The Revisions to GDP, GDI, and Their Major Components

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THE NATIONAL income and product accounts (NIPAs) provide a timely, comprehensive, and accurate picture of the condition of the U.S. economy. The two featured measures, gross domestic product (GDP) and gross domestic income (GDI), are measures of the same concept of total activity in the U.S. economy. GDP measures activity as the sum of all final expenditures in the economy; it is detailed on the product side of the domestic income and product account. GDI measures activity as the sum of all incomes generated in production; it is detailed on the income side of the account. Thus, in concept GDP and GDI measure the same economic activity, but in practice, they differ because each is constructed using different source data.[1]

Measuring the accuracy of the national accounts estimates is a long-standing challenge for several reasons:

- The early GDP and GDI estimates are based on partial and preliminary source data as well as trend projections when data are not available. They are intended to provide an "early read" on the general picture of economic activity for decisionmakers. These early estimates are subsequently revised as more complete information become available.

- The source data used to estimate the national economic accounts come from a mixture of survey, tax, and other business and administrative data. They are subject to a mix of sampling and nonsampling errors and biases that cannot be measured in terms of standard errors.

- The NIPAs are regularly revised to reflect changes in the economic concepts and methods necessary for the accounts to provide a relevant and accurate picture of the evolving U.S. economy. These updates range from expanding the definition of investment to include research and development activity as well as the production of entertainment, literary, and artistic originals to updating seasonal adjustment factors to reflect the most recent seasonal patterns.

As a result, accuracy cannot be assessed by conventional statistical measures, such as standard errors. Instead, we assess accuracy by examining magnitudes and patterns of NIPA revisions (see the box "Accuracy, Reliability, and Uncertainty"). The NIPAs are revised for a variety of reasons. Some revisions are due to the replacement of early extrapolations for missing source data or preliminary survey data with more complete and accurate annual and benchmark data, such as economic census data.[2] Other revisions are the result of updates to the concepts on which the accounts are based. These revisions to concepts and definitions can be substantial. In six comprehensive revisions—in 2009, 2003, 1999, 1995, 1991, and 1985—the average percentage change in the levels of current-dollar GDP for selected periods was 2 percent, and of that change, about one-third was from concepts and definitions and two-thirds from statistical revisions. In the 2013 comprehensive revision, the dollar level of GDP was revised up an average of 3.1 percent in 1993–2012, mainly because of the recognition of research and development and creation of artistic and literary originals as investment.[3] Another major cause of revisions is updated seasonal adjustment factors, which Fixler and Grimm (2002) reported accounted for an average revision to GDP (without regard to sign) of 1.0 percentage point.

BEA's principal standard of reliability is based on a comparison of its early estimates to the "latest" estimates, which are revised to incorporate the most up-to-date concepts, statistical methods, and the most complete and accurate source data available. These

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1. The difference between GDP and GDI is allocated to the income side of the account, and is known as the statistical discrepancy.

2. Economic censuses are conducted by the Census Bureau every 5 years and provide detailed product information on the goods and services produced by each industry in the United States. These data are the basis for BEA's benchmark input-output accounts, which are used to set the benchmarked level of GDP.

3. The end point of this study is 2012 because at the time this study was conducted, there were no annual revision estimates available for 2013. The 1983–92 period, which was included in several earlier studies, has been dropped in order to emphasize more recent issues affecting reliability. In addition, this study was conducted with data that does not reflect the 2014 annual revision of the NIPAs.

comparisons indicate that revisions do not substantively change BEA's measures of long-term growth, the picture of business cycles, and trends in major components of GDP. Economic policy decisions should not need to be reconsidered in the light of revisions to GDP estimates, and policymakers should be able to rely on the early estimates as correctly indicating the state of the economy. More specifically, BEA judges the qualitative reliability of its early estimates by whether they present the same general picture of economic activity as the latest estimates in terms of the following:

- Long-term growth rates
- Trends in saving, investment, government spending, corporate profits, and other key components of GDP and GDI

- Broad features of the business cycle, including the timing and depth of recessions, the strength of recoveries, and the major components contributing to growth and contractions
- The patterns of quarterly growth, including whether growth in any particular period is high or low relative to trend, is accelerating or decelerating, or is positive or negative

Quantitatively, revisions are measured as the changes from an earlier vintage of a given estimate to a later vintage of that estimate, for example, from the third current quarterly estimate to the first annual revision estimate (see the box "Vintages and Timing of Revisions"). Because the latest vintage incorporates the most recent comprehensive revision, they incorporate

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Accuracy, Reliability, and Uncertainty

How accurate are the gross domestic product (GDP) estimates? This is a fairly common question, often inspired by the release of revised estimates with the passage of time. From a statistical perspective, when one speaks of the accuracy of an estimate, one is usually referring to the difference between the estimate and some "true" value. For example, the difference between a sample mean and a population mean that is as taken as the true value.

The fact that BEA provides a sequence over time of estimates for a given quarter—which are referred to as vintage estimates—implies that users of the data should understand that there is some uncertainty surrounding the estimates, especially the early estimates. Because the true value of GDP can never be observed, its accuracy cannot be assessed.

However, over time, BEA acquires more and better information about GDP and schedules several revisions to the advance estimate of quarterly GDP. It is therefore able to revise its estimate of GDP. These revisions are believed to be a better estimates of the true value of GDP. The revised estimates can be viewed as repeated estimates of the aggregate economic activity for that quarter. By assessing the performance of these revised estimates, BEA can assess the reliability of estimates.

