Reliability of GDP and Related NIPA Estimates

By Dennis J. Fixler and Bruce T. Grimm

THE goal of BEA for the national income and product accounts (NIPA's) is to provide a timely, comprehensive, and reliable description of the condition of the U.S. economy.[1] The featured measures—gross domestic product (GDP) and its components and gross domestic income (GDI) and its components—provide a snapshot of the economy and are useful to planning by both government and business.

The term "reliability" is used in this article to refer to the magnitudes of revisions to the estimates of the featured measures. The revisions are the changes from an earlier vintage of estimates to a later vintage. The latest available estimates—which are presumed to be the best estimates—are used as the standards for reliability in most of this article. (See the box "Meaning of Revisions.")

In general, reliability refers to the ability of the successive vintages of GDP estimates to present a consistent, general picture of the economy as the estimates are revised to incorporate increasingly comprehensive and improved source data.

In order to present a timely picture of GDP, BEA produces current quarterly estimates that are based on a combination of preliminary results from Census Bureau surveys (such as those for retail sales and manufacturers' shipments) and extrapolations for a number of other components (such as international trade and a large share of consumer spending on domestic services). As revised and more comprehensive survey data and tax and other administrative data become available, the estimates are revised to incorporate these more complete source data. Because these data come from a wide range of sources—including random and nonrandom surveys, administrative records, and indirect estimates—construction of confidence intervals and standard errors is not strictly possible. Accordingly, it is not possible to exactly measure the accuracy of the estimates, except by reference to the later, more complete and more consistent estimates. (See the box "Vintages and Timing of Revisions.")

Using reliability as a standard, this study finds, as did previous studies, that the early estimates of current-dollar GDP, real GDP, GDI, and their components are reliable and present a useful picture of economic activity.[2] Thus, while the levels of the estimates can and will be revised, these estimates—over the course of the successive revisions that they undergo—are usually able to consistently indicate whether growth is positive or negative, whether growth is accelerating or decelerating, whether growth is high or low relative to trend, and where the economy is in relation to the business cycle.

Since the early 1980s, the revisions to the annual rates of change—without regard to sign—in the quarterly estimates of current-dollar and real GDP have averaged somewhat more than 1 percentage point. A substantial portion of the revisions from the advance (the first) estimates to the latest estimates results from the introduction of new concepts, methods, and source data in the comprehensive and annual revisions of the NIPA's. For example, in the 1999 comprehensive revision, the concept of investment was expanded to include computer software; this change, along with other definitional and statistical changes, raised the GDP growth rates in the latter half of the 1990s by an average of 0.4 percentage point.

The current quarterly revisions tend to be smaller;

1. This definition of reliability is different from that used in statistics to analyze survey results and quality control. Additionally, in statistical work, the term "accuracy" refers to the total measurement error, which in the NIPA's is never observed.

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2. This is the fourteenth of a series of BEA-supported studies of revisions to GDP and related measures. The first covered the period 1942–62 (Jaszi 1965). Studies published prior to the 1991 comprehensive revision emphasized GNP and its components. Studies published thereafter have emphasized GDP and its components. Young (1993) discusses five of the earlier studies. A list of the studies is at the end of this article.

the average revision—without regard to sign—from the advance estimates to the second (or preliminary) estimates is 0.7 percentage point. At the time of the preliminary estimates, survey and customs data for the third month of the quarter for two of the more volatile components of GDP—international trade in goods and change in private inventories—are substituted for BEA's extrapolations used in the advance estimates.

Finally, many of the current quarterly, annual, and comprehensive revisions are offsetting. The mean revision—with regard to sign—from the current quarterly estimates to the latest estimates is roughly 0.4 percentage point.[3]

To put these average revisions in perspective, the mean growth rate for real GDP in 1983:I–2000:IV was 3.6 percent at an annual rate, and the rates ranged from –3.2 to 9.8 percent. In this period, the current quarterly estimates of real GDP

3. As discussed later in detail, the positive mean revisions for this period largely reflect the upward revisions associated with comprehensive revisions. In particular, many definitional revisions that raised the level of GDP were introduced in the comprehensive revisions.

Meaning of Revisions

Total measurement error arises from errors in the source data and in the estimating procedures that use the source data. The latest available estimates are presumed to be the best estimates because it is believed that later source data are more accurate and that estimating procedures tend to improve over time. The vintages of the latest available estimates depend on the time period being examined. At present, the latest available estimates for the years through 1996 are those released in the most recent comprehensive revision (which was completed in March 2000), the latest available estimates for 1997 are those released in the July 2000 annual revision, and the latest available estimates for 1998–2000 are those released in the July 2001 annual revision.

Revisions arise primarily from five sources. The first is the replacement of early source data with later, better data. These replacements occur primarily during the 3 years following the earliest quarterly estimates and during comprehensive revisions when estimates are made based on input-output tables for the years in which economic censuses are taken. The second is the replacement of judgmental estimates with estimates based on source data. These replacements are particularly important in the successive vintages of the current quarterly estimates of inventories, imports, and exports (particularly from advance to preliminary vintages). The third is the introduction of changes in definitions and estimating procedures. Definitional changes are primarily made to adapt the NIPA's to a changing economy; an example is the recognition of computer software as investment in the 1999 comprehensive revision. Changes in estimating procedures are generally made to incorporate new measures or techniques or to incorporate data from new sources; an example is the adoption of chain indexes in 1996, which made the growth rates of real GDP and its components invariant to the choice of base period. The fourth is the updating of seasonal adjustment factors. Because many seasonal adjustments are centered weighted averages, the final seasonal factors for a given year depend on future-year values that are not known at the time of the early vintages of the quarterly estimates. The fifth is corrections of errors in source data or computations. Such corrections are unusual and are typically documented in materials describing the estimates at the time the corrections are made.

Some revisions may affect only components and not GDP or GDI. For example, a change in the allocation of autos sold between consumers and business affects personal consumption expenditures and gross private domestic investment but not GDP.

Small revisions do not necessarily indicate good reliability. For example, some source data may present substantial measurement challenges but are not subject to further revision. Large revisions do not necessarily indicate poor reliability. For example, the definitional change that recognized computer software as investment raised the average growth rate of real GDP by roughly 0.2 percentage point over the 1987–98 period. In addition, definitional changes may result in large revisions to components of GDP that are offsetting and thus do not affect GDP. For example, the movement of Commodity Credit Corporation purchases—which are highly volatile—from the government sector to the business sector in the 1996 comprehensive revision resulted in large offsetting revisions to the two sectors that did not affect either current-dollar or real GDP.

Further, the effect on revisions measures of changes in source data, definitions, and estimating methodology depends on the vintage of estimate in which the change is made. As explained in an earlier BEA study,

> An improvement in the current estimates results in a permanent decrease in revision size, while an improvement in the latest available estimates results in a permanent increase in revision size. Improvement in both the current and latest available estimates results in little change. Improvement that is introduced retrospectively into the latest available estimates, *as is often the case*, results in an increase in revision size for a period of years until the improvement is also reflected in the current estimates. *Thus one cannot assume a close correspondence between changes in the size of revisions and changes in accuracy.*
>
> (Young 1996, 436)

- Successfully indicated the direction of change in real GDP 97 percent of the time.
- Successfully indicated whether real GDP was accelerating or decelerating about three-fourths of the time.
- Successfully indicated whether real GDP growth was high relative to trend about three-fourths of the time and whether it was low relative to trend about two-thirds of the time.
- Successfully indicated the cyclical peak in four of the last five recessions in the period 1969–2000. The miss was the 1990 peak; the current quarterly estimates slowed in the second and third quarters but did not decline until the fourth quarter, while the latest estimates slow in the second quarter and decline in the third and fourth quarters.
- Successfully captured the cyclical trough in three of the five recessions. Both misses were within one quarter of the latest estimates of the quarter of the cyclical trough.

In addition to these characteristics, the current quarterly estimates of real GDP appear to be what earlier studies have described as "efficient" estimates.[4] That is, there does not appear to be any persistent pattern to the revisions that would indicate what future revisions will look like. While BEA intends to conduct further research on this issue, this study finds that

- A revision of any vintage contains very little information about any successive vintage of revision; that is, revisions have no momentum.
- The averages of cumulative revisions—without regard to sign—increase as estimates are revised, suggesting that revisions owe more to getting new information ("news") than correcting errors ("noise").
- The mean revision of the quarterly estimates is positive, but it is not statistically significant.
- A comparison of current-dollar GDP and GDI estimates in the last three business cycles does not show

4. They are efficient in the sense that the earlier estimates reflect all available information. See, for example, Mankiw and Shapiro (1986).

Vintages and Timing of Revisions

The two principal frequencies of NIPA estimates are quarterly and annual. The three current quarterly estimates made for each quarter are labeled—in sequence—advance, preliminary, and final estimates. They are released near the end of each of the 3 months following the end of each quarter. In addition, three annual revision estimates are normally made for each quarter. These are released near the end of July in each of the next 3 years and are labeled the first, second, and third annual revision estimates. (In the years when comprehensive revisions are planned, the annual revision estimates are not made.) After the third annual revision estimates, the estimates for each quarter are generally not revised until the next comprehensive revision; these revisions cover all or most of the quarters for which estimates are published. Comprehensive revisions occur about every 5 years, following the publication of the quinquennial input-output tables. In this article, the comprehensive revisions are labeled by the year the initial version was released. For example, the most recent comprehensive revision is referred to as the "1999 comprehensive revision"; the preliminary version was published in November 1999, and the final and complete version was published in March 2000.

Likewise, there are a number of vintages of annual-frequency estimates. The vintage corresponding to the final current quarterly estimates for a given year is released in late March of the following year; it usually contains a revised first-quarter estimate for the given year that was made during that year's annual revision. In this article, this vintage of annual-frequency estimates is labeled "sum of finals." There are also three successive annual revisions to the annual-frequency estimates; these are labeled the first, second, and third annual revision estimates. Finally, the comprehensive revisions are labeled by the year the initial version was released.

The accompanying table shows the mean absolute revisions for the current quarterly estimates of current-dollar GDP using various vintages as the later standard. For example, some might use the final estimate as a standard for measuring revisions from the advanced estimate because it is the last current quarterly estimate. Such a standard results in approximately a 0.7-percentage point increase in mean absolute revision. Using the first annual revision estimates as the standard instead of the final estimates results in a larger increase in the mean absolute revisions. Further increases result from using the latest available estimates as the standard; these estimates incorporate additional annual-frequency data and statistical and definitional revisions, and they have been benchmarked to one or more quinquennial input-output tables.

