BEA's Chain Indexes, Time Series, and Measures of Long-Term Economic Growth

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LAST YEAR, as part of a comprehensive revision of the national income and product accounts (NIPA's), the Bureau of Economic Analysis (BEA) introduced chain-type annual-weighted indexes, also known as Fisher indexes, as its featured measures of real output and prices. These new measures allow for the effects of changes in relative prices and in the composition of output over time, thereby eliminating a major source of bias in the previously featured fixed-weighted, or Laspeyres, measures of real output and prices. The advantages of the new indexes are particularly important for long-term time series, such as those presented in this issue of the SURVEY OF CURRENT BUSINESS, and for analyses of current economic conditions as the base period becomes out of date.

The new indexes are significantly more accurate, but they are also computationally more difficult to use than the old fixed-weighted "constant-dollar" estimates that provided additive and easily manipulated series. To deal with these complexities, BEA introduced dollar-denominated real output series that are based on, and consistent with, the new indexes but that have the computational simplicity of constant-dollar series. As BEA pointed out when these "chained (1992) dollar" series were introduced, they work well for periods close to the 1992 base year, but they may produce increasingly misleading results as one moves away from that year. This article briefly reviews the advantages of BEA's chain-type indexes for various types of analyses, explains the conceptual and empirical problems encountered when using chained-dollar estimates far from the base period, describes the time series BEA will publish, presents several sets of tables and estimates designed to assist analysts in using the NIPA chain-type estimates beginning with 1929, and discusses work that BEA is considering to further improve its chain-type indexes for the most recent quarters.

Problems with fixed-weighted indexes in time series analysis

Chain-type indexes attempt to address one of the most basic problems in measuring real output and prices: The choice of the base period with which all other periods are compared. Quantity and price indexes are analytical devices for decomposing changes in nominal gross domestic product (GDP) into that part due to changes in prices and that part due to changes in quantity. Thus, real GDP is an expression of the changes in output that are associated with changes in quantity and not with changes in prices. The easiest way to calculate real GDP is to specify a single base-period, or constant, set of prices and then value the output in all periods in those prices. Unfortunately, because relative prices and associated patterns of purchases change over time, this measure of real GDP growth will be quite sensitive to the choice of the base year, and a shift in the base year often has a significant impact on the measured growth rates. Indeed, professors of economics delight in illustrating this sensitivity to their students through a series of simple two-good, two-period examples. In these examples, simply shifting the base period, and thus the prices used to value a specified basket of goods, from the first period (known as a Laspeyres index) to the second period (known as a Paasche index) can result in either an increase or a decrease in the value of that basket of goods.[1] Normally, changing the base period does not reverse the direction of change in GDP, but the effect is still quite important. When the base year for real GDP was updated in past comprehensive NIPA revisions, the size of the revisions to the rates of growth in real GDP and its components due solely to updating the base year became topics of debate in discussions of budget projections and monetary policy.

1. For example, see C.E. Ferguson [4].

The use of fixed weights not only tends to cause errors and revisions in real GDP and prices when base periods are updated, but the errors themselves are biased. It has been long recognized in the index-number literature that output measures that use fixed weights of a single period tend to misstate growth as one moves further from the base period. This tendency, often called substitution bias, reflects the fact that the commodities for which output grows rapidly tend to be those for which prices increase less than average or decline. Thus, when real GDP is recalculated using more recent-period price weights, the commodities with strong output growth generally receive less weight, and growth in the aggregate measure is reduced.[2] These recalculations result in more accurate measures of growth near the base period because the weights more closely reflect the prices of the economy near the base period. However, the recalculations provide less accurate measures of growth for earlier periods because the price weights are further away from the prices appropriate to those periods. For later periods, even the new weights eventually get out of date, and measures of growth in output become increasingly overstated.[3]

Some countries address the long-run distortions caused by fixed-weighted output indexes by updating the base period at 5- or 10-year intervals and then using the new fixed-weighted (Laspeyres) index to extrapolate forward the old fixed-weighted index, thereby creating a series of fixed-weighted indexes that are linked together like a chain. Although this practice does avoid the problems and bias associated with using weights from, for example, the 1980's to value output in the 1950's, the resulting chained Laspeyres indexes is still subject to inaccuracy and bias during periods of extreme price movements.

In periods such as the energy crisis of 1973–75, relative price and consumption patterns can change rapidly, and significant bias can creep into fixed-weighted measures even during periods close to the base period. Moreover, chain-type Fisher indexes are superior to chain-type Laspeyres indexes even during periods when price movements are less extreme.[4] In addition, when chain-type Laspeyres indexes are used, the corresponding dollar-denominated real series are not additive in periods before the most recent base period, and series breaks cause the years adjacent to the base year to be noncomparable.

Finally, because fixed-weighted output and price indexes use different weights than those contained in current-period output and prices, the product of the output and price indexes for GDP does not equal the index for current-dollar GDP, a desirable characteristic for data users interested in decomposing and analyzing current-period growth and in forecasting future growth and inflation.[5] Instead, implicit price deflators, which are derived by dividing real GDP into nominal GDP and are simply the average price of goods and services in GDP, have been used for this purpose because the product of the implicit price index and the fixed-weighted quantity index does equal the index for current-dollar GDP. However, these implicit price deflators can be distorted by temporary shifts in the composition of output; for example, if consumers shift enough of their purchases from goods and services with relatively high price indexes to those with relatively low price indexes, the implicit price deflator will fall even though the price of every good and service, including those with relatively low price indexes, increased.[6]

Improvements in accuracy associated with chain-type indexes

BEA introduced the chain-type Fisher index into its measures of real output and prices to address these problems. This index, developed by Irving Fisher, is a geometric mean of the conventional fixed-weighted Laspeyres index (which uses the weights of the first period in a two-period example) and a Paasche index (which uses the weights of the second period).[7] Changes in this measure

2. The substitution bias in GDP relates to shifts in the composition of GDP across broad categories of goods and services, such as from new autos to used autos or from engines and turbines to computers. It should not be confused with possible biases in the detailed consumer price indexes (CPI's) used to deflate the components of consumer spending in GDP. This second type of substitution bias relates to shifts in consumer spending within a given type of good or service, such as from romaine to iceberg lettuce or from Coke to Pepsi. BEA's use of chain indexes in computing GDP, personal consumption expenditures (PCE), and other GDP components addresses what the Bureau of Labor Statistics (BLS) and the "Final Report of the Advisory Commission to Study the Consumer Price Index"—"the Boskin report"—have described as upper-level substitution bias, but it does not address the lower, or component, level bias contained in the detailed CPI's that BEA uses to deflate components that account for about three quarters of consumer spending.

3. For example, the published chain-type measure of real GDP growth in the first quarter of 1997 is 5.6 percent at an annual rate; the fixed (1992) weighted measure of real GDP growth in the first quarter is 6.3 percent, an overstatement of 0.7 percentage point.

4. See Robert P. Parker and Jack E. Triplett [8].

5. This characteristic also means that—discounting the effects of rounding and of interaction terms—the sum of the growth rates of real output and prices is approximately equal to the growth rate in nominal output.