The reliability of the GDP estimates, as assessed by studying the revision patterns, seeks to answer these questions: how similar are the repeated estimates of GDP for a given quarter? And do they tell the same story? Quantitatively, reliability is assessed by measuring the revision magnitudes and the corresponding means and standard deviations. Qualitatively, it is assessed by looking at such measures as the frequency of directional changes in the estimates. These measures are explained more fully in the text.

By using the means and standard deviations for revisions between different vintages of the GDP estimates given in tables 15 and 16 (page 22), a user can construct confidence intervals for an estimate. For example, consider the difference between the advance and second

quarterly estimate of real GDP for 1993–2012. Table 1 shows that the mean difference between these two estimates is 0.10 percentage point. (Note, however, that this mean revision is statistically indistinguishable from zero). Using the standard deviation of the revision between the advance and second estimates, 0.654 percentage point, and assuming a normal distribution, one can construct a 90 percent confidence interval for the revisions.

$$\bar{x} \pm z_{a/2}s = 0.10 \pm 1.65 \times 0.654 = 0.10 \pm 1.08,$$

where x bar is the mean, $z_{a/2}$ defines a 90 percent confidence interval (1.65), and s is the standard deviation. The same procedure could be used for all revisions between vintages. So what can be said about the uncertainty of the advance estimates? Using a 90 percent confidence criterion, the revision between the advance and second estimates is in the interval (–0.98 to 1.18). One could use this information to estimate the second estimate given the advance estimate. For example, the advance estimate for the first quarter of 2013 was 2.5 percent at an annual rate. Using the above equation, one could say with 90 percent confidence that the second estimate would be between 1.52 percent and 3.68 percent. In fact, the second estimate was 2.4 percent.

Given that BEA routinely revises its estimates during the course of a year, one might ask why BEA produces point estimates of GDP instead of interval estimates. In his review of the then new estimates of national income, Kuznets (1948) remarked, "The very fact that the estimates are cast in the form of unique series and not of ranges, is itself an invitation to treat them as firm results and tend to discourage questioning whether a total of x billion might just as well read $x+a$ or $x–a$." Although interval estimates would inform users of the uncertainty surrounding the estimates, most users prefer point estimates, and so they are featured. However, BEA provides the information that enables an interested user to construct their own interval estimate.

all the available source data that are believed to be the most reliable. Over the long run, this study finds the following:

- Revisions to long-term growth rates are small, averaging less than 0.1 percentage point for average growth rates over the 1993–2012 period.
- With the exception of conceptual revisions like the addition of R&D, there are no substantial revisions, as measured by shares of GDP or GDI for key components such as investment and government expenditures or for the national saving rate.
- The overall pattern of change in GDP over time is little changed by the revisions (chart 1).

In the short run, there are three vintages of "current quarterly" estimates of GDP—the advance, the second, and the third estimates. Each estimate is produced using a wide mix of source data—preliminary survey results, such as the Census Bureau's surveys of monthly retail trade and quarterly services as well as manufacturers' shipments and inventories, various indirect indicators, trade industry data, and some trend projections—that are later revised to reflect more complete information.[4]

The three vintages of GDP estimates successfully indicate the following:

- The direction of change in real GDP 96 percent of the time
- The acceleration or deceleration of growth about 75 percent of the time
- The relative magnitude of growth—whether it was above, near, or below trend (near trend is within one standard deviation from the mean) about 83 percent of the time
- The cyclical peaks before five of the seven recessions in 1969–2012
- The cyclical troughs of five of the seven recessions[5]

Early quarterly estimates are replaced successively with three vintages of "current annual" estimates that are primarily based on increasingly complete annual source data. Approximately every 5 years, the annual estimates are replaced with benchmark estimates when BEA conducts its comprehensive revisions of the NIPAs.

The measures of reliability used by BEA and discussed in this article are mean absolute revisions (MARs) and mean revisions (MRs). The MARs to the annual rates of change—that is, taking the average of the revisions without regard to sign—from the current quarterly estimates to the latest estimates for 1993–2012 of both current-dollar and real GDP have averaged somewhat more than 1 percentage point. (See the box "Mean Revisions, Mean Absolute Revisions, and Standard Deviations.") The MRs—that is taking the

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Vintages and Timing of Revisions

The Bureau of Economic Analysis prepares quarterly and annual estimates of gross domestic product (GDP) and gross domestic income (GDI). It prepares three current quarterly vintages of GDP estimates—advance, second, and third estimates. The advance estimates for a quarter are released about a month after the quarter ends. The second estimates for the quarter are released about 2 months after the quarter ends. And the third estimates are released about 3 months after the quarter ends. In addition, as part of the annual revision of the national income and product accounts (NIPAs) that are released in late July of each year, the quarterly estimates for the 3 preceding years—and possibly more—are revised.

For GDI, BEA prepares a fourth vintage of quarterly estimates. These revised estimates, which incorporate data from the quarterly census of employment and wages, are released with the second estimates of GDP for a quarter. These revised estimates are available beginning with the estimates for the first quarter of 2002.