Mean Absolute Revisions to Successive Vintages of Current Quarterly Estimates of Quarterly Changes in Current-Dollar GDP to Later Vintages of Estimates, 1983–97

[Percentage points]

	Vintage of revision used as standard			
Vintage of estimate	Preliminary	Final	First annual	Latest
Advance	0.55	0.69	1.07	1.08
Preliminary		0.28	0.87	1.08
Final			0.86	1.11

that the GDI estimates contained information that would have improved the then-contemporary understanding of the economy.

This study also presents new information on revisions to seasonal factors, the patterns of revisions by quarter, and the larger-than-average revisions to real GDP around turning points. These topics will provide the basis for future research on ways to reduce the size of revisions to the early estimates. The studies of the patterns of revisions are part of BEA's broad ongoing efforts to improve the reliability of GDP and related estimates through improvements in source data, methods, and concepts used to estimate GDP.[5]

The remainder of this article describe various quantitative measures of revisions to current-dollar and real GDP, to GDI, and to their major components. The first section presents statistics about quarterly estimates of GDP and its major components that emphasize measures of average revisions, provides additional analyses of revisions to quarterly estimates of GDP, and examines revisions to seasonal factors and revisions to successive vintages of quarterly estimates of GDP. The second section presents statistics about revisions to annual estimates of GDP and its major components and examines the revisions that arise at the time of comprehensive revisions. The third section presents statistics about revisions to quarterly estimates of GDI and its major components. The fourth section presents statistics about revisions to annual estimates of GDI and its major components. The fifth section contrasts the revisions to GDI with the corresponding revisions to GDP. The final section summarizes the results.

Revisions to Quarterly Estimates of GDP

Mean and mean absolute revisions

The measures of reliability featured in this article are the mean revision and mean absolute revision, which are calculated as follows.[6]

Mean revision is the average of the revisions

$$MR = \frac{\Sigma(L - E)}{n}$$

where E is the percentage change in the earlier quarterly (or annual) estimate, L is the percentage change in the later estimate—typically the latest estimate—and n is the number of observations in the sample period over which the summation is calculated.

Because revisions can be positive or negative and thus may offset each other, it is useful to look at the mean absolute revision (that is, the mean revision without regard to sign). The mean absolute revision is the average of absolute values of the revisions:

$$MAR = \frac{\Sigma|L - E|}{n}$$

Table 1 shows the mean absolute revisions for current quarterly current-dollar and real GDP and their major components for 1983–2000. For GDP, there is a modest decrease from the advance to the preliminary estimates and no further decrease for the final estimates. The latest available estimates are used as the standard for sizes of revisions. The magnitude of the revisions depends on the vintage of the estimate chosen as the standard because later vintages incorporate new and more complete data. However, mean absolute revisions for the current quarterly estimates using the first annual revision estimates as the standard are only moderately smaller than those using the latest available estimates. The latest available estimates incorporate additional data, definitional revisions, and statistical revisions (see the box "Vintages and Timing of Revisions").

The three vintages of the current-dollar estimates of GDP all have mean absolute revisions of slightly more than 1.0 percentage point, and the mean absolute revisions to the real estimates are about 0.2 percentage point larger. For comparison, the rate of growth of current-dollar GDP averaged 6.3 percent from 1983:I to 2000:IV and ranged from 0.2 percent to 14.2 percent; the rate of growth of real GDP averaged 3.6 percent and ranged from –3.2 percent to 9.8 percent.

The revision patterns for the components of current-dollar and real GDP are similar to these summary measures. From the advance to the preliminary estimates, the mean absolute revisions decrease for all 17 of the current-dollar components and for 14 of the real components. However, from the preliminary to the final estimates, the mean absolute revisions decrease for only six of the current-dollar and six of the real components. With the exception of personal consumption expenditures (PCE), the components' mean absolute revisions are considerably larger than the corresponding ones for GDP. The mean absolute revisions for the three components of PCE—durable goods, nondurable goods, and services—are larger than those for total PCE. Likewise, the mean absolute revisions for the components of fixed investment are larger than those for total fixed investment. In contrast, the mean absolute revisions for State and local government expenditures are much smaller than those for total government

5. For a discussion of these efforts, see "BEA's Preliminary Strategic Plan for 2001–2005," SURVEY OF CURRENT BUSINESS 81 (December 2001): 23–39.

6. Previous NIPA revisions studies at BEA have featured measures of bias and dispersion. Mean revision is the same as bias with the sign reversed. This change was made to make the measure more intuitive; upward revisions from the earlier to the later estimate are now positive. Mean absolute revision yields the same values as dispersion because of the taking of absolute values in the calculations.

expenditures.

Because change in private inventories is frequently negative, it is not possible to calculate percent changes or percentage point revisions measures. However, the effects of revisions to change in private inventories can be approximated by comparing the revisions measures for the three current quarterly estimates of gross private domestic investment (GPDI)—which is the sum of change in private inventories and fixed investment—with those for fixed investment. The mean absolute revisions for current-dollar and real GPDI are more than double those for fixed investment, indicating that revisions to the estimates of inventories contribute significantly to revisions to the estimates of GPDI.[7]

Table 1. Mean Absolute Revisions to Quarterly Changes in GDP and Its Major Components, Latest Estimates Less Current Quarterly Estimates, 1983–2000

[Percentage points]

	Current-dollar estimates	Real estimates
Gross domestic product		
Advance	1.10	1.28
Preliminary	1.05	1.21
Final	1.05	1.23
Personal consumption expenditures		
Advance	1.09	1.15
Preliminary	1.07	1.14
Final	1.05	1.13
Durable goods		
Advance	3.79	3.89
Preliminary	3.58	3.58
Final	3.59	3.60
Nondurable goods		
Advance	1.60	2.06
Preliminary	1.18	1.76
Final	1.22	1.72
Services		
Advance	1.16	1.11
Preliminary	1.18	1.06
Final	1.22	1.15
Gross private domestic investment		
Advance	7.99	8.01
Preliminary	7.98	7.95
Final	7.91	7.75
Fixed investment		
Advance	2.75	3.25
Preliminary	2.54	3.15
Final	2.56	3.28
Nonresidential		
Advance	3.36	3.82
Preliminary	3.40	3.78
Final	3.28	3.94
Structures		
Advance	5.75	5.44
Preliminary	5.07	4.92
Final	5.11	4.84
Equipment and software [1]		
Advance	3.69	4.40
Preliminary	4.05	4.65
Final	4.11	4.86
Residential		
Advance	4.64	4.66
Preliminary	4.45	4.64
Final	4.53	4.55
Change in private inventories [2]	.....	.....
Net exports of goods and services [2]	.....	.....
Exports		
Advance	4.71	4.71
Preliminary	3.95	4.05
Final	4.21	4.31
Imports		
Advance	5.92	7.00
Preliminary	4.75	6.41
Final	4.82	6.56
Government consumption expenditures and gross investment [3]		
Advance	2.65	3.08
Preliminary	2.68	2.92
Final	2.71	3.00
Federal		
Advance	5.84	6.64
Preliminary	6.07	6.64
Final	6.03	6.70
Defense		
Advance	3.43	4.38
Preliminary	3.25	3.81
Final	3.28	3.86
Nondefense		
Advance	21.77	25.12
Preliminary	22.35	25.32
Final	21.76	24.82
State and local		
Advance	1.55	1.65
Preliminary	1.52	1.59
Final	1.52	1.63

1. Following the 1999 comprehensive revision of the NIPA's, the latest estimates include computer software.
2. Negative values in some quarters make the calculation of percentage changes impossible.
3. Following the 1996 comprehensive revision of the NIPA's, the estimates include consumption of fixed capital.

Table 2 shows the mean absolute revisions for current-dollar and real GDP and their major components and subcomponents for 1983–92 and 1993–2000. The presentation of two time periods separates the estimates for the earlier period, which have now been fully benchmarked to input-output tables (including the 1992 table) from those for the later period, which will be revised when the NIPA's are benchmarked to future input-output tables. In addition, the later period incorporates a change in the treatment of purchases and sales of agricultural goods by the Commodity Credit Corporation (CCC) and an improvement in the Census Bureau's procedures for the processing of information about international trade in goods. These two changes, which were made in 1991 and 1985, respectively, resulted in substantial revisions to the quarterly estimates of change in private inventories, government expenditures, and imports of goods.

The effects of the CCC-related change may be seen by comparing the mean absolute revisions of the estimates of GPDI and of fixed investment. The mean absolute revisions for GPDI are substantially smaller in 1993–2000, but those for fixed investment are only modestly smaller. Likewise, the mean absolute revisions for government expenditures, and its components that include Federal nondefense purchases, are substantially smaller in 1993–2000. (GDP was unaffected because the revisions were offsetting.)

The improvements in the processing of source data for international trade in goods resulted in substantial reductions in mean absolute revisions for the later period. In particular, the mean absolute revisions for imports are about one-third the size of those for the earlier period. The improvements had smaller, but still noticeable, effects on exports.

In addition, the later period includes only about 3 years of real GDP estimates before this measure was

7. Previous revisions studies, however, found that mean absolute revisions to final sales of GDP (GDP less change in private inventories) were only slightly smaller than those for GDP. Thus, revisions to inventories tend to be offset by revisions to the other components of GDP.