6. Effective with the recent comprehensive NIPA revision, real output is calculated using the chain-type index, with the result that the implicit price deflator is the equivalent of the chain-type price index and, thus, is not subject to the limitations discussed in this paragraph.

7. Laspeyres quantity index (L):

$$I_{i,o} = \frac{\sum P_o Q_i}{\sum P_o Q_o}$$

are calculated using the weights of adjacent years. These annual changes are "chained" (multiplied) together to form a time series that allows for the effects of changes in relative prices and in the composition of output over time. Thus, BEA is able to calculate an index that uses weights appropriate for each period and thereby avoids the rewriting of economic history that results from updating the base period of a fixed-weighted index as well as the substitution bias that is inherent in fixed-weighted indexes. The chain-type indexes also provide more accurate measures of current-period output during periods of significant price changes. Finally, they provide real output and price indexes whose product equals the index for current-dollar GDP without the distortions caused by shifts in the composition of output associated with the old implicit price deflator.[8]

The improvement in accuracy associated with the new indexes is significant. The new indexes produce more accurate estimates of growth in GDP, components of GDP, and GDP by industry.

- BEA's new indexes eliminate the substitution bias in real GDP growth that tends to cause an understatement of growth for periods before the base period and an overstatement of growth for periods after the base period:

  The old fixed-weighted (1987) index understated real GDP growth during the post-World War II era expansions prior to 1987 by an average of 0.4 percentage point and overstated growth during the current expansion by 0.5 percentage point (chart 1).[9] As a result, comparisons of the relative strength of the current expansion may have been overstated by roughly a full percentage point.

  The fixed-weighted (1987) index understated real GDP annual growth for 1929–87 by 0.4 percentage point; use of the chain index raises the long-term growth rate from 3.0 percent to 3.4 percent. The growth rate from 1987 to 1994—the last full year for which BEA prepared fixed (1987) weighted estimates—was reduced from 2.4 percent to 2.3 percent.

- The new indexes also eliminate the distortion of growth in components and industries that results from the use of fixed-weighted indexes:

  The chain-type indexes eliminate an understatement of growth in investment spending in the past and an overstatement in current periods. The annual growth rate for gross private domestic investment for 1929–87 is raised from 2.8 percent to 3.8 percent, and the growth

Paasche quantity index (P):

$$I_{i,o} = \frac{\sum P_i Q_i}{\sum P_i Q_o}$$

Fisher quantity index:

$$I_{i,o} = \sqrt{L * P}$$

The Fisher Ideal index was one of many index formulas examined by Irving Fisher [5].

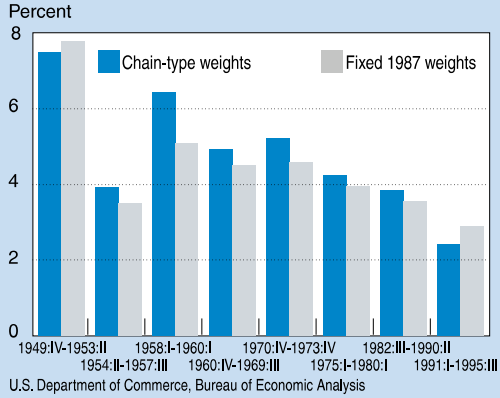
8. Chain indexes address shifts over time in the composition of output that cause substitution bias by using weights that are updated annually. Chain-price indexes moderate the distortions associated with implicit price deflators by using the average (geometric mean) of the weights in two adjacent periods. In any given quarter or year, chain-type price indexes reflect the change in prices, whereas implicit price deflators reflect changes in prices *and* in the composition of output. In addition, implicit price deflators that are based on fixed-weighted output indexes tend to exaggerate the impact of shifts in the composition of output by using outdated weights (for example, 1987 = 100) that exaggerate the effects of temporary shifts in the composition of output on prices. Finally, as pointed out by Triplett (see [11]), Fisher indexes are superior to other superlative indexes—such as Tournquist indexes—because for those indexes, the product of the price and real output indexes does not equal the nominal output index.

9. Although the substitution bias in fixed-weighted measures causes them to understate real GDP growth for most periods, there are instances in which both the quantities *and* prices of some components have risen rapidly. In these instances, the use of fixed-weighted indexes can overstate growth. For example, in the 1949–53 economic expansion, which included the Korean war buildup, rapid growth in government spending accounted for a very large share of real GDP growth; the use of 1987 relative prices for government—which were quite high relative to the prices of the early 1950's—weights the contribution of government even more heavily and results in an even higher overall real GDP growth during this period.

The expansion from the third quarter of 1982 to the second quarter of 1990 is included in the calculation of the average growth during postwar expansions before 1987 because the bulk of this expansion is before 1987.

CHART 1

Rates of Change in Real GDP: Comparison of Alternative Measures During Economic Expansions



U.S. Department of Commerce, Bureau of Economic Analysis

rate for 1987–94 is lowered from 3.5 percent to 2.5 percent.

The chain-type indexes also avoid misstatements of growth by industry. For example, the use of chain-type indexes corrects an understatement in real growth in manufacturing that would result from using fixed-weighted indexes for years prior to the base period of 1987. As measured by chain-type indexes, manufacturing industries grew at an average annual rate of 2.7 percent for 1977–87; measured by fixed 1987 weights, the growth rate would have been 1.7 percent.[10]

- Finally, the new indexes eliminate the anomalies that arose from using recent-period price weights to measure periods in the past when a far different set of prices prevailed.

  As measured by the old 1987 fixed-weighted index, real GDP dropped 25 percent from 1944 to 1947, reflecting the post-World War II demobilization and the associated sharp cutbacks in defense spending. However, much of this drop reflects the use of 1987 prices for defense equipment rather than the low postwar prices for defense equipment. As measured by the more appropriate price weights of BEA's new chain-type indexes, the postwar drop in real GDP is 13 percent.

Other U.S. statistical agencies have moved to, or are considering a move to, various types of chain-type indexes. For example, The Federal Reserve Board switched to Fisher indexes for the industrial production and capacity utilization indexes earlier this year, and the Bureau of Labor Statistics recently released an experimental CPI that is based on a geometric mean index. Internationally, the new System of National Accounts recommends the use of Fisher indexes for computing output and price indexes.

Chained-dollar measures and their limitations

As with most improvements, there is a cost to the new chain-type indexes. Although the annual weights provide more accurate estimates, the chained (1992) dollars are not strictly additive, especially for periods far away from the base period. Previously, the use of the same base period for all time periods produced a set of indexes that converted to dollar-denominated measures in which the components were valued in the same prices over all time periods and added up precisely to the totals. BEA had featured such measures partly because many users consider this additive property to be useful; for example, it facilitates analyses of contributions to growth and provides flexibility in aggregating the detailed components. (It also facilitates verification of calculations using these detailed components.)