BEA initially prepares four vintages of annual estimates—early annual, first annual, second annual, and third annual estimates. For GDP and GDI, the early estimates are the sum of the third quarterly estimates for that year. The estimates of GDP are released in March with the third estimates for the fourth quarter of that year. The estimates of GDI are released with the release of the fourth estimates for the fourth quarter of the year in late May. In most years, the quarterly estimates for the first quarter of the previous year are from the first current annual estimate released the previous summer. The current annual estimates for the 3 preceding years are revised as part of the annual NIPA revision. After the third annual revision of the estimates for a year is released, these estimates are generally not revised or released again until the next comprehensive revision. Occasionally, however, revisions extend further back in time.

Annual NIPA revision estimates are superseded by comprehensive NIPA revisions, which occur about every 5 years. These revisions incorporate changes in definitions, in classifications, and in statistical methodology. The most recent comprehensive revision was released in late July 2013. It presented revised annual estimates for 1929–2012 and revised quarterly estimates for 1947–2012. The latest available estimates for 1990–2012 in this study are the comprehensive revision estimates of 2013.

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4. For more information on the source data underlying GDP and GDI estimates, see Holdren (2014).

5. No major measure of economic activity captures all of the cyclical peaks and troughs of all of the postwar recessions. This applies to GDP and GDI as well as the four monthly frequency measures emphasized by the Business Cycle Dating Committee of the National Bureau of Economic Research in determining peaks and troughs. See Grimm (2005).

averages and allowing both positive and negative values for the revisions—have averaged about –0.1 percentage point.

The MARs between the current quarterly estimates are smaller. For example, the MAR from the advance estimates to the second estimates of GDP is 0.5 percentage point, and the MAR from the advance estimates to the third estimates is 0.6 percentage point. The MAR from the second estimates to the third estimates is 0.2 percentage point.

MRs indicate whether the revisions are generally positive or negative. Because revisions may be offsetting, the MRs are much smaller than the MARs. The MR for real GDP from the advance estimates to the latest estimates is between 0 and –0.1 percentage point, much of which reflects the result of NIPA comprehensive revisions. The MRs from the second and third estimates to the latest estimates are both between 0 and –0.2 percentage point. To put these MRs into context for 1993–2012, the mean growth of real GDP was 2.5 percent, and the growth rates ranged from –8.3 percent to 7.8 percent.

The remainder of this article discusses (1) revisions to quarterly estimates of GDP and its components, (2) revisions to annual estimates of GDP and its components, (3) revisions to quarterly estimates of GDI and

Chart 1. Percent Change in Real GDP, 1993–2012

U.S. Bureau of Economic Analysis
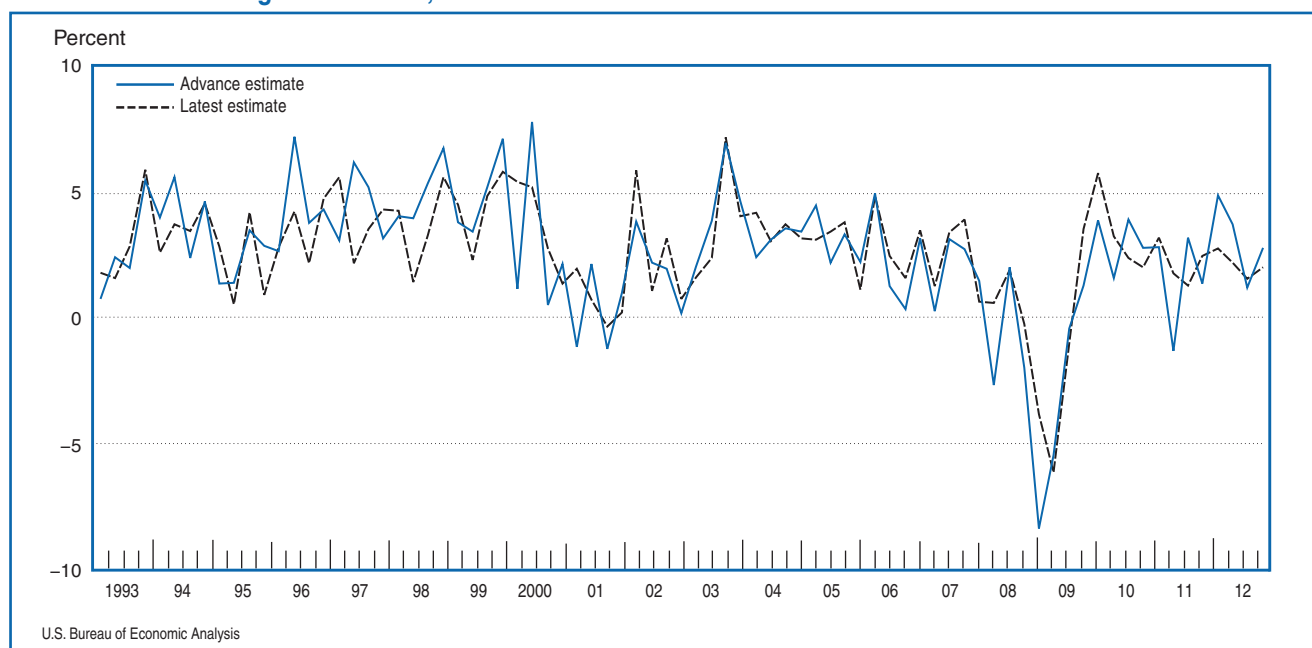
Mean Revisions, Mean Absolute Revisions, and Standard Deviations

By convention, revisions are calculated as the later vintage estimates less the earlier vintage estimates; that is, for any time t, the revision is

$$R_t = L_t - E_t$$

where L is the percent change in the later vintage quarterly or annual estimates, and E is the percent change in the earlier vintage estimates. Percent changes in quarterly estimates are at annual rates, this corresponds to the convention generally used for the estimates.