Table 2. Mean Absolute Revisions to Quarterly Changes in GDP and Its Major Components, Latest Estimates Less Current Quarterly Estimates for Selected Periods

[Percentage points]

	1983–92		1993–2000	
	Current-dollar estimates	Real estimates	Current-dollar estimates	Real estimates
Gross domestic product				
Advance	1.09	1.28	1.11	1.23
Preliminary	1.13	1.32	0.94	1.07
Final	1.16	1.38	0.91	1.04
Personal consumption expenditures				
Advance	1.40	1.46	0.70	0.77
Preliminary	1.40	1.42	0.66	0.78
Final	1.34	1.42	0.69	0.77
Durable goods				
Advance	4.19	4.12	3.28	3.60
Preliminary	4.02	3.86	3.03	3.21
Final	4.10	4.01	2.64	3.10
Nondurable goods				
Advance	1.78	2.36	1.38	1.67
Preliminary	1.20	1.99	1.16	1.46
Final	1.22	1.97	1.12	1.40
Services				
Advance	1.55	1.43	0.67	0.70
Preliminary	1.60	1.34	0.65	0.70
Final	1.66	1.47	0.66	0.76
Gross private domestic investment				
Advance	10.00	9.44	5.48	6.22
Preliminary	9.65	9.30	5.90	6.25
Final	9.66	9.17	5.72	5.97
Fixed investment				
Advance	3.19	3.76	2.19	2.60
Preliminary	2.75	3.44	2.29	2.78
Final	2.86	3.63	2.19	2.85
Nonresidential				
Advance	3.74	4.27	2.89	3.22
Preliminary	3.52	3.96	3.26	3.58
Final	3.33	4.20	3.25	3.54
Structures				
Advance	5.82	5.40	5.66	5.49
Preliminary	4.44	4.51	5.85	5.43
Final	4.96	4.74	5.30	4.97
Equipment and software[1]				
Advance	3.81	4.95	3.54	3.70
Preliminary	4.14	4.97	3.92	4.25
Final	4.20	5.26	3.94	4.37
Residential				
Advance	5.54	5.62	3.51	3.46
Preliminary	5.33	5.33	3.35	3.49
Final	5.44	5.43	3.38	3.94
Change in private inventories[2]	.....	.....	.....	.....
Net exports of goods and services[2]	.....	.....	.....	.....
Exports				
Advance	4.96	5.26	4.39	4.02
Preliminary	4.76	4.64	2.95	3.31
Final	5.16	5.24	3.03	3.14
Imports				
Advance	8.17	9.67	3.11	3.65
Preliminary	7.27	9.80	1.60	2.18
Final	7.52	10.03	1.46	2.21
Government consumption expenditures and gross investment[3]				
Advance	3.62	4.36	1.44	1.48
Preliminary	3.61	4.21	1.52	1.30
Final	3.71	4.36	1.46	1.29
Federal				
Advance	8.30	9.95	2.78	2.61
Preliminary	8.46	9.70	3.07	2.82
Final	8.44	9.76	3.03	2.87
Defense				
Advance	3.82	4.18	2.94	4.62
Preliminary	3.23	3.04	3.27	4.77
Final	3.23	3.17	3.25	4.73
Nondefense				
Advance	34.46	40.91	5.90	5.39
Preliminary	35.82	41.65	5.51	4.91
Final	34.74	40.50	5.54	5.22
State and local				
Advance	1.50	1.74	1.61	1.54
Preliminary	1.52	1.73	1.52	1.40
Final	1.56	1.79	1.48	1.43

1. Following the 1999 comprehensive revision of the NIPA's, the latest estimates include computer software.
2. Negative values in some quarters make the calculation of percentage changes impossible.
3. Following the 1996 comprehensive revision of the NIPA's, the estimates include consumption of fixed capital.

converted to chain-type indexes from fixed-weight indexes. This conversion eliminated the sensitivity of percent changes in the real estimates to changes in base period of the price indexes used in their estimation.

Overall, the mean absolute revisions for current-dollar and real GDP and most of their components are generally smaller in the later period than in the earlier period. However, the later estimates have been subject to fewer vintages of revisions, so this result does not necessarily indicate that the revisions will ultimately be smaller than those of the earlier period.

Table 3 shows the mean revisions to current-dollar and real GDP and their major components for 1983–2000. The mean revisions for GDP are small and positive, indicating a tendency toward upward revisions. The mean revisions for the preliminary and final estimates are about 0.1 percentage point smaller than those for the advance estimates. The mean revisions for PCE and its components are also positive. With the exception of the current-dollar advance estimates of fixed investment, the mean revisions for GPDI and fixed investment are negative. With the exception of nonresidential structures, the mean revisions of most investment components are also negative. The mean revisions for current-dollar and real exports are large and positive, whereas the mean revisions for final current-dollar imports and for all three vintages of real imports are negative. The mean revisions for total government expenditures and for most of its components are positive. However, the mean revisions for current-

Table 3. Mean Revisions to Quarterly Changes in GDP and Its Major Components, Latest Estimates Less Current Quarterly Estimates,1983–2000

[Percentage points]

	Current-dollar estimates			Real estimates		
	Advance	Preliminary	Final	Advance	Preliminary	Final
Gross domestic product	**0.48**	**0.32**	**0.34**	**0.46**	**0.36**	**0.38**
Personal consumption expenditures	**0.52**	**0.38**	**0.42**	**0.41**	**0.27**	**0.31**
Durable goods	0.63	0.53	0.47	0.55	0.40	0.31
Nondurable goods	0.81	0.49	0.55	1.07	0.76	0.82
Services	0.31	0.24	0.31	0.10	0.04	0.16
Gross private domestic investment	**–0.81**	**–0.48**	**–0.82**	**–1.05**	**–0.68**	**–1.17**
Fixed investment	0.17	–0.32	–0.50	–0.48	–0.80	–1.11
Nonresidential	0.27	–0.46	–0.69	–0.52	–1.12	–1.49
Structures	0.96	0.22	0.34	0.55	0.18	0.17
Equipment and software[1]	0.18	–0.73	–1.22	–0.60	–1.46	–1.97
Residential	–0.10	–0.09	–0.11	–0.45	0.03	–0.15
Change in private inventories[2]	.....	.....	.....	.....	.....	.....
Net exports of goods and services[2]	.....	.....	.....	.....	.....	.....
Exports	2.58	1.07	0.70	2.10	0.84	0.49
Imports	0.87	0.12	–0.36	–0.35	–1.31	–1.67
Government consumption expenditures and gross investment[3]	**0.39**	**0.13**	**0.27**	**0.80**	**0.52**	**0.76**
Federal	0.21	–0.18	0.18	0.30	–0.04	0.47
Defense	0.18	0.17	0.21	–0.30	–0.38	–0.49
Nondefense	–4.35	–5.98	–4.47	6.19	7.92	6.13
State and local	0.44	0.29	0.30	0.97	0.79	0.81

1. Following the 1999 comprehensive revision of the NIPA's, the latest estimates include computer software.
2. Negative values in some quarters make the calculation of percentage changes impossible.
3. Following the 1996 comprehensive revision of the NIPA's, the estimates include consumption of fixed capital.

dollar nondefense expenditures are large and negative, whereas the mean revisions for real nondefense expenditures are large and positive.

Reliability near cyclical turning points

The behavior of the estimates around cyclical turning points provides another view of the reliability of the estimates. Table 4 shows the mean absolute revisions and mean revisions around the peaks and troughs for the last five recessions, beginning with the 1969–70 recession. "Peak" identifies the last positive quarter before the onset of a recession, and "trough" identifies the last negative quarter before the beginning of a recovery. "Previous" identifies the quarter immediately before a peak or trough quarter, and "next" identifies the quarter immediately following a peak or trough quarter. Comparisons of the sizes of the averages of revisions for peaks and troughs must be interpreted cautiously because there are only five observations, and averages—especially mean revisions—tend to be quite sensitive to the period examined.

Table 4. Revisions to Changes in Real GDP at Cyclical Turning Points, Latest Estimates Less Current Quarterly Estimates
[Percentage points]

Quarter	Mean absolute revisions		Mean revisions	
	Advance	Final	Advance	Final
Previous	2.16	2.51	–0.40	–0.10
Peak	0.98	0.50	0.59	0.23
Next	1.56	1.80	0.16	0.62
Previous	2.31	2.26	1.74	1.82
Trough	2.29	2.70	0.02	0.31
Next	2.62	2.64	2.62	1.99
1983–92	1.28	1.38	0.70	0.68

NOTE. The cyclical peaks are 1969:III, 1973:IV, 1980:I, 1981:I, and 1990:II. The cyclical troughs are 1970:IV, 1975:I, 1980:III, 1982:III, and 1991:I. For the first first two recessions, the estimates used are preliminary (there were no final estimates), and they are for gross national product.

At cyclical peaks, the mean absolute revisions for both advance and final estimates of real GDP are somewhat smaller than the mean absolute revisions of these estimates for 1983–92 shown in table 2, and they are well within the range of 1.4–2.4 percentage points found in earlier BEA revisions studies that covered the 1960s and 1970s. The mean revisions at the cyclical peaks are also smaller than those for 1983–92. However, for the "previous" quarters, the mean absolute revisions are nearly double those for 1983–92, but the mean revisions are much smaller than those for 1983–92 and indicate overestimates of growth rates. For the "next" quarters (the initial quarter of negative growth), the mean absolute revisions are modestly larger than those for 1983–92, but the mean revisions are somewhat smaller than those for 1983–92.

At cyclical troughs, the revisions are noticeably larger than at peaks. The mean absolute revisions for both advance and final estimates are roughly double the 1983–92 values. Similarly large mean absolute revisions are found for both the "previous" and the "next" quarters (the initial quarter of positive growth). Although the mean revisions are small at the troughs, they range up to 2½ percentage points for both the "previous" and the "next" quarters. Thus, the upward revisions to the advance and final estimates for these quarters indicate that there is a tendency to overstate declines immediately before troughs and understate growth immediately before recoveries.

Additional analysis of revisions to quarterly estimates

Revisions relative to the trend rate of GDP growth

Table 5 shows the relationship between the final current quarterly estimates of real GDP and its long-term trend rate of growth—which is defined here as 3.4 percent, the median rate of growth of real GDP for 1983:I–2000:IV. "Near" trend growth is defined as being within one standard deviation of the trend; that is, the rates of growth are between 2.5 percent and 4.3 percent. The rows of the table show whether the final quarterly estimates were above, near, or below trend, and the columns show whether the latest estimates are above, near, or below trend. Each entry in each row indicates the percentage of final estimates in each category that are in each category of the latest estimates. For example, the entry at the upper left indicates that 74 percent of the above-trend final estimates remain above trend in the latest estimates. The rows each sum to 100 percent, but the columns do not.

Table 5. Relationships Between the Final Current Quarterly Estimates of Real GDP and the Latest Estimates in Terms of Trend Growth, 1983–2000
[Percent]

Final estimate	Latest estimate		
	Above trend	Near trend	Below trend
Above trend	74	22	4
Near trend	38	43	19
Below trend	7	25	68

NOTE. Above trend is a change at annual rate of more than 4.3 percent, near trend is from 2.5 percent to 4.3 percent, and below trend is less than 2.5 percent.

More than four-tenths of the near-trend final estimates remain near trend, in the latest estimates, nearly four-tenths become above trend, and one-fifth become below trend. Two-thirds of below-trend final estimates remain below trend in the latest estimates, and one-fourth become near trend. Overall, final estimates that are above, near, and below trend remain in the same categories nearly two-thirds of the time. Of the estimates that change categories, nearly two-thirds are revised to a more rapid growth category.

Thus, the final current quarterly estimates of GDP are reliable in the sense that revisions do not generally change the relationship between that estimate of GDP growth and the trend growth rate. However, revisions to real GDP tend to be upward when moving from the final to the latest estimates, a result that is consistent with the upward average revision shown in table 3. The quantitative results for the advance and preliminary current quarterly estimates of real GDP (not shown) are similar.