In order to assist users, BEA introduced several series as part of the recent comprehensive NIPA revision. In particular, the new chained (1992) dollar estimates provide users with real estimates for current-period analysis and for macro-modeling that are approximately additive and are free of upper-level substitution bias.

The chained (1992) dollars are constructed by setting 1992 as the base year and by using the percent changes in the annual chain-type indexes to extrapolate the real chained-dollar estimates for GDP and its components from their 1992 current-dollar levels. Although the resulting estimates are not precisely additive, for years close to the 1992 base year (when the price weights of the chain-type index are not too far from the prices of the base year), the "residual" is small, and the contributions to growth obtained from the chained (1992) dollars are reasonable approximations to those calculated by BEA from the detailed chain-type indexes.[11] However, for periods far from the base period, the residual in chained dollars becomes large, and contributions to GDP growth computed from the chained-dollar components can differ significantly from those produced by the chain-type indexes.

The residuals arise because the chained (1992) dollar indexes are inconsistent in that the growth rates of the chain-type indexes for real GDP and its components are calculated using annual weights for each year, whereas the chained (1992) dollar levels are based both on these annual weights and on the "weights" from the 1992 base year. Therefore, the chained (1992) dollars produce estimates, such as the contributions of

10. Because of the large bias in real GDP-by-industry estimates, BEA switched to a type of chain-weighted measure—a benchmark-weighted index—in 1993, 2 years before the switch to chain-type annual-weighted measures for real GDP. See Robert P. Parker [9] and Robert E. Yuskavage [13].

11. Because of the formula used for calculating real GDP, the chained (1992) dollar estimates for the detailed GDP components do not add to the chained-dollar value of GDP or to any intermediate aggregate. In the NIPA tables, the residual is the difference between GDP and the sum of the most detailed components shown in each table. However, the residuals shown in the special tables accompanying this article are the difference between GDP and the sum of the major aggregates (see the footnotes to the special tables).

components to GDP growth, that are inconsistent with those produced by the chain-type indexes. These inconsistencies become more apparent as the estimates move farther from the base period. Examples of these errors include the following:

- Expenditure components of GDP:

  As measured by chained (1992) dollars, private investment in equipment accounted for 6 percent of real GDP growth during the 1954–57 expansion. However, as measured using a more appropriate (contemporaneous) base period, the contribution was 10 percent (table 1).[12]

  As measured by chained (1992) dollars, consumer spending on services accounted for 35 percent of real GDP growth in 1954–57; as measured using a more appropriate (contemporaneous) base period, the contribution of services was 28 percent.

- GDP by industry:

  As measured by chained (1992) dollars, services accounted for 37 percent of real GDP growth in 1977–82; as measured using a more appropriate (contemporaneous) base period, the contribution of services was 28 percent (table 2).

  As measured by chained (1992) dollars, agriculture, forestry, and fisheries accounted for 4 percent of real GDP growth in 1977–82; as measured using a more appropriate (contemporaneous) base period, the contribution of this industry was 7 percent.

- Macroeconomic analyses and real GDP:

  For 1982–96, the residual—and errors in component contributions—are small,

12. The "contemporaneous" weights used here are taken from the midpoint of the period being analyzed. For example, the contributions for the second quarter of 1954 to the third quarter of 1957 expansion are derived from real estimates that are based on the percent changes in the quarterly chain indexes from the current-dollar levels at the midpoint of the expansion, the fourth quarter of 1955. Other tables in this article also use the midpoints of the period as the base period (see the accompanying "Note on Computing Alternative Chained-Dollar Indexes and Contributions to Growth"). It is possible, however, that the midpoint of a period is not the most appropriate base period; for example, if the middle year of a decade is a recession year and the price weights are taken from that year, the picture of the economy over that decade may be distorted.

Table 1.—Contributions to Change in Gross Domestic Product, 1954:II–1957:III, Using Chained (1992) Dollars and Chained (1955:IV) Chained Dollars

Line		Contribution to change in GDP, 1992=100 (percent) (1)	Contribution to change in GDP, 1955:IV=100 (percent) (2)	Difference (1)–(2)
1	**Gross domestic product**	**100.0**	**100.0**	**0**
2	**Personal consumption expenditures**	**67.4**	**67.2**	**.2**
3	Durable goods	5.8	10.5	–4.7
4	Nondurable goods	26.8	29.1	–2.2
5	Services	34.6	27.6	7.1
6	**Gross private domestic investment**	**21.7**	**28.1**	**–6.4**
7	Fixed investment	13.4	16.3	–2.9
8	Nonresidential	11.5	15.2	–3.7
9	Structures	5.5	5.1	.5
10	Producers' durable equipment	6.2	10.1	–3.9
11	Residential	.9	.9	0
12	Change in business inventories [1]			
13	**Exports of goods and services**	**8.2**	**10.7**	**–2.4**
14	Goods	5.9	8.5	–2.5
15	Services	2.1	2.2	–.1
16	**Imports of goods and services**	**–6.0**	**–6.0**	**–12.1**
17	Goods	–3.1	–3.3	–6.4
18	Services	–2.9	–2.8	–5.7
19	**Government consumption expenditures and gross investment**	**.3**	**.2**	**.1**
20	Federal	–13.7	–11.1	–2.6
21	National defense	–10.3	–8.2	–2.1
22	Defense	–3.6	–3.0	–.7
23	State and local	15.1	11.1	4.0
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	8.4	–.1	8.5

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

Table 2.—Contributions to Change in Gross Domestic Product by Industry, 1977–82, Using Chained (1992) Dollars and Chained (1977) Dollars

Line		Contribution to change in GDP, 1992=100 (percent) (1)	Contribution to change in GDP, 1977=100 (percent) (2)	Difference (1)–(2)
1	**Gross domestic product**	**100.0**	**100.0**	**0**
2	Agriculture, forestry, and fisheries	4.2	7.3	–3.1
3	Mining	–1.0	–1.4	.4
4	Construction	–11.9	–11.0	–.9
5	Manufacturing	4.0	4.9	–.9
6	Durable goods	–2.1	–2.8	.7
7	Nondurable goods	7.1	7.7	–.6
8	Transportation and public utilities	9.6	10.4	–.8
9	Transportation	.1	.2	0
10	Communications	10.3	13.6	–3.3
11	Electric, gas, and sanitary services	–1.9	–1.6	–.3
12	Wholesale trade	13.2	19.7	–6.5
13	Retail trade	6.8	7.5	–.7
14	Finance, insurance, and real estate	38.8	31.4	7.4
15	Services	36.5	27.6	8.9
16	Government and government enterprises	10.3	8.9	1.4
17	Residual (line 1 less lines 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16)	28.5	24.4	4.0

and the residual averages less than 0.1 percent of GDP.

For 1949–81, the residual is larger and averages 1½ percent of GDP.

For 1929–48, the residual averages over 8 percent of GDP; most of this very large residual results from the use of chained (1992) dollars for measuring growth in the World War II era, when prices and patterns of output were changing rapidly.

The residual is mainly negative and shrinks in size as one moves forward in time, but it remains rather volatile (chart 2).

