CQ_{t-1}^{GO} \times FQ_{t-1,t}^{GO},$$

$$CQ_t^{II} = CQ_{t-1}^{II} \times FQ_{t-1,t}^{II}, \text{ and}$$

$$CQ_t^{VA} = CQ_{t-1}^{VA} \times FQ_{t-1,t}^{VA}.$$

In the reference year (2000 for this comprehensive revision),

$$CQ_t^{GO} = CQ_t^{II} = CQ_t^{VA} = 100.$$