Revisions by size class

Examining revisions by size provides another perspective on the revisions to GDP and its major components. Table 6 shows revisions to current-dollar GDP and its major components from final to latest estimates for 1983–2000 by size class of revision. This table supplements the mean average revision and the mean revision statistics shown in tables 1 and 3. Rows of the table sum to 100 percent.

The revisions to current-dollar GDP are generally small: 58 percent are less than 1 percentage point, and 84 percent are less than 2 percentage points. For comparison, the average rate of growth for current-dollar GDP was 6.3 percent, and it ranged from 0.2 percent to 14.2 percent.

The revisions to most of the major components are all somewhat larger. However, for PCE, 88 percent of the revisions are less than 2 percentage points, and 5 percent are between 3 and 5 percentage points. For GPDI, just 16 percent of the revisions are less than 2 percentage points, and 61 percent are more than 5 percentage points. These large revisions are partly attributable to the typically large revisions to inventories, but even so, only 51 percent of revisions to fixed investment (which excludes inventories) are less than 2 percentage points, and 16 percent are more than 5 percentage points.

The revisions to exports, imports, and Federal Government expenditures are also often large. For exports, the revisions exceed 5 percentage points 31 percent of the time; for imports, 25 percent; and for Federal Government expenditures, 37 percent. The revisions to State and local government expenditures are typically somewhat less large: 68 percent were less than 2 percentage points, and none were more than 5 percentage points.

Dispersion of the revision measures

In addition to the mean absolute revisions and mean revisions statistics featured in this article, measures of their dispersion can provide additional information about the nature of revisions. Although such measures can be calculated for both mean revisions and mean absolute revisions, the following analysis focuses on mean absolute revisions. The standard deviation of the mean absolute revision is defined as

$$SD = \sqrt{\frac{\Sigma(|L-E| - MAR)^2}{n}}.$$

The distribution of the mean absolute revisions can also be characterized by the mean absolute deviation. More specifically, the mean absolute deviation is the average absolute value of the absolute value of revisions less the mean absolute revision:

$$MAD = \frac{\Sigma||L-E| - MAR|}{n}.$$

In addition, the coefficient of variation of the absolute revisions is the ratio of the standard deviation to the mean absolute revision and gives a sense of the "tightness" of the distribution:

$$CV = (SD / MAR).$$

Table 7 shows these measures for the final estimates of current-dollar and real GDP and their major components for 1983–2000. The standard deviations for current-dollar and real GDP—and for all of their components except imports, Federal expenditures, and Federal nondefense expenditures—are somewhat smaller than the mean absolute revisions. As is the case

Table 6. Shares of Revisions to Quarterly Changes in Current-Dollar GDP and Its Major Components Grouped by Size of Revision, Latest Estimates Less Final Current Quarterly Estimates, 1983–2000

[Percent]

	Size class of absolute value of revision, in percentage points at annual rates						
	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 10	more than 10
Gross domestic product	**58**	**26**	**14**	**1**	**0**	**0**	**0**
Personal consumption expenditures	63	25	7	4	1	0	0
Gross private domestic investment	13	3	6	10	8	33	28
Exports of goods and services	11	13	21	10	15	24	7
Imports of goods and services	29	15	15	8	7	14	11
Federal Government consumption expenditures and gross investment	8	15	18	11	10	22	15
State and local government consumption expenditures and gross investment	40	28	22	6	4	0	0
Addendum:							
Fixed investment	28	25	15	14	1	15	1

for mean absolute revisions, all the components' standard deviations are larger than those for GDP. The standard deviations for PCE are the smallest, and the standard deviations for Federal nondefense expenditures are the largest. The mean absolute deviations for current-dollar and real GDP and their components are all somewhat smaller than the corresponding standard deviations, and their relative patterns are maintained.

For all components except imports, Federal expenditures, Federal nondefense expenditures, and real government expenditures, the coefficients of variation are less than 1.00. The same patterns observed for the other summary measures are again observed for the coefficients of variation. For the various investment measures, however, the coefficients are roughly the same size as those for PCE and its components. In addition, the coefficients of variation for exports are smaller than those for PCE, and the coefficient of variation for current-dollar exports is slightly smaller than that for GDP. Because the mean absolute deviations are smaller than the standard deviations, their use in computing the coefficient of variations would result in smaller values; for imports, the value would be reduced from greater than 1.00 to less than 1.00.

Thus, the distributions of the mean absolute revision for GDP and for some of its components, including PCE, are relatively tight. The pattern is qualitatively the same for the bilateral comparison of the other vintages of estimates (not shown). Accordingly, inferences drawn from the pattern of the movement of mean absolute revisions across vintages are informative.

Dynamics of the average revisions statistics

Revisions by quarter

Additional information about the nature and distribution of revisions may be gained by examining, by quarter, the revisions statistics discussed in the section "Reliability near cyclical turning points." Such a decomposition reveals new patterns of change.

Because BEA receives source data over time, its estimation methods can yield different average revisions for each quarter of the year. For example, the average revisions for the first-quarter estimates may differ from the average revisions for each of the other quarters and for all quarters.

Table 8 shows the mean absolute revisions and mean revisions for the final estimates of current-dollar and real GDP and their components for all first quarters, all second quarters, all third quarters, all fourth quarters, and for all quarters for the years 1983–2000. (The revisions for all quarters are the same summary measures as those presented in tables 1 and 3.)

The mean absolute revisions for current-dollar GDP range from 0.80 percentage point for second quarters to 1.45 percentage points for fourth quarters, and the mean absolute revision for all quarters is 1.05 percentage points. Thus, the mean absolute revisions for the

Table 7. Summary Measures of Absolute Revisions to Quarterly Changes in Current-Dollar and Real GDP and Its Major Components, Latest Estimates Less Final Current Quarterly Estimates, 1983–2000

[Percentage points]

	Current-dollar				Real			
	Mean absolute revisions [1]	Standard deviations	Mean absolute deviations	Coefficients of variation	Mean absolute revisions [2]	Standard deviations	Mean absolute deviations	Coefficients of variation
Gross domestic product	**1.05**	**0.79**	**0.62**	**0.75**	**1.23**	**0.87**	**0.71**	**0.71**
Personal consumption expenditures	**1.05**	**0.93**	**0.69**	**0.89**	**1.13**	**0.93**	**0.71**	**0.82**
Durable goods	3.59	2.80	2.34	0.78	3.60	2.87	2.33	0.80
Nondurable goods	1.17	0.95	0.79	0.81	1.72	1.15	0.95	0.67
Services	1.22	1.11	0.85	0.92	1.15	1.01	0.82	0.87
Gross private domestic investment	**7.91**	**6.29**	**4.93**	**0.80**	**7.75**	**6.29**	**5.04**	**0.81**
Fixed investment	2.56	2.41	1.83	0.94	3.28	3.89	1.94	0.72
Nonresidential	3.28	2.71	2.26	0.83	3.94	3.33	2.72	0.85
Structures	5.11	4.11	3.33	0.80	4.84	4.01	3.35	0.83
Equipment and software [3]	4.11	2.78	2.32	0.68	4.86	3.81	2.96	0.78
Residential	4.53	4.45	3.23	0.98	4.55	3.86	2.99	0.85
Change in private inventories [4]	.....	.....	.....	.....	.....	.....	.....	.....
Net exports of goods and services [4]	.....	.....	.....	.....	.....	.....	.....	.....
Exports	4.21	3.13	32.43	0.74	4.31	3.31	2.66	0.77
Imports	4.82	7.83	4.63	1.62	6.56	10.31	6.36	1.57
Government consumption expenditures and gross investment [5]	**2.71**	**2.63**	**1.84**	**0.97**	**3.00**	**3.27**	**2.32**	**1.09**
Federal	6.03	6.45	4.47	1.07	6.70	7.44	5.36	1.11
Defense	3.28	2.26	1.81	0.69	3.86	3.73	2.63	0.96
Nondefense	21.76	35.13	21.52	1.61	24.82	38.08	25.17	1.53
State and local	1.53	1.14	0.95	0.75	1.63	1.21	0.97	0.74
Addendum:								
Final sales	1.04	1.05	0.73	1.01	1.30	1.65	1.28	1.28

1. These revisions are also reported in the "final" rows of the first column of table 1.
2. These revisions are also reported in the "final" rows of the second column of table 1.
3. Following the 1999 comprehensive revision of the NIPA's, the latest estimates include computer software.
4. Negative values in some quarters make the calculation of percentage changes impossible.
5. Following the 1996 comprehensive revision of the NIPA's, the estimates include consumption of fixed capital.

various quarters range from 24 percent below to 38 percent above the mean average revision for all quarters.

The differences in mean revisions among quarters are even more striking. The mean revisions for GDP range from –0.19 percentage point for third quarters to 1.14 percentage points for fourth quarters, and the mean revision for all quarters is 0.34 percentage point.

The quarter-by-quarter patterns of mean absolute revisions for GDP components differ considerably. For some components, there is little change from quarter to quarter. For example, exports' mean absolute revisions for individual quarters range from 2 percent below to 3 percent above that for all quarters. For other components, there is considerable change from quarter to quarter. For example, equipment and software investment's mean absolute revisions for individual quarters range from 10 percent below to 27 percent above that for all quarters, and residential investment's mean absolute revisions range from 62 percent below to 25 percent above that for all quarters. The quarterly variations in mean absolute revisions for change in private inventories cannot be observed directly, but their impact is suggested by the larger range of gross private domestic investment—from 24 percent below to 43 percent above the average for all quarters—than of fixed investment—from 20 percent below to 15 percent above the average for all quarters.