Note on Computing Alternative Chained Dollar Indexes and Contributions to Growth

Users can easily prepare close approximations of contributions to real GDP growth or to the growth of other aggregates using chain-type annual-weighted indexes. The table below shows how to estimate these contributions to real GDP growth, using the cyclical expansion from the second quarter of 1954 to the third quarter of 1957 as an example. This methodology provides a close approximation of the component contributions, as indicated by the "residual" line in the table below. The table of component contributions regularly released by BEA (table 8.2) use exact formulas for attributing growth to the components of GDP or of other aggregates but these tables are limited to contributions to changes from the preceding year or quarter.

The contributions are calculated as follows: First, the levels of real GDP and its major components at a midpoint of the period—in this example, the fourth quarter of 1955—are set equal to the published current-dollar levels. Second, corresponding dollar series for the beginning and end of the period—the second quarter of 1954 and the third quarter of 1957—are computed by extrapolating (multiplying) the fourth-quarter 1955 level for each component by the ratio of the chain-type output index for that component; that is, the ratio of the index from the second quarter of 1954 to the fourth quarter of 1955 and from the fourth quarter of 1955 to the third quarter of 1957. Finally, the contribution of each component to the change in GDP is calculated as the ratio of the dollar change in each component to the dollar change in GDP.

1954:II–1957:III

[1955:IV=100]

Line		Current-dollar levels	Chain-type annual-weighted indexes			Chain-type annual-weighted indexes (ratios)		Dollar-denominated levels		Average annual rate of change	Contribution to change in GDP, 1955:IV=100 (percent)
		1955:IV	1954:II	1955:IV	1957:III	1954:II to 1955:IV	1955:IV to 1957:III	1954:II	1957:III		
1	**Gross domestic product**	**426.4**	**29.6**	**32.5**	**33.5**	**0.91**	**1.03**	**388.2**	**439.7**	**3.9**	**100.0**
2	**Personal consumption expenditures**	**265.6**	**27.2**	**30.1**	**31.1**	**.91**	**1.04**	**240.4**	**275.0**	**4.2**	**67.2**
3	Durable goods	39.6	17.1	21.4	20.1	.80	.94	31.8	37.2	5.0	10.5
4	Nondurable goods	127.5	39.1	42.4	44.0	.92	1.04	117.5	132.5	3.8	29.1
5	Services	98.4	22.6	24.4	26.2	.93	1.07	91.2	105.4	4.6	27.6
6	**Gross private domestic investment**	**73.7**	**25.5**	**34.4**	**32.3**	**.74**	**.94**	**54.8**	**69.2**	**7.5**	**28.1**
7	Fixed investment	66.6	28.3	33.4	32.5	.85	.98	56.6	65.0	4.4	16.3
8	Nonresidential	42.5	23.1	27.5	28.1	.84	1.02	35.6	43.4	6.3	15.2
9	Structures	16.2	44.7	49.7	52.8	.90	1.06	14.6	17.2	5.2	5.1
10	Producers' durable equipment	26.3	15.9	19.8	19.8	.80	1.00	21.0	26.3	7.0	10.1
11	Residential	24.2	44.3	51.1	45.3	.87	.89	21.0	21.4	.6	.9
12	Change in business inventories [1]	7.1									
13	**Exports of goods and services**	**18.3**	**9.6**	**10.5**	**12.7**	**.91**	**1.21**	**16.6**	**22.1**	**9.2**	**10.7**
14	Goods	14.9	10.3	11.1	13.5	.93	1.22	13.9	18.2	8.8	8.5
15	Services	3.3	6.7	8.0	9.5	.83	1.18	2.8	3.9	11.2	2.2
16	**Imports of goods and services**	**18.1**	**11.4**	**12.8**	**13.7**	**.89**	**1.06**	**16.1**	**19.2**	**5.6**	**–6.0**
17	Goods	12.5	9.2	10.4	10.6	.89	1.02	11.1	12.7	4.5	–3.3
18	Services	5.6	20.8	23.1	26.6	.90	1.15	5.1	6.5	7.9	–2.8
19	**Government consumption expenditures and gross investment**	**86.9**	**44.7**	**42.1**	**44.8**	**1.06**	**1.06**	**92.4**	**92.5**	**0**	**.2**
20	Federal	54.4	69.8	60.4	63.4	1.15	1.05	62.8	57.1	–2.9	–11.1
21	National defense	46.7	87.6	74.6	80.9	1.17	1.08	54.9	50.7	–2.4	–8.2
22	Defense	7.7	30.6	29.4	24.7	1.04	.84	8.0	6.5	–6.3	–3.0
23	State and local	32.5	26.1	28.7	31.2	.91	1.09	29.7	35.4	5.6	11.1
24	**Residual (line 1 less lines 2, 6, 13, 16, 19)** [1]							**.1**	**.1**		**–.1**

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in this note (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this note, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

Were analysts to estimate the quarterly residual for 1959–82 by assuming either that the residual in period t was the same as in period $t-1$ or that the change in the residual in period t was the same as in $t-1$, the quarterly mean absolute forecast error would be increased by between 1.1 and 2.0 percentage points.

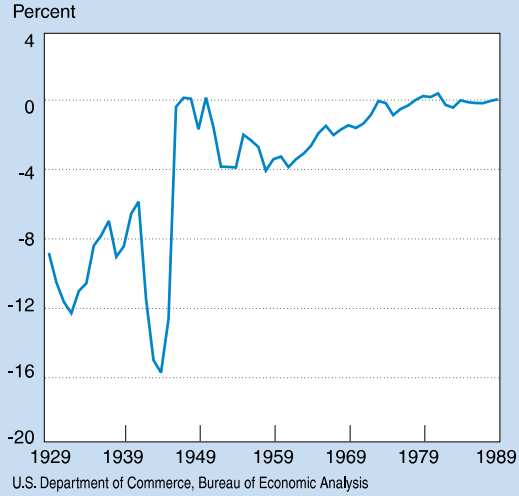
For analyses of changes over time in an individual component, the chained dollars do produce the same results as the chain-type indexes. The percent changes in chained (1992) dollars are based on—and therefore equal to—the percent changes in the chain indexes; the chained dollars are simply indexed to the level of current-dollar GDP and its components during 1992, while the indexes are all indexed to 100.00 in 1992.

For analyses of contributions to GDP growth, however, the problems with using chained (1992) dollars have led BEA to prepare a special table of component contributions (NIPA table 8.2) for periods far from the base period—especially for periods prior to 1982, when both the overall residual and the errors in contributions to growth become quite large. The annual and quarterly indexes and the contributions tables provided by BEA offer a significantly more accurate basis for assessing contributions to growth in the economy, both in the aggregate and by component, than do chained dollars indexed to a single base year.[13]

13. As a result of the increased emphasis on chain-type indexes, BEA is now showing them with an additional decimal place to provide the same level of precision for calculating changes in the indexes as that provided by the chained-dollar estimates.