The mean revision is the average of the revisions in the sample period.

$$MR = \Sigma_t R_t / n, \, t = 1, \ldots, n$$

The revisions can be positive or negative, so they may be offsetting. As a result, it is also useful to look at the mean absolute revision, which is the average of the absolute revisions in the sample period.

$$MAR = \Sigma_t |R_t| / n, \, t = 1, \ldots, n$$

For some purposes, it is also useful to calculate the standard deviation of the revisions. The standard deviation is the square root of the variance of the revisions. In turn, the variance is the average of the square of the deviation of the revisions about their mean.

$$SD(R) = Var(R)^{1/2}$$

and

$$Var(R) = \Sigma_t (R_t - MR)^2 / n, \, t = 1, \ldots, n$$

The mean absolute revision and the standard deviations are complementary measure of the distribution of the revision around their mean.

its components, (4) revisions to annual estimates of GDI and its components, and (5) the relationship of quarterly estimates of GDP and GDI and weighted averages of the two measures. These are followed by a brief summary and conclusions.

Revisions to Quarterly Estimates of GDP

The featured reliability measures featured MRs and MARs from the three vintages of current quarterly estimates to the latest estimates. Standard deviations are also shown in selected tables, providing information about the distribution of the revisions.

Mean absolute revisions

The measures of revisions for real and current-dollar GDP and their components are shown in table 1. In

1993–2012, the MARs for both current-dollar GDP and real GDP are somewhat larger than 1.2 percentage points for both the second and third current quarterly estimates, with those for real GDP slightly smaller than those for current-dollar GDP. For both measures, the MARs decline slightly but steadily from the advance estimates to the third estimates.[6]

In general, previous BEA revision studies have found little or no tendency for MARs to decline with successive vintages of estimates, in either real or current dollars. However, this study—which drops the 1983 to 1992 time period included in earlier studies— finds that the MARs for GDP and for many of its

6. This is somewhat different from the results of previous BEA studies, which found no particular tendency of MARs to increase or decrease with successive estimates.

Table 1. Revisions, Current Quarterly Estimates to the Latest Estimates, Changes in Gross Domestic Product and Its Major Components, 1993–2012

[Percentage points]

Vintage	Mean revision		Standard deviation		Mean absolute revision		Vintage	Mean revision		Standard deviation		Mean absolute revision	
	Current dollar	Real	Current dollar	Real	Current dollar	Real		Current dollar	Real	Current dollar	Real	Current dollar	Real
Gross domestic product							Second	−1.10	−1.58	6.44	5.84	5.23	4.83
Advance	0.12	−0.06	1.69	1.61	1.35	1.29	Third	−1.36	−1.40	6.62	6.08	5.44	4.98
Second	−0.01	−0.17	1.56	1.53	1.28	1.25	**Residential**						
Third	−0.10	−0.19	1.53	1.49	1.21	1.20	Advance	0.67	0.06	6.02	4.88	4.49	3.81
Personal consumption expenditures							Second	0.38	−0.22	5.29	4.52	3.89	3.48
Advance	−0.06	−0.07	1.27	1.19	1.00	0.95	Third	0.09	−0.44	5.34	4.47	3.61	3.45
Second	−0.09	−0.10	1.13	1.05	0.89	0.82	**Change in private inventories [1]**						
Third	−0.10	−0.10	1.15	1.05	0.87	0.82	**Net exports of goods and services [1]**						
Durable goods							**Exports**						
Advance	−0.12	−0.23	5.50	5.53	4.31	4.40	Advance	4.98	1.34	12.09	4.64	4.14	3.69
Second	−0.06	−0.15	5.35	5.38	4.33	4.42	Second	1.29	0.31	5.23	4.00	3.29	3.11
Third	−0.15	0.21	5.28	6.00	4.24	4.65	Third	0.19	0.24	4.28	3.81	2.69	3.00
Nondurable goods							**Imports**						
Advance	−0.21	0.01	2.59	2.31	1.96	1.68	Advance	0.71	0.77	5.53	5.09	4.37	4.16
Second	−0.33	−0.02	2.39	2.32	1.82	1.69	Second	0.14	−0.18	4.62	3.87	3.28	3.00
Third	−0.33	−0.10	2.45	2.25	1.83	1.61	Third	0.11	−0.06	4.13	3.78	3.19	2.91
Services							**Government consumption expenditures and gross investment**						
Advance	−0.05	−0.12	1.14	0.99	0.86	0.81	Advance	0.30	0.03	2.02	1.88	1.65	1.52
Second	−0.04	−0.18	1.09	1.00	0.84	0.79	Second	0.08	−0.09	2.06	1.90	1.58	1.48
Third	−0.05	−0.14	1.05	1.01	0.80	0.76	Third	0.07	−0.02	2.07	1.85	1.59	1.45
Gross private domestic investment							**Federal**						
Advance	0.59	−0.66	6.63	6.97	5.16	5.27	Advance	0.10	−0.06	3.40	3.29	2.76	2.60
Second	−0.11	−0.99	7.15	7.20	5.82	5.87	Second	0.00	0.01	3.58	3.47	2.75	2.76
Third	−0.24	−1.03	6.88	6.90	5.61	5.63	Third	0.03	0.12	3.51	3.39	2.72	2.71
Fixed investment							**Defense**						
Advance	0.70	−0.34	3.47	3.54	2.71	2.79	Advance	−0.14	−0.28	4.61	4.56	3.55	3.39
Second	0.06	−0.84	3.44	3.53	2.68	2.85	Second	−0.12	−0.10	4.46	4.33	3.43	3.18
Third	−0.01	−0.92	3.53	3.50	2.74	2.92	Third	−0.05	−0.01	4.39	4.24	3.33	3.04
Nonresidential							**Nondefense**						
Advance	0.08	−0.60	4.36	4.39	3.39	3.51	Advance	0.45	0.20	5.79	5.48	4.22	4.16
Second	−0.61	−1.18	4.48	4.46	3.61	3.72	Second	0.00	−0.05	6.14	5.81	4.43	4.38
Third	−0.76	−1.22	4.47	4.43	3.49	3.75	Third	−0.05	−0.11	6.17	5.89	4.56	4.61
Structures							**State and local**						
Advance	2.85	1.39	10.81	9.17	8.32	7.10	Advance	0.45	0.11	2.67	2.08	2.10	1.59
Second	1.47	0.16	10.62	9.46	7.67	6.96	Second	0.12	−0.11	2.52	2.00	1.85	1.61
Third	0.86	−0.11	10.17	7.92	7.13	5.89	Third	0.13	−0.18	2.55	2.14	1.89	1.64
Equipment and intellectual property products													
Advance	−0.55	−1.12	6.10	5.72	4.94	4.63							