The patterns of mean revisions for components also differ considerably. Some components have mean revisions that are always of the same sign. For example, the mean revisions for PCE vary from 0.15 percentage

Table 8. Mean Absolute Revisions and Mean Revisions to Quarterly Changes in GDP and Its Major Components by Quarter of Estimate, Latest Estimates Less Final Current Quarterly Estimates, 1983–2000

[Percentage points]

	Mean absolute revisions					Mean revisions				
	Quarters					Quarters				
	First	Second	Third	Fourth	All [1]	First	Second	Third	Fourth	All [2]
Current-dollar estimates										
Gross domestic product	**1.10**	**0.80**	**0.85**	**1.45**	**1.05**	**–0.05**	**0.44**	**–0.19**	**1.14**	**0.34**
Personal consumption expenditures	**1.25**	**0.90**	**1.02**	**1.02**	**1.05**	**0.15**	**0.37**	**0.50**	**0.68**	**0.42**
Durable goods	4.23	3.25	4.05	2.82	3.59	–0.89	1.79	–0.31	1.27	0.27
Nondurable goods	1.35	1.19	0.91	1.25	1.13	–0.16	0.49	0.73	1.13	0.55
Services	1.68	0.77	1.23	1.19	1.22	0.48	0.05	0.55	0.17	0.31
Gross private domestic investment	**11.04**	**5.88**	**6.94**	**7.77**	**7.71**	**–5.84**	**1.38**	**–6.20**	**7.39**	**–0.82**
Fixed investment	2.95	2.39	2.86	2.06	2.56	–0.76	–1.27	–0.84	–0.85	–0.50
Nonresidential	3.56	2.83	4.10	2.65	3.28	–1.10	–1.98	–1.47	1.77	–0.69
Structures	4.94	5.84	5.47	4.20	5.11	–0.17	1.74	–0.29	0.08	0.34
Equipment and software [3]	3.83	3.71	5.20	3.70	4.11	–1.53	–3.09	–2.32	2.08	–1.22
Residential	5.66	5.36	1.74	5.35	4.53	–0.02	0.28	0.43	–1.14	–0.11
Change in private inventories [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Net exports of goods and services [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Exports	4.13	4.18	4.32	4.22	4.21	–0.41	3.75	–1.90	1.38	0.70
Imports	4.12	4.42	6.66	4.10	4.82	–1.80	3.18	–5.04	2.23	–0.36
Government consumption expenditures and gross investment [5]	**3.32**	**2.65**	**2.34**	**2.49**	**2.71**	**2.69**	**–0.55**	**0.10**	**–1.14**	**0.27**
Federal	6.51	6.22	6.04	5.35	6.03	4.57	–1.74	1.04	–3.16	0.18
Defense	3.77	3.56	3.00	2.80	3.28	0.31	–0.29	0.59	0.22	0.21
Nondefense	20.02	26.18	17.25	23.59	21.76	13.75	–15.23	1.69	–18.07	–4.47
State and local	1.69	1.56	1.44	1.42	1.53	1.18	0.10	–0.48	0.39	0.30
Real estimates										
Gross domestic product	**1.35**	**1.05**	**1.06**	**1.46**	**1.23**	**–0.00**	**0.76**	**–0.18**	**0.94**	**0.38**
Personal consumption expenditures	**1.15**	**1.15**	**1.21**	**1.02**	**1.13**	**0.00**	**0.34**	**0.24**	**0.67**	**0.31**
Durable goods	4.68	3.43	3.54	2.76	3.60	–0.96	1.39	0.01	0.80	0.31
Nondurable goods	1.82	2.09	1.20	1.76	1.72	0.01	0.69	0.69	1.63	0.82
Services	1.41	0.76	1.16	1.29	1.15	0.19	0.33	0.33	0.15	0.16
Gross private domestic investment	**11.12**	**5.21**	**7.00**	**7.67**	**7.75**	**–7.21**	**2.13**	**–6.31**	**6.61**	**–1.17**
Fixed investment	3.96	3.26	2.85	3.07	3.28	–1.70	–1.82	–1.07	0.15	–1.11
Nonresidential	5.09	3.72	3.57	3.37	3.94	–2.31	–2.86	–1.87	1.06	–1.49
Structures	4.73	5.33	5.27	4.04	4.84	–0.91	2.26	–0.34	–0.32	0.17
Equipment and software [3]	5.52	5.30	4.07	4.57	4.86	–3.00	–4.36	–2.31	1.78	–1.97
Residential	4.56	5.78	2.22	5.61	4.55	–0.22	0.63	1.02	–2.01	–0.15
Change in private inventories [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Net exports of goods and services [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Exports	2.96	4.82	5.07	4.37	4.31	–0.54	4.11	–2.22	0.62	0.49
Imports	6.05	4.98	9.88	5.32	6.56	–5.14	2.60	–6.68	2.56	–1.67
Government consumption expenditures and gross investment [5]	**4.39**	**2.74**	**2.30**	**2.55**	**3.00**	**3.68**	**–0.03**	**0.34**	**–0.94**	**0.76**
Federal	8.35	6.44	5.95	6.05	6.70	6.30	–1.55	0.50	–3.39	0.47
Defense	4.55	4.56	3.10	3.25	3.86	–1.20	–1.46	0.36	0.35	–0.49
Nondefense	22.90	27.45	18.23	30.70	24.82	–14.37	15.69	–0.77	23.96	6.13
State and local	2.02	1.62	1.42	1.46	1.63	1.43	0.80	0.09	0.93	0.81

1. These revisions are also reported in the "final" rows of the first two columns of table 1.
2. These revisions are also reported in the "final" columns of table 3.
3. Following the 1999 comprehensive revision of the NIPA's, the latest estimates include computer software.
4. Negative values in some quarters make the calculation of percentage changes impossible.
5. Prior to the fourth quarter of 1995, this component was defined as "government purchases" and thus excluded consumption of fixed capital.

point to 0.68 percentage point; the mean revision for all quarters is 0.42 percentage point. Other components have mean revisions that change sign from quarter to quarter. For example, the mean revisions for exports are –0.41 percentage point for first quarters, 3.75 percentage points for second quarters, –1.90 percentage points for third quarters, and 1.38 percentage points for fourth quarters; the mean revision for all quarters is 0.70 percentage point.

The average revisions for real GDP and its components are generally similar to those for current-dollar GDP. The mean absolute revisions for real GDP range from 1.05 percentage points for second quarters to 1.46 percentage points for fourth quarters. The mean absolute revision for all quarters is 1.23 percentage points. Thus, the mean absolute revisions for the various quarters range from 15 percent below to 16 percent above the mean absolute revision for all quarters.

The quarter-by-quarter patterns of real GDP components' mean absolute revisions for the individual quarters again differ considerably, but they are not always in lockstep with the mean absolute revisions for current-dollar estimates. For example, real exports' mean absolute revisions vary from 31 percent below to 18 percent above that for all quarters, a much larger variation than observed for current-dollar exports. Conversely, real equipment and software investment's mean absolute revisions vary from 16 percent below to 14 percent above that for all quarters, a smaller variation than observed for current-dollar equipment and software investment.

The pattern of mean revisions for real GDP and its major components are roughly similar to those for their current-dollar counterparts. Mean revisions for real GDP range from –0.18 percentage point for third quarters to 0.94 percentage point for fourth quarters; the mean revision for all quarters is 0.38 percentage point. Again, some components have mean revisions that have the same signs in all quarters, whereas others change sign from quarter to quarter.

Thus, the quarter-by-quarter patterns of mean absolute revisions and mean revisions for both current-dollar and real GDP and their components typically vary considerably from overall averages, and they fluctuate considerably among the individual quarters. This finding warrants further research, particularly a closer examination of seasonal adjustment of GDP and its components.

Revisions to seasonal factors

BEA adjusts the estimates of some GDP components for seasonality, but most source data are provided on a seasonally adjusted basis. Because of changing seasonal patterns, the seasonal factors used to adjust series are recomputed annually. (For more information, see the box "Seasonal Adjustments.")

Previous BEA studies found that revisions to seasonal factors for GDP are substantial in comparison with revisions to seasonally adjusted GDP.[8] As indicated in Young (1996), "the average absolute revision in the quarterly changes in the seasonal factors in the period 1983 to 1988 . . . is about one half the size of the total revision (seasonally adjusted) from the current estimates to the latest available estimate of GDP." Thus, BEA has held the view that revisions to seasonal factors are an important source of revisions to seasonally adjusted GDP estimates.

The seasonally unadjusted quarterly estimates of current-dollar GDP and its components, which are published about 2 months after annual and comprehensive revisions, correspond to the first through the third annual revision estimates. An examination of these estimates does not give a full picture of the effects of the revisions to seasonal factors for two reasons. First, some source data are not available on a seasonally unadjusted basis, and some of the seasonally unadjusted data are constructed at a different level of detail than the seasonally adjusted estimates. Second, some seasonal factors are revised between the current quarterly estimates and the first annual revision estimates; these revisions are not captured. Nevertheless, a study of the effects of revisions to seasonal factors between the first and third annual revision estimates is useful.

Table 9 presents the revisions to quarterly current-dollar GDP and its major components resulting from revisions due to seasonal factors and from revisions

8. In addition, BEA found that the downward revision to the seasonal factor for change in private inventories in 1990:III was more than half of the downward revision in GDP; this quarter was the cyclical peak in the current quarterly estimates, but the peak has been revised to be one quarter earlier in the latest estimates.

Table 9. Effects of Revisions to Seasonal Factors From First Annual Revision Estimates to Third Annual Revision Estimates of Quarterly Changes in Current-Dollar GDP and its Major Components, 1987–97 [1]

	Mean absolute revisions, Percentage points at annual rates		
	Seasonally adjusted estimates	Seasonally unadjusted estimates	Seasonal factors
Gross domestic product	**0.67**	**1.73**	**1.00**
Personal consumption expenditures	0.57	1.09	0.61
Gross private domestic investment	3.80	7.91	3.91
Fixed investment	1.91	2.40	1.94
Exports of goods and services	1.88	2.78	1.90
Imports of goods and services	1.81	1.54	1.00
Government consumption expenditures and gross investment	1.68	4.51	2.82
Addendum:			
Final sales	1.04	1.30	1.11

1. Seasonally unadjusted estimates were not made in the 1996 annual revision.

due to causes other than seasonal factors for the estimates for 1987–97. The three columns show mean absolute revisions from the first to the third annual estimates for the seasonally adjusted estimates, for the seasonally unadjusted estimates, and for the unrevised seasonally unadjusted estimates times the revised seasonal factors—that is, the revisions due to seasonal factors alone. The first row of table 9 shows that the mean absolute revision for seasonally adjusted GDP is 0.67 percentage point; for seasonally unadjusted GDP, 1.73 percentage points; and for the GDP seasonal factor, 1.00 percentage point. Overall, the mean absolute revisions for the seasonally unadjusted estimates are much larger than those for the seasonally adjusted estimates for GDP and all its major components except imports. The mean absolute revisions due to seasonal factors are also larger than the corresponding revisions for seasonally adjusted GDP and its major components except imports.[9] Thus, the mean absolute revisions to seasonally unadjusted estimates and the revisions due to seasonal factors are both larger than the mean absolute revisions to seasonally adjusted estimates. In the most extreme case, government expenditures, the two mean absolute revisions are 4.51 and 2.82 percentage points, compared with the mean absolute revision to the seasonally adjusted estimates of 1.68 percentage points.