CHART 2

Residual as a Percent of Real GDP



For users who rely on real estimates that are denominated in dollars, the July 1995 SURVEY contained a sample table that demonstrated how to prepare close approximations of contributions to real growth or relative changes for any period.[14] That example is reproduced in the note accompanying this article for the period from the second quarter of 1954 to the third quarter of 1957. In effect, users can compute a chained-dollar series for any period by using the percent changes in the chain-type annual-weighted indexes to compute chained-dollar series indexed to the current dollars of whatever base period is appropriate for the analysis. In addition, in this article, BEA has provided a number of chained-dollar series over frequently cited time periods, such as decades and business cycles. In computing these series, BEA used different base periods, depending upon the time period analyzed; for example, for decades and business cycles, BEA used the midpoints of these periods. However, users should be aware that these tables of contributions are approximations and may produce misleading results for periods far from the base period or when prices are changing rapidly, such as during the energy crisis of 1973–75.

Presentation of the estimates

Consistent with this discussion, BEA is providing users with the following measures of real output and prices:

- Chain-type quantity and price indexes, percent-change tables, and contributions-to-growth tables (based on the indexes themselves) for 1929 to the present, in NIPA tables 7.1–7.14, 8.1, and 8.2, respectively.
- Annual growth rates for major NIPA measures of real output and prices for all yearly intervals from 1970 to the present, in the "BEA Current and Historical Data" section of the SURVEY, pages D-39 to D-46.
- Chained (1992) dollar estimates for all periods close to the base period, that is, 1982 to the present.
- Chained (1992) dollar estimates for selected aggregate measures, including GDP and GNP for 1929 to the present.
- A series of special supplementary tables in this article that facilitate the use of the chain indexes, including contributions to growth over business cycles and decades (based on

14. See [7], table 1, page 37.

chained dollars indexed to the midpoint of the period) and estimates in chained 1952, 1972, and 1992 dollars (tables 3–7). These tables will be available on the Economic Bulletin Board of the Commerce Department's STAT-USA (**http://www.stat-usa.gov**).

The chain-type quantity and price indexes, in combination with the current-dollar GDP estimates, provide users with the basic data series for the NIPA's. All other analytical tables and presentations are derived from these base data. The chained (1992) dollars provide accurate estimates

Table 3.—Component Contributions to Real GDP Growth Over Expansions, Calculated Using Chain-Type Annual-Weighted Indexes

Line		1949:IV–1953:II (1951:III=100)	1954:II–1957:III (1955:IV=100)	1958:I–1960:I (1959:I=100)	1960:IV–1969:III (1965:I=100)	1970:IV–1973:IV (1972:II=100)	1975:I–1980:I (1977:III=100)	1982:III–1990:II (1986:III=100)	1991:I–1996:IV (1993:III=100)
1	**Gross domestic product**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
2	**Personal consumption expenditures**	**36.6**	**67.2**	**46.7**	**60.6**	**56.2**	**57.0**	**65.4**	**68.6**
3	Durable goods	4.8	10.5	9.4	13.0	18.3	10.9	15.0	16.7
4	Nondurable goods	16.5	29.1	15.9	20.0	13.4	18.6	14.7	15.4
5	Services	15.3	27.6	21.4	27.7	24.5	27.2	35.5	36.4
6	**Gross private domestic investment**	**22.0**	**28.1**	**43.5**	**23.6**	**40.4**	**35.4**	**18.4**	**37.4**
7	Fixed investment	10.0	16.3	20.1	18.3	25.9	29.5	15.3	33.8
8	Nonresidential	8.8	15.2	8.1	15.0	18.8	22.3	9.3	24.5
9	Structures	3.8	5.1	1.5	3.8	3.0	6.9	.3	.8
10	Producers' durable equipment	5.0	10.1	6.3	11.2	15.8	15.3	9.0	23.5
11	Residential	1.2	.9	11.9	3.3	7.4	7.7	6.3	9.5
12	Change in business inventories [1]								
13	**Exports of goods and services**	**1.8**	**10.7**	**5.8**	**6.2**	**12.0**	**14.9**	**18.1**	**29.6**
14	Goods	1.1	8.5	4.5	4.5	10.4	12.7	13.4	24.1
15	Services	.6	2.2	1.3	1.7	1.6	2.2	4.7	5.6
16	**Imports of goods and services**	**–7.6**	**6.0**	**–6.2**	**–9.1**	**–6.5**	**–15.6**	**–20.2**	**–36.6**
17	Goods	–4.2	3.3	–5.1	–7.6	–7.3	–14.5	–16.2	–34.4
18	Services	–3.3	2.8	–1.1	–1.5	.8	–1.1	–4.0	–2.1
19	**Government consumption expenditures and gross investment**	**47.1**	**.2**	**10.9**	**18.4**	**–3.0**	**8.0**	**18.8**	**1.1**
20	Federal	44.5	–11.1	5.7	7.6	–9.4	3.1	7.5	–8.9
21	National defense	43.8	–8.2	1.2	5.4	–10.9	1.0	5.5	–10.4
22	Defense	.7	–3.0	4.5	2.2	1.4	2.1	1.9	1.5
23	State and local	2.4	11.1	5.2	10.8	6.3	4.9	11.3	10.0
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	.1	–.1	–.7	.2	.9	.4	–.5	–.2

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

Table 4.—Component Contributions to Real GDP Growth Over Decades, Calculated Using Chain-Type Annual Weighted Indexes

Line		1930–40 (1935=100)	1940–50 (1945=100)	1950–60 (1955=100)	1960–70 (1965=100)	1970–80 (1975=100)	1980–90 (1985=100)
1	**Gross domestic product**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
2	**Personal consumption expenditures**	**55.1**	**55.8**	**61.5**	**66.7**	**63.4**	**71.3**
3	Durable goods	7.0	13.9	5.7	12.0	10.5	15.5
4	Nondurable goods	40.9	21.7	24.7	22.6	18.0	16.5
5	Services	7.7	20.5	31.4	32.0	34.2	39.0
6	**Gross private domestic investment**	**25.5**	**21.1**	**7.1**	**16.3**	**19.9**	**13.6**
7	Fixed investment	2.7	19.1	8.7	16.5	20.8	11.4
8	Nonresidential	–2.0	9.5	7.3	14.4	18.5	9.2
9	Structures	–6.3	3.2	4.2	3.9	4.7	.6
10	Producers' durable equipment	4.1	6.3	3.1	10.5	13.6	8.6
11	Residential	4.3	9.5	1.5	2.1	3.0	2.3
12	Change in business inventories [1]						
13	**Exports of goods and services**	**3.2**	**3.8**	**7.1**	**7.7**	**20.2**	**17.5**
14	Goods	2.8	2.9	5.6	5.8	16.6	12.4
15	Services	.4	.9	1.5	2.0	3.7	5.3
16	**Imports of goods and services**	**.8**	**–3.4**	**–7.2**	**–9.0**	**–10.0**	**–22.0**
17	Goods	–.4	–2.0	–3.5	–7.2	–10.0	–17.8
18	Services	1.1	–1.2	–3.6	–1.7	–.3	–4.2
19	**Government consumption expenditures and gross investment**	**20.5**	**17.1**	**32.3**	**18.3**	**6.0**	**21.0**
20	Federal	17.0	12.4	20.7	5.8	–2.3	9.9
21	National defense	6.2	12.1	19.4	3.4	–5.5	8.4
22	Defense	11.1	–.3	1.2	2.4	3.1	1.4
23	State and local	3.1	3.7	11.2	12.3	8.3	11.0
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	–5.1	5.5	–.8	–.1	.4	–1.3