1. Percent changes cannot be calculated because of the presence of both positive and negative values.

components decline with successive vintages and with more complete and revised source data.[7]

The MARs for current-dollar personal consumption expenditures (PCE) are about 0.3 percentage point smaller than those for the corresponding vintages of current-dollar GDP; they are 1.0 percentage point for the advance estimates and 0.9 percentage point for both the second and third estimates. Those for real PCE are slightly smaller, about 0.8 percent for the second and third vintages. Both measures tend to decline slightly with successive vintages. Within PCE, the MARs for durable goods are noticeably larger, about 4.3 percent for current-dollars and 4.4 percent for real durable goods; the MARs do not decline with succes-

sive vintages.

The MARs for nondurable goods are also larger than those for all PCE, and show some tendency to decline with successive vintages of estimates. The MAR for the advance estimate is 2.0 percentage points. The MARs for the second and third estimates are 1.8 percentage points. The MARs for the real estimates are about 0.2 percentage point smaller than those for current-dollar estimates.

The MARs for PCE services are the smallest of those of any of the major PCE components shown in the table. The MARs for current-dollar PCE are 0.9 percentage point for the advance estimate, and 0.8 percentage point for both the second and third estimates. The MARs for the corresponding real estimates are slightly smaller, but the differences are less than 0.1 percentage point. Again, there is a modest tendency for the MARs to decline with successive vintages. Fixler and Grimm

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7. This finding of declines with successive vintages is the expected finding: the absence of this finding in previous studies was puzzling because the later vintages, with more and better source data, would be expected to be closer to the latest estimates.

Revisions to Monthly Estimates of Price Indexes for Personal Consumption Expenditures

The reliability measures used to analyze prices are the mean revisions (MRs) and mean absolute revisions (MARs) for the current monthly estimates to the later vintage estimates of the percent changes in two indexes: (1) the price index for personal consumption expenditures (PCE) and (2) the index for personal consumption expenditures excluding food and energy (PCEX). The MRs and MARs are calculated using monthly data for 1996–2013 for PCE and monthly data for 2000–2013 for PCEX (see the table). Both MRs and MARs increase for any vintage of estimates as progressively later vintages of estimates are used as standards. The revisions are measured in terms of annualized percent changes; for example, the first vintage of estimates to the latest revision estimates of PCE has a MAR of 0.92 percent, which corresponds to a month-to-month rate MAR of 0.07 percent.

The MRs for PCE and PCEX follow similar patterns. All have positive values.[1] Both have progressively larger MRs for the earlier vintages as progressively later vintages are used as standards. The MRs for PCE range from 0.04 for the third estimate to the latest estimate to 0.18 for the first estimate to the latest estimate. A difference in patterns is that the smallest MR for PCE is for the third estimate to the latest estimate, and the smallest MR for PCEX is for the second estimate to the third estimate. In addition, for PCE, the MR for first estimate to the third estimate is larger than the MR for the second estimate to the latest estimate, with values of 0.14 and 0.10, respectively. For PCEX, the MR for the first estimate to third estimate is smaller than the MR for the second estimate to the latest estimate, with values of 0.10 and 0.12,

respectively.

The MARs for PCE and PCEX also follow similar patterns. Both have progressively larger MARs for the earlier vintages as progressively later vintages are used as standards. The MARs for PCE range from 0.36 for the second estimate to third estimate to 0.92 for the first estimate to the latest estimate. The MARs for PCEX range from 0.23 for the second estimate to third estimate to 0.66 for the first estimate to the latest estimate.