These findings indicate that the revisions due to seasonal factors tend to offset the revisions to seasonally unadjusted estimates. Accordingly, BEA's earlier view

9. The revisions to the seasonal factors for inventories have large effects. The mean absolute revisions for gross private domestic investment are much larger than those for fixed investment. However, the mean absolute revision for final sales due to revisions to seasonal factors is only somewhat larger than that for GDP. This suggests that the revisions to inventory seasonal factors tend to be offset by revisions to the seasonal factors for other components of final sales.

Seasonal Adjustments

Much of the economic source data that are available at sub-annual frequencies (typically monthly or quarterly) contain within-year patterns that approximately repeat each year. For example, many stores make a large portion of their sales during the Christmas season. In order to determine what is new or distinctive about economic activity in a particular month or quarter, it is necessary to remove the effects of these recurring patterns by making seasonal adjustments.

Seasonal patterns change gradually over time. Thus, rather complex methods have been developed to deal with these and other complicating factors. At present, the most widely used seasonal adjustment method is the X–12 ARIMA method developed at the U.S. Bureau of the Census.[1] This method uses a statistical analysis to calculate how the seasonal pattern of a series has changed recently and how it might be expected to change further over the next year.

The GDP estimates are based on data that BEA receives from a large number of different sources, primarily other government agencies and trade associations. Most of these data have already been adjusted for seasonal variation. Source data provided to BEA that have not been checked for seasonal patterns are tested for seasonality and adjusted using the X–12 ARIMA method if seasonality is found. Because of changing seasonal patterns, most of the seasonal factors used to adjust series are recomputed annually. Data for an additional year improve the reliability of seasonal factors calculated for the most recent preceding years. The revised seasonal factors for the most recent 3 years are incorporated in the annual NIPA revisions. Revisions to seasonal factors for earlier years are incorporated in the comprehensive NIPA revisions that occur about every 5 years. For a few series for which seasonal patterns change rapidly, new seasonal factors are calculated each quarter, a process called concurrent seasonal adjustment. The new seasonal factor is applied only to the current quarter; preceding quarters are not revised until the annual revision. The NIPA series for which concurrent seasonal adjustment is used include change in private inventories and, to a lesser extent, private equipment and software.

The seasonal factors are not published by BEA, but they may be calculated for the first annual revision estimates as follows:

$$sf(t)^{1st} = X_{sa}(t)^{1st} / X_{nsa}(t)^{1st}$$

where $sf(t)$ is the seasonal factor for GDP or a component in period t, $X(t)$ is the estimate of GDP or a component in period t, $1st$ refers to the first annual revision estimate of $X(t)$, sa indicates seasonally adjusted estimates, and nsa indicates seasonally unadjusted estimates.

Revised seasonal factors are calculated as

$$sf(t)^{3rd} = X_{sa}(t)^{3rd} / X_{nsa}(t)^{3rd}$$

where $3rd$ refers to the third annual revision estimate of $X(t)$.

Estimates of measures with revised seasonal factors may be used to calculate the mean absolute revisions due to seasonal factors. Unrevised seasonally unadjusted data times revised seasonal factors are calculated as

$$Xr_{sa}(t) = X_{nsa}(t)^{1st} \cdot sf(t)^{3rd}.$$

1. Some source data are seasonally adjusted using similar programs, such as X–11 and X–11 ARIMA. The programs are all designed to take into account special factors that affect seasonal patterns, such as the number of business days in a period or the date of Easter.

may have overemphasized the importance of revisions to seasonal factors because it did not consider the possibility of offsetting effects.[10] In a sense, the finding of offsetting revisions is not surprising, because the purpose of seasonal adjustment is to smooth out seasonal-frequency jumps in a series. For example, an upward revision in an estimate leads to a downward revision in the corresponding seasonal factor (however, some jumps in the estimates are treated as outliers and are not used in seasonal adjustment calculations). In summary, revisions to seasonal factors do not appear to be a principal source of volatility in the estimates. Again, a more detailed analysis of this finding is warranted.

Successive vintages of GDP revisions

This section analyzes whether a revision to the estimates of current-dollar GDP for 1983–98 from one vintage to the next is likely to be followed by similar revisions to succeeding vintages. (The estimates for 1999–2000 are not included in this evaluation, because they will undergo future annual revisions.)

Table 10 shows the correlations of each vintage of revisions with each successive vintage of revisions. For example, the entry at the upper left shows a correlation of 0.26 between the advance-to-preliminary revision and the preliminary-to-final revision. Generally, the correlations are quite small and negative. In particular, all of the correlations involving the vintages of annual revisions are negative.

Table 10. Correlations of Different Vintages of Revisions to Current-Dollar GDP Estimates, 1983–98

	Vintage of subsequent revision				
Vintage of revision	Preliminary to final	Final to first annual	First annual to second annual	Second annual to third annual	Third annual to latest [1]
Advance to preliminary	0.26	–0.03	–0.08	–0.15	–0.09
Preliminary to final		0.09	–0.15	–0.05	–0.24
Final to first annual			–0.20	–0.15	–0.26
First annual to second annual				–0.05	–0.10
Second annual to third annual					–0.21

1. 1983–95.

The correlations reflect several factors. One is that there is nearly an equal chance that a revision from one vintage to the next will be either up or down. For the estimates of current-dollar GDP for 1983–98, the share of upward revisions is only slightly more than half for most successive pairs of revisions, such as the advance-to-preliminary or the third annual-to-final. Overall, the share of upward revisions for all of the successive vintages is 54 percent. The combination of this result and the negative correlations shown in table 10 suggests that the downward revisions are typically larger than the upward revisions.

Although an upward (or downward) revision from the advance to the preliminary estimate of current-dollar GDP is modestly more likely to be followed by another upward (or downward) revision to the final estimate, this result does not hold for other pairs of vintages of estimates. Beginning with the preliminary estimates and going through the third annual estimates, only 39 percent of upward or downward revisions are followed by another revision of the same sign.

Additionally, the sizes of mean absolute revisions for current-dollar GDP vary from one vintage of estimates to the next. The mean absolute revision from the advance to the preliminary estimates is 0.55 percentage point; from the preliminary to final estimates, it is 0.28 percentage point. For later vintages of revisions, the mean absolute revisions from one vintage to the succeeding vintage are each roughly three-fourths of a percentage point.

Thus, a revision of any given vintage contains very little information about any successive vintage of revision. That is, revisions do not have momentum. There is no quarter in the 1983–98 period for which all five vintages of revisions to current-dollar GDP are in the same direction (not shown).

Revisions to Annual Estimates of GDP

Mean and mean absolute revisions

Table 11 shows the mean absolute revisions and the mean revisions for annual-frequency current-dollar and real GDP and their major components for 1983–98. The successive vintages of annual estimates incorporate the increasing amounts of source data that become available following the end of each year.[11] (Data that would allow a complete evaluation of the 1999–2000 estimates are not yet available.)

The estimates of annual current-dollar and real GDP and their major components have much smaller mean absolute revisions than those for the current quarterly estimates of GDP shown in table 1. The sizes of the mean absolute revisions tend to decrease as the successive annual revision estimates are made. For current-dollar and real GDP, the largest decreases occur between the "sum of finals" estimates and the first annual estimates. This result partly reflects the fact that

10. The revisions to GDP due to seasonal factors as shown in table 9 are larger than those cited by Young (1996), because of different time periods and different revision vintages—first annual to third annual in this study, versus current quarterly to latest in Young's article.

11. Annual revisions were not made in the years of comprehensive revisions—1985, 1991, 1996, and 1999. For these years, the comprehensive revision estimates—which incorporate the information contained in annual revision estimates—were substituted for the "missing" annual estimates.

annual estimates are unaffected by revisions to seasonal adjustments or other reallocations of expenditures among the quarters of years. Among the annual revision estimates, the largest decreases are between the second and third annual estimates. As found for the quarterly frequency estimates, the mean absolute revisions for real GDP and its major components are somewhat larger than those for current-dollar GDP and its major components. Similarly, the mean absolute revisions for current-dollar and real GDP are generally smaller than those of their major components. Among the components, PCE has the smallest mean absolute revisions, and nonresidential fixed investment and Federal Government expenditures have the largest.

The mean revisions for current-dollar and real GDP and their major components have values that are roughly similar to those for the current quarterly estimates of GDP. Again, most mean revisions for investment and real imports are negative. Most other mean revisions are positive, including those for the second and third annual estimates of nonresidential fixed investment.

Comprehensive revisions to current-dollar GDP

Comprehensive revisions incorporate both definitional and statistical revisions.[12] Definitional revisions are made to adapt the NIPA's to a changing economy and have little to do with reliability. In addition, definitional revisions, such as the recognition of software as investment in the 1999 comprehensive revision, have generally increased the levels of both current-dollar and real GDP. Chart 1 shows the effects of definitional and statistical revisions in the 1999 comprehensive revision on the levels of current-dollar GDP in 1987–98.

12. Statistical revisions generally reflect the incorporation of better data including new input-output tables, but it is sometimes difficult to separate revisions that are due to better data from those that are due to methodological improvements. For example, the 1996 comprehensive revision incorporated a better methodology for calculating depreciation, but it also incorporated new and revised source data on investment.