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

of percent changes of GDP and its components; they also provide comparisons of levels over time for a single aggregate as well as reasonable approximations of the relative importance, and the contributions to growth, of components for 1982 to the present. The chained (1992) dollars provide data on levels for computing certain key aggregates, such as per capita GDP. The contributions-to-growth tables provide appropriately weighted approximations of the contributions to growth for frequently used components over common intervals—decades and economic expansions. The chained 1952, 1972, and 1992 dollar series for GDP and its major expenditure components provide appropriately weighted estimates for users that want them for all periods. Users interested in chained dollars for specific detailed components or for specific subperiods are referred to the note accompanying this article.

Further work

For recent quarters, BEA's chain-type annual-weighted measure differs from that used for earlier periods: The most recent quarterly values are calculated using as weights the annual

Table 5.—Gross Domestic Product in Chained (1952) Dollars, 1942–62

Line		1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
1	**Gross domestic product**	**260.9**	**303.6**	**327.9**	**324.3**	**288.6**	**285.2**	**297.2**	**295.0**	**321.2**	**345.7**	**358.6**	**375.0**	**372.4**	**398.9**	**406.7**	**414.4**	**410.2**	**440.6**	**451.1**	**461.3**	**489.3**
2	**Personal consumption expenditures**	**146.1**	**150.1**	**154.4**	**164.1**	**184.3**	**188.0**	**192.1**	**197.3**	**209.9**	**212.9**	**219.7**	**230.3**	**235.2**	**252.2**	**259.4**	**265.5**	**267.7**	**283.0**	**290.7**	**296.6**	**311.3**
3	Durable goods	11.6	10.1	9.3	10.5	19.9	23.6	25.1	27.1	33.1	30.1	29.3	33.1	33.1	40.3	38.6	38.6	35.5	40.3	41.1	39.6	44.2
4	Nondurable goods	86.7	89.5	93.1	99.8	105.2	102.4	102.7	104.3	107.5	110.4	114.7	118.3	119.8	125.6	129.9	132.3	133.6	139.1	141.2	143.8	148.4
5	Services	47.9	50.4	52.1	53.9	59.0	61.9	64.2	65.9	69.1	72.5	75.7	79.0	82.2	86.4	90.8	94.3	97.8	103.0	107.5	111.8	117.4
6	**Gross private domestic investment**	**18.5**	**10.7**	**13.4**	**17.6**	**45.4**	**43.6**	**55.4**	**41.9**	**60.1**	**60.4**	**54.0**	**56.5**	**53.9**	**67.2**	**66.2**	**63.1**	**57.6**	**69.7**	**69.4**	**68.7**	**77.5**
7	Fixed investment	15.8	12.2	15.0	20.6	37.4	45.0	49.5	45.2	54.0	51.5	50.5	54.2	55.0	62.2	62.0	61.4	56.8	64.9	65.4	65.1	70.9
8	Nonresidential	11.5	9.6	12.8	18.0	25.9	30.2	31.7	28.7	31.3	32.6	31.9	34.9	34.1	37.9	39.6	40.4	35.7	38.7	40.9	40.5	44.0
9	Structures	4.5	3.3	4.3	5.8	11.5	10.4	11.0	10.6	11.4	12.3	12.2	13.3	13.8	14.7	16.3	16.3	15.3	15.7	16.9	17.1	17.9
10	Producers' durable equipment	7.0	6.3	8.4	12.0	14.5	19.8	20.7	18.1	19.9	20.3	19.7	21.6	20.4	23.2	23.4	24.1	20.5	23.0	24.0	23.4	26.1
11	Residential	4.6	2.7	2.3	2.7	11.6	14.9	17.9	16.5	22.6	18.9	18.6	19.3	20.8	24.2	22.3	20.9	21.1	26.5	24.6	24.7	27.1
12	Change in business inventories [1]																					
13	**Exports of goods and services**	**6.5**	**5.4**	**5.8**	**8.2**	**17.9**	**20.5**	**16.1**	**16.0**	**14.0**	**17.1**	**16.3**	**15.3**	**16.0**	**17.7**	**20.6**	**22.4**	**19.4**	**19.5**	**23.6**	**24.0**	**25.3**
14	Goods	5.2	4.1	4.4	6.6	15.2	17.5	13.6	13.5	11.6	14.2	13.4	12.5	13.2	14.6	17.2	18.5	15.7	15.6	19.3	19.4	20.2
15	Services	1.2	1.3	1.4	1.6	2.7	2.9	2.6	2.5	2.3	3.0	2.9	2.7	2.7	3.1	3.5	3.9	3.6	3.9	4.3	4.6	5.0
16	**Imports of goods and services**	**9.2**	**11.6**	**12.2**	**12.9**	**10.7**	**10.2**	**11.9**	**11.4**	**13.5**	**14.1**	**15.3**	**16.7**	**15.9**	**17.8**	**19.3**	**20.1**	**21.0**	**23.2**	**23.6**	**23.4**	**26.1**
17	Goods	6.1	7.0	7.3	7.3	8.4	8.1	9.2	8.9	10.8	10.6	10.8	11.5	10.6	11.8	12.9	13.3	13.6	16.0	15.7	15.7	18.0
18	Services	2.8	3.9	4.2	4.8	2.3	2.1	2.6	2.5	2.7	3.4	4.5	5.3	5.3	6.0	6.4	6.8	7.4	7.3	7.8	7.7	8.1
19	**Government consumption expenditures and gross investment**	**102.4**	**152.8**	**171.5**	**149.8**	**51.7**	**43.0**	**45.9**	**51.2**	**51.0**	**69.4**	**83.8**	**89.6**	**83.3**	**80.1**	**80.4**	**83.9**	**86.6**	**91.6**	**91.4**	**95.8**	**101.6**
20	Federal	83.7	132.7	151.0	129.9	35.2	25.2	27.0	29.4	27.6	45.4	59.4	63.9	55.3	50.2	49.5	51.2	51.2	54.9	53.2	55.3	59.9
21	National defense	77.5	126.3	144.0	123.9	30.0	20.3	20.3	21.1	20.6	39.3	52.5	55.6	47.5	42.8	42.6	44.4	44.2	45.4	44.5	46.3	49.1
22	Defense	5.4	4.2	4.4	3.7	5.2	5.0	6.9	8.6	7.2	6.1	6.9	8.3	7.9	7.4	6.9	6.8	7.0	9.5	8.7	9.0	10.8
23	State and local	15.8	14.4	13.9	14.2	15.7	17.9	19.1	22.0	23.9	24.1	24.5	25.7	27.9	30.0	30.9	32.7	35.5	36.7	38.2	40.6	41.8
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	–3.4	–3.9	–5.2	–2.6	.1	.3	–.5	.1	–.2	–.1	0	0	0	–.5	–.6	–.5	–.1	0	–.5	–.3	–.2