Average Revisions to Successive Vintages of Monthly Estimates of Annualized Percent Changes in Price Indexes for Personal Consumption Expenditures (PCE) and PCE Excluding Food and Energy

	Vintage of revision used as standard [1]		
	Second estimate	Third estimate	Latest estimate
Mean revision			
PCE			
First monthly estimate	0.08	0.14	0.18
Second monthly estimate	....	0.06	0.10
Third monthly estimate	....	....	0.04
PCE excluding food and energy			
First monthly estimate	0.07	0.10	0.19
Second monthly estimate	....	0.03	0.12
Third monthly estimate	....	....	0.09
Mean absolute revision			
PCE			
First monthly estimate	0.40	0.50	0.92
Second monthly estimate	....	0.36	0.86
Third monthly estimate	....	....	0.80
PCE excluding food and energy			
First monthly estimate	0.25	0.35	0.66
Second monthly estimate	....	0.23	0.57
Third monthly estimate	....	....	0.53

1. First is the first monthly estimate, second is the second monthly estimate, and third is the third monthly estimate. Latest is the latest estimate.

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1. The current quarterly estimates of PCE prices were also found to be positive and not statistically significant; see Fixler, Greenaway-McGrevy, and Grimm (2011), 27.

2011 presented average revisions for price indexes for GDP and major components. They were found to be small and generally not statistically significant. BEA also produces monthly estimates of PCE and prices. These are discussed for the first time in the box "Revisions to Monthly Estimates of Price Indexes for Personal Consumption Expenditures."

The MARs for the other components of GDP are all considerably larger than those for GDP and PCE The MARs for gross private domestic investment are relatively large; they range from 5.2 percentage points to 5.9 percentage points for both current-dollar and real investment. Both increase 0.6 percentage point from the advance to the second estimates, then decrease 0.2 percentage point to the third estimates. The MARs for fixed investment are smaller; in current dollars, they cluster near 2.7 percentage points and near 2.8 percentage points in constant dollars. The smaller sizes are the result of the exclusion of inventory investment, which in a previous study were found, using an alternative methodology, to have large revisions; see Fixler and others (2011).

Within private fixed investment, MARs for current-dollar nonresidential structures decrease from 8.3 percentage points for the advance estimates to 7.7 percentage points for the second estimates and 7.1 percentage points for the third estimates. Real structures have a similar pattern, but at values roughly 1 percentage point lower.

The expansion of the category "equipment and software" to include other intellectual property products" influenced the sizes of the MARs for the category.[8] They are near 5 percentage points for both current-dollar and real estimates for all the current quarterly vintages. In the new estimates, the expansion increased the size of this category by a little more than one fourth, with a generally increasing trend ratio. To the extent that the quarterly pattern of change for R&D plus literary and artistic originals is different from that for equipment and software, the MARs are increased due to the expansion. The MARs for the three current quarterly estimates are roughly 1 percent point higher than those found in the previous study. The MARs for the real estimates are also higher, but by roughly 0.3 percentage point. The change also tends to increase MARs for broader investment categories, but because the shares of the revision in totals is not large, the effects are not easily observed.

The MARs for the various current quarterly vintages of residential structures investment are only modestly smaller than those for equipment and intel-lectual property products investment. They decline across successive vintages in both real and current dollars. The MARs for real investment are about 0.4 percentage point smaller than those for current dollars.

The MARs for exports and imports, in both current and real dollars, and for the current quarterly vintages range from about 3 percentage points to somewhat more than 4 percentage points.[9] Each of the four series has MARs that decline steadily across the successive vintages of current quarterly estimates.

The MARs for total government consumption expenditures and gross investment are all roughly 1.5 percentage points in both current and real dollars. They show little tendency to decline with successive vintages. MARs for federal expenditures are about 2.75 percentage points and show no particular tendency to decline with successive vintages. Within federal, defense expenditures' MARs decline from 3.5 percentage points for the advance estimates to 3.3 percentage points for the third estimates. The MARs for real estimates are somewhat smaller, ranging from 3.4 percentage points for the advance estimates to 3.0 percentage points for the third estimates. Nondefense expenditures' MARs increase with successive vintages, ranging from 4.1 percentage points for the advance estimates, to 4.6 percentage points for the third estimates, in both real and current dollars.

The MARs for state and local government consumption expenditures and gross investment decline from 2.1 percentage points for the current-dollar advance estimates to 1.9 percentage points for both the second and third estimates. MARs for the real estimates are about 1.6 percentage points and show no tendency to decrease across vintages.

Mean revisions

The MRs for real and current-dollar GDP are rather small, generally much smaller, than the MARs for GDP because the MARs are functions of both the MRs and the variances of the estimates, which by definition are positive. This occurs because individual revisions are both positive and negative and tend to offset one another. For most of the measures shown here, there is little or no tendency for MRs to become smaller with successive vintages of estimates.

The MRs for both current-dollar and real GDP are rather small and generally negative. The MRs for advance estimates of current-dollar GDP and real GDP are 0.1 percentage point and –0.1 percentage point, respectively. The MRs for the second and third current-dollar estimates of GDP are negative. For real GDP, the MRs are –0.2 percentage point. The MRs for the

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8. For this study, we combine the NIPA components "equipment" and "intellectual property products." In previous studies, we used the (now outdated) NIPA component "equipment and software."

9. BEA has published an extensive analysis of the international transactions accounts (Yorgason and Scott 2012).

components and subcomponents of real and current-dollar GDP are generally small and both positive and negative, and the signs of the MRs sometimes vary with successive vintages. The MRs for current-dollar structures investment and exports are generally much larger than for other components and subcomponents. The MRs for GDP and its components reflect definition changes that are part of comprehensive revisions.