Table 11. Mean Absolute Revisions and Mean Revisions to Annual Changes in GDP and Its Major Components, Latest Estimates Less Earlier Vintage Estimates, 1983–98 [1]

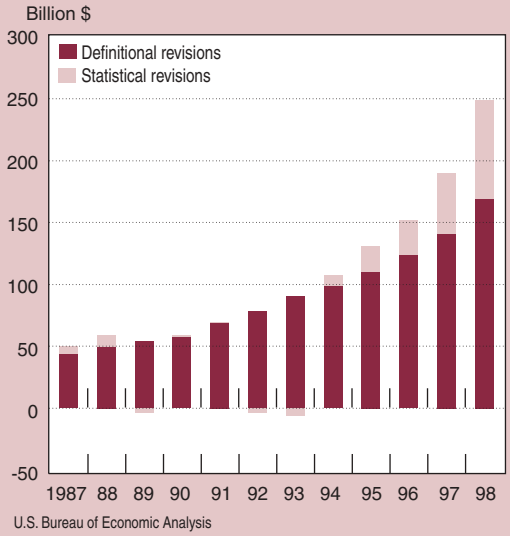
[Percentage points]

	Mean absolute revisions		Mean revisions	
	Current-dollar estimates	Real estimates	Current-dollar estimates	Real estimates
Gross domestic product				
Sum of finals [2]	0.50	0.59	0.43	0.54
First annual	0.37	0.53	0.25	0.42
Second annual	0.35	0.49	0.22	0.40
Third annual	0.26	0.31	0.15	0.38
Personal consumption expenditures				
Sum of finals [2]	0.67	0.59	0.59	0.56
First annual	0.43	0.56	0.41	0.55
Second annual	0.32	0.42	0.24	0.41
Third annual	0.32	0.43	0.19	0.43
Nonresidential fixed investment				
Sum of finals [2]	1.93	3.36	–0.25	–0.79
First annual	1.60	3.00	–0.31	–0.75
Second annual	1.40	2.16	0.71	1.12
Third annual	1.20	1.14	0.65	0.45
Residential fixed investment				
Sum of finals [2]	1.65	1.71	0.19	0.10
First annual	0.58	0.77	–0.22	–0.36
Second annual	0.45	0.36	–0.05	–0.08
Third annual	0.44	0.37	–0.02	–0.13
Change in private inventories [3]	.....	.....	.....	.....
Net exports of goods and services [3]	.....	.....	.....	.....
Exports				
Sum of finals [2]	0.95	1.42	0.72	0.55
First annual	0.76	1.22	0.67	0.35
Second annual	0.58	0.97	0.34	–0.02
Third annual	0.81	1.14	–0.11	–0.44
Imports				
Sum of finals [2]	0.66	1.49	0.48	–0.51
First annual	0.50	1.07	0.27	–0.31
Second annual	0.34	0.76	0.13	–0.22
Third annual	0.47	0.79	–0.04	–0.22
Federal Government consumption expenditures and gross investment [4]				
Sum of finals [2]	1.15	1.67	0.25	0.66
First annual	1.17	1.73	0.25	0.65
Second annual	1.17	1.61	0.32	0.50
Third annual	1.41	1.69	0.36	0.39
State and local government consumption expenditures and gross investment [4]				
Sum of finals [2]	0.80	1.05	0.28	0.85
First annual	0.52	0.68	0.07	0.48
Second annual	0.50	0.57	0.12	0.31
Third annual	0.34	0.43	–0.12	0.11

1. 1983–95 for third annual estimates.
2. For most years, these estimates consist of the final current quarterly estimates for the second, third, and fourth quarters, and a post-final estimate—published in late July—for the first quarter. In years following comprehensive revisions, the estimate for the fourth quarter is a final current quarterly estimate, the estimate for the third quarter is either from the comprehensive revision or is a final current quarterly estimate, and the estimates for the first two quarters are from the comprehensive revision.
3. Negative values in some years make the calculation of percent changes impossible.
4. Following the 1996 comprehensive revision of the NIPA's, the estimates include consumption of fixed capital.

CHART 1

Revisions to Current-Dollar GDP in the 1999 Comprehensive Revision



The definitional revisions raised the levels by large and increasing amounts throughout the period. In contrast, the statistical revisions were small and both positive and negative until 1994; thereafter, they added to the levels by increasingly large amounts.

Although definitional revisions increased the levels of current-dollar GDP in both the 1996 and the 1999 comprehensive revisions, in the 1996 revision, the upward revisions did not increase as rapidly as GDP for the period 1982–95. Thus, the definitional revisions had the effect of lowering the average growth rate. The statistical revisions raised the average growth rate and slightly more than offset the effects of the definitional revisions, resulting in a total revision that was positive but less than 0.005 percentage point (table 12).

Table 12. Effects of Comprehensive Revisions on Growth Rates of Current-Dollar GDP

[Average annual rates of growth, in percent]

	1982–95	1995–98
1996 comprehensive revision:		
Total revision	0.00	.....
Definitional revisions	–0.03	.....
Statistical revisions	0.04	.....
1999 comprehensive revision:		
Total revision	0.09	0.40
Definitional revisions	0.08	0.17
Statistical revisions	0.01	0.23

In the 1999 comprehensive revision, both definitional and statistical revisions increased the average growth rate of current-dollar GDP in 1982–95, but most of the increase was due to definitional revisions. In 1995–98, rapidly increasing statistical revisions had an even larger effect than the definitional revisions; together, they produced a 0.40-percentage point increase in the average growth rate.

More generally, comprehensive revisions tend to raise the long-run average growth rates of current-dollar GDP. As a result of the 1996 comprehensive revision, the average growth rate of current-dollar GDP for 1978:I–1991:III was revised up 0.16 percentage point from the 1991 comprehensive revision. As a result of the 1999 comprehensive revision, the average growth rate for 1978:I–1995:III was revised up 0.08 percentage point from the 1996 comprehensive revision estimates and 0.15 percentage point from the latest estimates in place prior to the 1999 comprehensive revision.

Comprehensive revisions also result in substantial mean absolute revisions from the previous comprehensive revision estimates. Comparing the same three pairs of revisions over the same time periods, the mean absolute revisions for the rates of change in the quarterly estimates of current-dollar GDP were 0.53, 0.54, and 0.55 percentage points, respectively. These revisions are not substantially smaller than the 0.77-percentage-point mean absolute revision from the third annual estimates to the latest estimates for 1983–95.

Revisions to the Estimates of GDI

This analysis of the income-side revisions is somewhat less detailed than that of current-dollar GDP. In particular, no detail is provided on the size distribution of revisions to GDI, and no analysis is provided for successive vintages of revisions. In addition, BEA does not prepare seasonally unadjusted estimates of GDI.

Revisions to quarterly estimates

Table 13 shows mean absolute revisions and mean revisions for the current quarterly estimates of GDI, national income, and their major components for 1983–2000. The mean absolute revisions for GDI are somewhat larger than those for current-dollar GDP, and the mean absolute revisions for national income are even larger. The larger mean absolute revisions for national income reflect substantial and not fully offsetting mean absolute revisions for the components that are added and subtracted from GDI to obtain national income.[13]

Among the major components of GDI and national

13. These components are consumption of fixed capital, business transfer payments, indirect business tax and nontax liability, and current surplus of government enterprises less subsidies. Some of these components were greatly affected by the incorporation of a new depreciation pattern into consumption of fixed capital and a new treatment of government investment that were introduced in the 1996 comprehensive revision. The new depreciation patterns yielded revisions both to consumption of fixed capital and to the capital consumption adjustment for the three types of business income, and the new treatment of government investment resulted in the addition of consumption of capital for government.

income, only compensation of employees has mean absolute revisions similar in magnitude to those for most major components of GDP. The other components have much larger mean absolute revisions, primarily reflecting the very limited availability of current quarterly source data. For the annual revision estimates of the components, the second annual estimates incorporate the final revisions of some annual-frequency data. The large mean absolute revisions to proprietors' income reflect typically large revisions to farm proprietors' income; the mean absolute revisions to nonfarm proprietors' income are only about half as large as those for total proprietors' income. As with the product-side estimates, there is little tendency for reductions in mean absolute revisions when progressing from advance to preliminary to final estimates.

Mean revisions for GDI, national income, and major components are similar in size to those for current-dollar GDP and its major components; in fact, the mean revisions for GDI and national income are smaller than those for GDP. Thus, the larger mean absolute revisions do not translate into larger mean revisions.

Additional analysis of revisions to quarterly estimates

Table 14 shows mean absolute revisions and mean revisions for final estimates of GDI, national income, and their components for 1983–2000, disaggregated by quarter. As with the product-side measures (shown in table 8), the mean absolute revisions for individual quarters differ substantially. For GDI, they range from 1.00 percentage point for fourth quarters to 1.59 percentage points for first quarters. Thus, the mean absolute revisions for the various quarters range from 17 percent below to 33 percent above the mean average revision of 1.20 percentage points for all quarters. The differences in mean revisions are also quite large. The mean revisions for GDI range from 0.06 percentage point for third quarters to 0.75 percentage point for

Table 13. Mean Absolute Revisions and Mean Revisions to Quarterly Changes in Gross Domestic Income, National Income, and Its Major Components, Latest Estimates Less Final Current Quarterly Estimates, 1983–2000

[Percentage points]

	Mean absolute revisions			Standard Deviations	Mean revisions		
	Advance	Preliminary[1]	Final	Final	Advance	Preliminary[1]	Final
Gross domestic income	.....	**1.21**	**1.20**	**0.95**	.....	**0.26**	**0.25**
National income	.....	**1.54**	**1.44**	**1.12**	.....	**0.33**	**0.23**
Compensation of employees	1.18	1.19	1.18	0.82	0.28	0.26	0.22
Proprietors' income with inventory valuation and capital consumption adjustments	10.35	10.66	10.26	10.07	–0.92	–0.96	–0.84
Nonfarm	5.70	5.62	5.74	5.73	–0.72	–0.65	–0.55
Rental income of persons with capital consumption adjustment[2]	.....	.....	.....	.....	.....	.....	.....
Corporate profits with inventory valuation and capital consumption adjustments	.....	11.47	11.62	10.74	.....	0.47	–1.04
Net interest	.....	7.35	7.14	6.44	.....	1.31	1.37

1. No preliminary estimates were made for the fourth quarters of 1995 through 2000.
2. Negative values in some quarters make the calculation of percent changes impossible.

Table 14. Mean Absolute Revisions and Mean Revisions to Quarterly Changes in Gross Domestic Income, National Income, and Its Major Components by Quarter of Estimate, Latest Estimates Less Final Current Quarterly Estimates, 1983–2000

[Percentage points]

	Quarter				
	First	Second	Third	Fourth	All[1]
	Mean absolute revisions				
Gross domestic income	**1.59**	**1.04**	**1.17**	**1.00**	**1.20**
National income	**1.72**	**2.13**	**1.56**	**0.77**	**1.44**
Compensation of employees	1.43	1.07	1.13	1.09	1.18
Proprietors' income with inventory valuation and capital consumption adjustments	11.24	9.03	7.73	13.01	10.26
Of which: Nonfarm	8.86	5.25	3.94	4.91	5.74
Rental income of persons with capital consumption adjustment[2]	.....	.....	.....	.....	.....
Corporate profits with inventory valuation and capital consumption adjustments	15.30	11.10	10.44	9.64	11.62
Net interest	8.60	6.86	6.12	6.97	7.14
	Mean revisions				
Gross domestic income	**0.10**	**0.10**	**0.06**	**0.75**	**0.25**
National income	**–0.18**	**0.68**	**0.21**	**0.20**	**0.23**
Compensation of employees	–0.11	0.20	0.34	0.44	0.22
Proprietors' income with inventory valuation and capital consumption adjustments	–0.65	1.77	6.35	–10.81	–0.84
Of which: Nonfarm	1.07	–0.09	–0.29	–2.87	–0.55
Rental income of persons with capital consumption adjustments[2]	.....	.....	.....	.....	.....
Corporate profits with inventory valuation and capital consumption adjustments	–3.39	2.37	–6.90	3.76	–1.04
Net interest	0.44	2.32	0.60	2.13	1.37

1. These revisions are also reported in the third and seventh columns of table 13.
2. Negative values in some quarters make the calculation of percent changes impossible.

fourth quarters; the average for all quarters is 0.25 percentage point.