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

Table 6.—Gross Domestic Product in Chained (1972) Dollars, 1962–82

Line		1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	**Gross domestic product**	**820.4**	**855.3**	**905.1**	**962.8**	**1,025.7**	**1,051.8**	**1,100.8**	**1,134.1**	**1,135.4**	**1,173.0**	**1,237.3**	**1,308.8**	**1,300.4**	**1,294.6**	**1,364.5**	**1,428.2**	**1,504.9**	**1,547.5**	**1,542.3**	**1,577.6**	**1,544.0**
2	**Personal consumption expenditures**	**489.3**	**509.3**	**539.9**	**573.9**	**606.8**	**624.8**	**660.4**	**685.1**	**701.1**	**727.2**	**770.7**	**807.9**	**802.2**	**819.9**	**865.9**	**902.7**	**941.6**	**963.5**	**960.1**	**971.8**	**983.0**
3	Durable goods	53.8	59.0	64.5	72.6	78.8	80.0	88.8	92.0	89.0	97.9	110.4	121.8	113.4	113.3	127.8	139.6	147.0	146.3	134.5	136.1	135.9
4	Nondurable goods	218.1	222.7	233.7	246.1	259.5	263.7	275.6	283.0	289.9	295.1	308.0	318.2	311.9	316.6	332.3	340.9	352.9	360.9	359.4	362.5	364.6
5	Services	218.6	228.4	242.3	255.2	268.2	281.2	295.7	309.9	322.4	334.3	352.3	368.2	377.0	390.2	406.6	423.6	443.5	457.6	466.2	473.3	482.2
6	**Gross private domestic investment**	**116.8**	**124.4**	**134.7**	**153.6**	**166.5**	**159.2**	**167.6**	**177.2**	**164.8**	**183.6**	**205.6**	**230.3**	**211.3**	**172.7**	**207.8**	**240.6**	**268.1**	**274.5**	**243.0**	**265.3**	**227.1**
7	Fixed investment	109.9	118.0	129.3	142.4	150.1	147.1	157.3	166.6	162.5	174.9	195.7	213.5	199.5	177.2	194.7	223.3	248.6	261.7	243.9	248.5	229.6
8	Nonresidential	68.8	72.3	80.8	94.7	106.3	104.6	109.1	117.0	115.8	115.7	126.1	144.4	145.2	130.0	136.2	152.3	173.1	189.8	188.9	199.0	190.2
9	Structures	32.2	32.6	35.9	41.7	44.5	43.4	44.0	46.4	46.5	45.8	47.2	51.0	50.0	44.7	45.8	48.1	53.3	60.0	64.0	69.1	68.0
10	Producers' durable equipment	37.6	40.5	45.5	53.8	62.2	61.5	65.3	70.7	69.4	70.0	78.9	93.5	95.4	85.4	90.7	104.8	120.6	130.4	124.6	129.2	120.9
11	Residential	41.7	46.6	49.3	47.9	43.6	42.2	48.0	49.4	46.4	59.2	69.7	69.2	54.9	47.8	59.1	71.6	76.3	73.5	58.0	53.3	43.6
12	Change in business inventories [1]																					
13	**Exports of goods and services**	**35.8**	**38.5**	**43.6**	**44.5**	**47.5**	**48.5**	**52.1**	**54.9**	**60.9**	**61.3**	**66.2**	**80.7**	**88.4**	**87.9**	**93.0**	**95.2**	**105.1**	**115.1**	**127.6**	**129.1**	**119.9**
14	Goods	28.0	30.2	34.4	34.5	36.9	37.1	40.0	42.1	46.9	46.8	51.8	63.7	68.7	67.2	70.3	71.3	79.2	88.6	99.1	98.1	89.2
15	Services	7.7	8.2	9.2	10.0	10.5	11.4	12.0	12.8	13.9	14.5	14.4	17.0	19.9	21.2	23.4	24.9	26.8	27.1	28.8	31.8	31.8
16	**Imports of goods and services**	**34.0**	**34.9**	**36.7**	**40.7**	**46.7**	**50.1**	**57.6**	**60.9**	**63.5**	**66.8**	**74.2**	**77.5**	**75.5**	**67.0**	**80.1**	**88.6**	**96.3**	**97.9**	**91.4**	**93.8**	**92.6**
17	Goods	22.7	23.6	25.1	28.7	33.2	35.0	42.2	44.5	46.2	50.1	56.9	61.0	59.3	51.8	63.5	71.2	77.6	78.9	73.1	74.6	72.7
18	Services	11.3	11.3	11.6	11.9	13.5	15.1	15.4	16.3	17.2	16.7	17.3	16.6	16.2	15.4	16.4	17.1	18.3	18.5	18.1	19.1	20.1
19	**Government consumption expenditures and gross investment**	**216.0**	**221.0**	**225.4**	**232.2**	**253.3**	**272.6**	**281.0**	**279.4**	**272.9**	**268.0**	**268.9**	**267.2**	**271.7**	**275.9**	**276.1**	**278.6**	**286.7**	**291.2**	**296.4**	**298.4**	**302.3**
20	Federal	126.1	125.6	123.5	123.5	137.6	151.2	152.7	147.5	137.0	127.3	125.1	119.0	118.2	118.0	116.8	118.6	121.1	122.9	128.0	133.3	137.7
21	National defense	103.2	100.6	96.2	94.3	108.1	122.2	124.5	118.5	108.4	97.4	93.2	87.3	84.9	83.7	82.2	82.7	82.8	84.2	87.2	91.9	98.3
22	Defense	23.2	25.3	27.4	29.3	29.7	29.4	28.6	29.2	28.8	29.9	31.9	31.7	33.4	34.4	34.8	36.2	38.6	39.1	41.3	41.7	39.3
23	State and local	90.5	95.9	102.5	109.4	116.4	122.1	129.0	132.6	136.3	140.7	143.8	148.2	153.5	158.0	159.3	159.9	165.6	168.3	168.4	165.0	164.6
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	–3.6	–3.0	–1.7	–.8	–1.7	–3.3	–2.7	–1.7	–.8	–.2	0	.3	2.1	5.2	1.7	–.3	–.4	1.2	6.6	6.8	4.3

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

prices for only the most recently available year. When the next full year of data becomes available, the weights are updated to incorporate the prices from the 2 adjacent years. For example, as part of the annual revision of the NIPA's in August 1996, annual weights for 1995 were incorporated: The quarterly changes from the third quarter of 1994 to the second quarter of 1995 and the annual change for 1995 were recalculated using the weights of the adjacent years 1994 and 1995. Previously, the changes for these periods were calculated using only 1994 weights.