The standard deviations of revisions are somewhat larger than the MARs for GDP and its components, although the standard deviations for vintages have similar patterns and relationships to those of the MARs. The standard deviations can be used to test whether the MRs are statistically significant. For 1993–2012, the MRs for GDP or its components and subcomponents generally are not statistically different from zero and, therefore, are not statistically significant and do not indicate bias.[10]

Charts 2 and 3 provide supplemental pictures of the revisions. Chart 2 is a histogram that shows the numbers of times that revisions from the advance to the latest estimates are within various size categories. The chart reflects average revisions (both median and mean) of –0.06 percent. The smallest and largest revisions are –4.53 percent and 4.01 percent, respectively.

Chart 3 is a scatter diagram showing advance estimates of real GDP and the corresponding size of the revisions from those advance estimates to the latest estimates. The scatter shows no apparent relationship between the sizes of the advance estimates and the ultimate extent of revisions to the latest estimate. The chart indicates that there is nothing systematic about revisions available at the time of earlier estimates.

Table 2 presents revisions triangles that show the MARs for the various vintages of current-dollar GDP estimates to later estimates. All tend to increase with later vintages. For example, the MARs for the second estimates increase rapidly to the first annual estimates, and more slowly thereafter. The revisions to each successive vintage decrease steadily; that is, revisions decline with later vintages. Because comprehensive revisions of the NIPAs are made about every 5 years, the first annual revision estimates contain major redefinitions and reclassifications about one-fifth of the time; the second annual revision estimates, two-fifths; and the third annual revision estimates, three-fifths. Thus, the MARs for the successive annual revision estimates increasingly reflect the effects of these changes as well as the incorporation of increasing amounts of annual data that are available with 1-to-3-year lags.

These same patterns generally hold for the five major components of GDP. The MARs for the various

vintages of estimates of PCE to the various later vintages of estimates are modestly lower than those for GDP, but follow the same general patterns. The patterns of MARs for the three components of PCE also generally follow the same patterns. The MARs for PCE durable goods are several times those of total PCE. MARs for PCE nondurable goods are less than half

Chart 2. Frequency of Revisions to Estimates of Real GDP From Advance to Latest Estimates, 1993–2012

U.S. Bureau of Economic Analysis
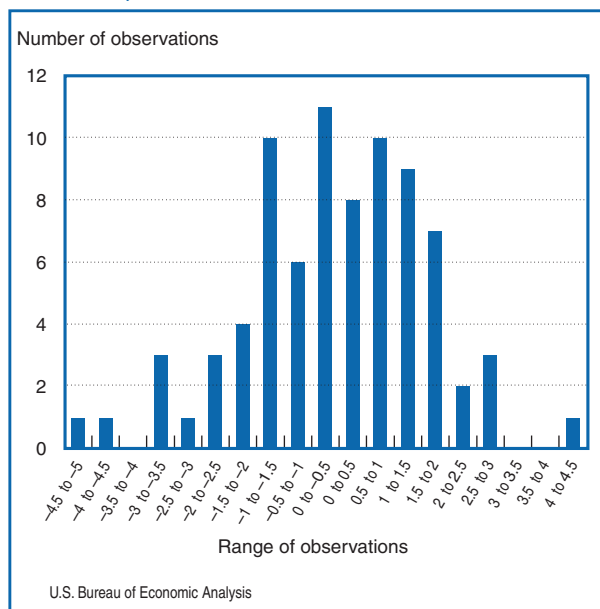
Chart 3: Advance Estimates of Real GDP and Revisions From Advance to Latest Estimates of Real GDP

U.S. Bureau of Economic Analysis

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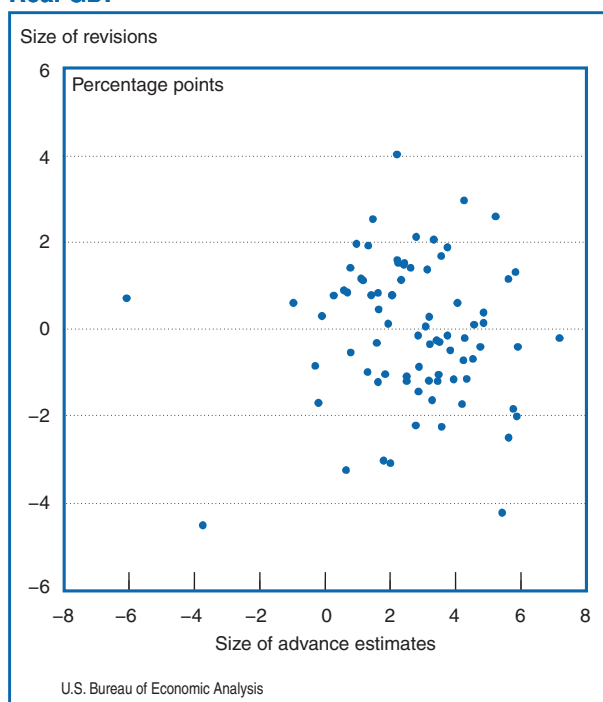
10. A Jarque-Bera statistic of 1.53 for the group of revisions indicates that the hypothesis of normality cannot be rejected, with a p-value of 0.47.