The quarter-by-quarter patterns of the mean absolute revisions for national income and its components also show considerable fluctuation. Likewise, the quarter-to-quarter patterns of the mean revisions also vary considerably. The mean revisions for national income, compensation of employees, and proprietors' income have both positive and negative signs, depending on the quarter.

Revisions to Annual Estimates of GDI

Table 15 shows mean absolute revisions and mean revisions for annual-frequency estimates of GDI, national income, and its major components for 1983–98. As with the quarterly frequency estimates, the mean absolute revisions for GDI are somewhat larger than those for current-dollar GDP, and the mean absolute revisions for national income are somewhat larger than those for GDI. Likewise, only compensation of employees has mean absolute revisions similar in magnitude to those of major components of GDP. As was seen for the successive annual revision estimates of the product side, the revisions to the estimates of GDI, national income, and their components are successively smaller moving from the sum of finals estimates to the first annual estimates and then to the second annual estimates. However, moving to the third annual estimates, the mean absolute revisions increase slightly for GDI, national income, and some of their components.

The mean revisions for GDI, national income, and their components are similar in size to those of the corresponding vintages of the estimates of current-dollar GDP and its major components. For GDI and national income, the largest reductions are between the "sum of finals" estimates and the first annual estimates.

The mean absolute deviations for GDI, national income, and their major components are smaller than the corresponding standard deviations. These findings are similar to those for GDP.

Table 15. Mean Absolute Revisions and Mean Revisions to Annual Changes in Gross Domestic Income, National Income, and Its Major Components, Latest Estimates Less Earlier Vintage Estimates, 1983–98 [1]

[Percentage points]

	Mean absolute revisions	Mean revisions
Gross domestic income		
Sum of finals [2]	0.96	0.49
First annual	0.48	0.18
Second annual	0.38	0.06
Third annual	0.41	0.17
National income		
Sum of finals [2]	1.06	0.44
First annual	0.61	0.11
Second annual	0.43	0.04
Third annual	0.56	0.12
Compensation of employees		
Sum of finals [2]	0.94	0.19
First annual	0.34	–0.02
Second annual	0.24	0.01
Third annual	0.24	0.08
Proprietors' income with inventory valuation and capital consumption adjustments		
Sum of finals [2]	4.34	0.42
First annual	2.56	0.45
Second annual	2.01	–0.40
Third annual	2.87	0.21
Of which: Nonfarm		
Sum of finals [2]	4.57	0.64
First annual	3.08	0.15
Second annual	2.55	–0.33
Third annual	3.58	0.18
Rental income of persons with capital consumption adjustment [3]	.....	.....
Corporate profits with inventory valuation and capital consumption adjustments		
Sum of finals [2]	4.80	1.86
First annual	4.83	1.29
Second annual	3.58	0.31
Third annual	2.92	–0.21
Net interest		
Sum of finals [2]	5.27	2.42
First annual	4.23	1.13
Second annual	3.02	0.47
Third annual	1.99	0.74

1. 1983–95 for third annual estimates.
2. For most years, these estimates consist of the final current quarterly estimates for the second, third, and fourth quarters, and a post-final estimate—published in late July—for the first quarter. In years following comprehensive revisions, the estimate for the fourth quarter is a final current quarterly estimate, the estimate for the third quarter is either from the comprehensive revision or is a final current quarterly estimate, and the estimates for the first two quarters are from the comprehensive revision.
3. Negative values in some years make the calculation of percent changes impossible.

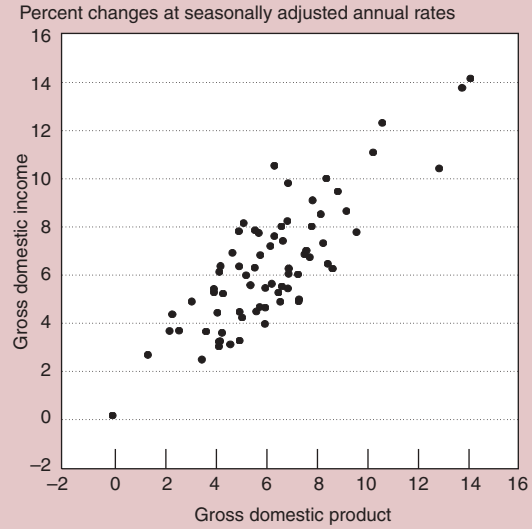
Relationship Between GDI and GDP

Some analysts have suggested that GDI contains information about the current state of the overall economy that is not fully conveyed by GDP alone. Accordingly, some combination of the two measures should be superior to either one alone.

The relationship between the final estimates of GDP and those of GDI is close; their correlation is 0.97 (chart 2). The correlation of revisions to GDP and GDI

CHART 2

Final Quarterly Current-Dollar Estimates of GDP and GDI, 1983–2000



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from final to latest estimates is 0.48.

Some analysts have also suggested that the GDI estimates might be used to provide a more accurate picture of the economy around peaks and troughs. A comparison of GDP and GDI estimates in the last three business cycles, however, does not indicate GDI contained information that would have improved the then-contemporary understanding of the economy.[14] As indicated in chart 3, GDP and GDI maintained their close relationship around the turning points of each of the three cycles. In terms of revisions, the GDP estimates were closer to the latest estimates for all three peaks but for only one of the troughs. In terms of the "next" quarters, the GDP estimates were closer than the GDI estimates twice after peaks and also twice after troughs. Thus, there is only a limited indication that examinations of GDI would provide additional information about the timing of business cycle turning points.

Nevertheless, further research may find a way to use the information from the estimates of GDI to reduce the revisions to the GDP estimates and to improve the contemporaneous understanding of the direction of the economy around peaks and troughs in business cycles.

14. Current quarterly estimates of GDI were not computed prior to 1977, because information did not exist to construct them.

Conclusions

The principal results of this review of revisions are consistent with those of previous BEA studies of revisions. The estimates of current-dollar and real GDP and of GDI are reliable; the mean absolute revisions for the respective quarterly estimates are somewhat more than 1 percentage point, and those of the annual estimates are somewhat less than 1 percentage point. The mean revisions for these measures are positive, primarily reflecting the improvements in the coverage of economic activity that were introduced in comprehensive revisions in order to adapt the NIPA's to a changing economy. In addition, this study found that the quarterly estimates are reliable indicators of whether the economy is growing at rates above, near, or below the long-term trend, though it also found that there is a modest tendency for upward revisions to the latest estimates.

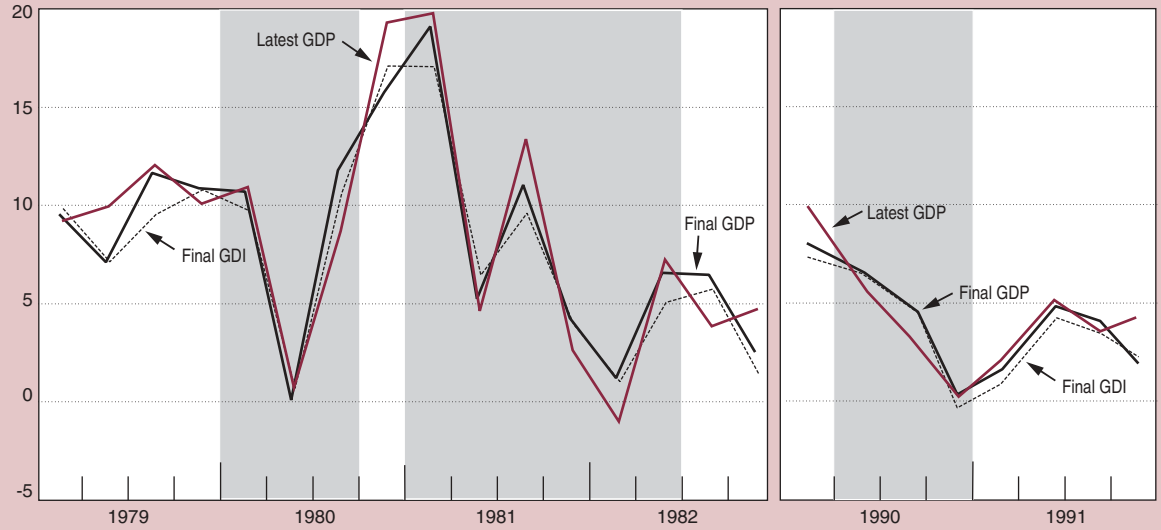
There are substantial reductions in the mean absolute revisions for annual estimates from the "sum of finals" estimates available at the end of the first quarter following a year to those of the first annual revision estimates. There are also noticeable reductions in mean absolute revisions between the first and second annual revision estimates and between the second and third annual revision estimates.

This study is the first to find that there is a modest decline in the mean absolute revisions for the current-

CHART 3

Current-Dollar GDP and GDI Near Cyclical Turning Points

Percent changes at seasonally adjusted annual rates



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dollar and real GDP, GDI, and most of their major components from the advance to the preliminary estimates. This decline is particularly evident for the 1993–2000 period.

This study also finds some properties of revisions that were not described in recent studies; the findings result from both augmenting previous analyses and from new analyses. The properties include the following:

- Around cyclical turning points, the quarterly estimates of real GDP tend to overstate the decline in the initial quarter following the peak and to understate recoveries in the quarters at and following troughs.
- For the individual quarters of the year, there are substantial differences among the four quarters in both the mean absolute revisions and the mean revisions for current-dollar and real GDP, GDI, and their major components.
- For the quarterly estimates of current-dollar GDP and its major components, revisions to the seasonal adjustment factors are larger than revisions to the seasonally adjusted estimates. However, they are not as large as revisions due to other causes, so the revisions due to seasonal factors tend to offset the other revisions.
- Most of the revisions to the GDP estimates are less than 2 percentage points, but most of its major components have many more large revisions.
- Correlations of successive vintages of revisions to current-dollar GDP are generally very small. This result, combined with other ways of looking at successive revisions, indicates that successive revisions do not have momentum.
- The 1996 comprehensive revision of the NIPA's raised the level of current-dollar GDP, but it had little effect on the trend rate of growth because the statistical and definitional revisions largely offset each other. In contrast, the 1999 comprehensive revision raised both the level of GDP and its growth rate—especially in the 1995–1998 period—because the statistical and definitional revisions augmented each other.

The two findings of substantial differences in revisions by quarter and of the offsetting effects of revisions to seasonal factors and revisions due to other causes call for further analysis by BEA.

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