BEA is considering replacing this method for recent quarters with a Fisher chain-type measure that uses weights from the two adjacent quarters. Although weights based on quarterly data are likely to be less stable and subject to more statistical noise and revision than weights based on annual data, there are a number of advantages to the use of adjacent quarterly weights when the adjacent annual weights are not available. First, the use of quarterly weights within a Fisher formula would put the estimates for the most recent quarters on the same conceptual basis as those for earlier periods. (As a result, the product of the real output and price indexes for recent quarters would equal the index for nominal output; it does not with the current weighting system.) Second, based on a review of past revisions, the introduction of changes in weights on a more gradual—quarterly—basis will produce more accurate estimates and reduce the size of revisions when the annual weights are introduced (use of the geometric mean between the adjacent quarters should help smooth out quarterly instability in the estimates). The use of a quarterly chain-type index will also reduce the differences for recent quarters between the chain-price index and the implicit price deflator based on the chained-dollars. Finally, the use of a quarterly chain index will make it easier to model, analyze, and forecast current-period estimates.

In addition to possible changes in the method for calculating real GDP for recent quarters, BEA plans to continue its efforts to develop more accurate estimates of contributions to growth over longer periods to replace the approximations presented in this article.

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Table 7.—Gross Domestic Product in Chained (1992) Dollars, 1982–96

Line		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	**Gross domestic product**	**4,620.3**	**4,803.7**	**5,140.1**	**5,323.5**	**5,487.7**	**5,649.5**	**5,865.2**	**6,062.0**	**6,136.3**	**6,079.4**	**6,244.4**	**6,386.1**	**6,608.4**	**6,742.2**	**6,906.9**
2	**Personal consumption expenditures**	**3,081.5**	**3,240.6**	**3,407.6**	**3,566.5**	**3,708.7**	**3,822.3**	**3,972.7**	**4,064.6**	**4,132.2**	**4,105.8**	**4,219.8**	**4,339.5**	**4,473.2**	**4,577.8**	**4,690.7**
3	Durable goods	285.5	327.4	374.9	411.4	448.4	454.9	483.5	496.2	493.3	462.0	488.5	524.1	562.0	579.8	611.4
4	Nondurable goods	1,080.6	1,112.4	1,151.8	1,178.3	1,215.9	1,239.3	1,274.4	1,303.5	1,316.1	1,302.9	1,321.8	1,348.8	1,390.5	1,421.9	1,442.0
5	Services	1,728.2	1,809.0	1,883.0	1,977.3	2,041.4	2,126.9	2,212.4	2,262.3	2,321.3	2,341.0	2,409.4	2,466.7	2,521.4	2,577.0	2,638.3
6	**Gross private domestic investment**	**587.2**	**642.1**	**833.4**	**823.8**	**811.8**	**821.5**	**828.2**	**863.5**	**815.0**	**738.1**	**790.4**	**857.0**	**979.3**	**1009.4**	**1056.6**
7	Fixed investment	610.4	654.2	762.4	799.3	805.0	799.4	818.3	832.0	805.8	741.3	783.4	836.4	921.1	975.9	1042.1
8	Nonresidential	464.3	456.4	535.4	568.4	548.5	542.4	566.0	588.8	585.2	547.7	557.9	593.6	652.1	714.3	766.8
9	Structures	207.2	185.7	212.2	227.8	203.3	195.9	196.8	201.2	203.3	181.6	169.2	166.3	168.8	181.1	190.0
10	Producers' durable equipment	260.3	272.4	324.6	342.4	345.9	346.9	369.2	387.6	381.9	366.2	388.7	427.6	484.1	534.5	578.6
11	Residential	140.1	197.6	226.4	229.5	257.0	257.6	252.5	243.2	220.6	193.4	225.6	242.7	268.9	262.8	276.7
12	Change in business inventories [1]															
13	**Exports of goods and services**	**311.4**	**303.3**	**328.4**	**337.3**	**362.2**	**402.0**	**465.8**	**520.2**	**564.4**	**599.9**	**639.4**	**658.2**	**712.0**	**775.4**	**825.9**
14	Goods	213.5	207.3	223.7	231.7	243.6	270.5	321.4	361.7	391.6	419.2	448.7	464.5	511.5	565.9	608.8
15	Services	98.5	96.8	105.9	106.1	120.3	133.4	145.0	158.7	173.1	180.8	190.7	193.7	200.9	210.4	218.2
16	**Imports of goods and services**	**325.5**	**366.6**	**455.7**	**485.2**	**526.1**	**558.2**	**580.2**	**603.0**	**626.3**	**622.2**	**669.0**	**730.2**	**817.6**	**883.0**	**939.5**
17	Goods	257.4	292.4	363.1	385.9	425.5	445.2	463.2	482.7	497.3	497.1	544.9	602.6	684.1	744.7	796.3
18	Services	68.9	74.4	92.9	99.7	100.2	113.1	117.1	120.2	129.4	125.3	124.1	127.7	133.8	138.8	143.8
19	**Government consumption expenditures and gross investment**	**960.1**	**987.3**	**1,018.4**	**1,080.1**	**1,135.0**	**1,165.9**	**1,180.9**	**1,213.9**	**1,250.4**	**1,258.0**	**1,263.8**	**1,261.0**	**1,260.0**	**1,260.2**	**1,270.6**
20	Federal	429.4	452.7	463.7	495.6	518.4	534.4	524.6	531.5	541.9	539.4	528.0	509.2	489.8	472.3	467.1
21	National defense	316.5	334.6	348.1	374.1	393.4	409.2	405.5	401.6	401.5	397.5	375.8	355.4	337.0	319.6	313.9
22	Defense	113.3	118.5	115.9	121.8	125.2	125.3	119.1	130.1	140.5	142.0	152.2	153.8	152.6	152.3	152.8
23	State and local	531.4	534.9	555.0	584.7	616.9	631.8	656.6	682.6	708.6	718.7	735.8	751.8	770.5	788.6	804.3
24	Residual (line 1 less lines 2, 6, 13, 16, 19) [1]	5.6	–3.0	8.0	.9	–3.8	–4.0	–2.1	2.8	.6	–.3	0	.7	1.6	2.3	2.6

1. Because change in business inventories (CBI) is the difference between two inventory series and can be either positive or negative, chain-type indexes cannot be constructed for it. Without a separate index, chained-dollars for CBI were not constructed using the method described in the note acccompanying this article (though the value is included in gross private domestic investment). Because no separate values for CBI are constructed in this table, the residual can be calculated only at the major component level. In the NIPA's, chained (1992) dollar values for CBI are calculated from inventory stock series that have been derived using the same chain-type formula that is used to calculate other aggregates.

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This electronic version of the article reflects a few corrections to the initially published version. In particular, in table 3 line 24 on page 65, the residual for 1954:II–1957:III has been corrected to −0.1 from −12.2, and in the "Note on Computing Alternative Chained Dollar Indexes and Contributions to Growth" on page 63, the table (and the accompanying text) has been changed to clarify that columns 5 and 6 present ratios, and those ratios are now shown to two decimal places.