Table 2. Mean Absolute Revisions, Changes In Current-Dollar GDP and Its Components, 1993–2012

[Percentage points]

Vintage	Vintage of revision used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Gross domestic product						
Advance	0.56	0.63	0.93	1.11	1.21	1.35
Second	....	0.28	0.79	0.98	1.13	1.28
Third	....	....	0.72	0.94	1.08	1.21
First annual	....	....	....	0.64	0.88	0.99
Second annual	....	....	....	....	0.55	0.89
Third annual	....	....	....	....	....	0.68
Personal consumption expenditures						
Advance	0.32	0.38	0.72	0.94	1.03	1.00
Second	....	0.21	0.64	0.80	0.92	0.89
Third	....	....	0.60	0.81	0.94	0.87
First annual	....	....	....	0.59	0.74	0.77
Second annual	....	....	....	....	0.49	0.72
Third annual	....	....	....	....	....	0.66
Durable goods						
Advance	1.10	1.50	2.86	3.37	3.75	4.31
Second	....	0.37	2.68	3.16	3.83	4.33
Third	....	....	2.96	3.22	3.71	4.24
First annual	....	....	....	2.32	2.88	3.23
Second annual	....	....	....	....	2.05	2.66
Third annual	....	....	....	....	....	1.87
Nondurable goods						
Advance	0.67	0.65	1.14	1.59	1.86	1.96
Second	....	0.22	0.92	1.45	1.76	1.82
Third	....	....	0.87	1.45	1.76	1.82
First annual	....	....	....	1.08	1.42	1.73
Second annual	....	....	....	....	0.86	1.29
Third annual	....	....	....	....	....	1.14
Services						
Advance	0.28	0.42	0.68	0.88	1.00	0.86
Second	....	0.32	0.72	0.83	0.96	0.84
Third	....	....	0.64	0.82	0.89	0.80
First annual	....	....	....	0.52	0.74	0.68
Second annual	....	....	....	....	0.53	0.67
Third annual	....	....	....	....	....	0.61
Gross private domestic investment						
Advance	2.90	3.11	4.89	5.50	5.43	5.15
Second	....	1.04	4.45	5.36	5.74	5.82
Third	....	....	4.22	5.07	5.51	5.61
First annual	....	....	....	3.10	3.60	4.26
Second annual	....	....	....	....	2.92	3.71
Third annual	....	....	....	....	....	2.91
Fixed investment						
Advance	1.29	1.68	2.55	2.74	2.85	2.71
Second	....	0.82	2.18	2.52	2.73	2.68
Third	....	....	2.21	2.60	2.78	2.74
First annual	....	....	....	1.93	2.38	2.42
Second annual	....	....	....	....	1.49	1.89
Third annual	....	....	....	....	....	1.80
Fixed nonresidential investment						
Advance	1.68	1.90	3.11	3.68	4.08	3.39
Second	....	0.85	2.71	3.53	3.97	3.61
Third	....	....	2.68	3.51	3.95	3.49
First annual	....	....	....	3.09	3.66	2.94
Second annual	....	....	....	....	2.50	2.37
Third annual	....	....	....	....	....	2.32
Nonresidential structures investment						
Advance	3.75	4.35	7.33	8.28	8.30	8.32
Second	....	1.99	6.91	7.80	8.00	7.67
Third	....	....	6.00	7.16	7.73	7.13
First annual	....	....	....	3.95	4.70	4.81
Second annual	....	....	....	....	2.82	3.67
Third annual	....	....	....	....	....	3.38

Vintage	Vintage of revision used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Equipment and intellectual property investment						
Advance	1.68	2.02	3.78	4.98	4.07	4.94
Second	....	0.88	3.44	5.24	4.42	5.23
Third	....	....	3.28	5.17	4.70	5.44
First annual	....	....	....	4.05	3.65	4.41
Second annual	....	....	....	....	2.90	3.90
Third annual	....	....	....	....	....	2.53
Residential investment						
Advance	1.56	1.94	3.67	4.02	4.14	4.49
Second	....	0.73	2.85	3.38	3.50	3.89
Third	....	....	2.64	3.11	3.23	3.81
First annual	....	....	....	2.04	2.47	3.35
Second annual	....	....	....	....	1.29	2.52
Third annual	....	....	....	....	....	1.99
Exports						
Advance	1.06	2.67	2.42	1.97	1.16	4.14
Second	....	2.56	3.64	4.27	4.55	3.29
Third	....	....	2.71	3.02	3.50	3.20
First annual	....	....	....	3.06	3.47	2.69
Second annual	....	....	....	....	2.91	1.93
Third annual	....	....	....	....	....	1.16
Imports						
Advance	2.72	2.74	3.59	3.97	4.03	4.37
Second	....	1.19	2.57	2.86	2.74	3.28
Third	....	....	2.28	2.62	2.47	3.19
First annual	....	....	....	1.82	2.01	2.58
Second annual	....	....	....	....	1.12	1.90
Third annual	....	....	....	....	....	1.39
Government consumption expenditures and gross investment						
Advance	0.72	0.79	1.33	1.36	1.57	1.65
Second	....	0.27	1.20	1.30	1.62	1.58
Third	....	....	1.19	1.27	1.58	1.59
First annual	....	....	....	0.72	1.26	1.37
Second annual	....	....	....	....	0.98	1.22
Third annual	....	....	....	....	....	1.10
Federal government						
Advance	1.02	0.95	2.66	2.79	3.32	2.76
Second	....	0.31	2.54	2.74	3.37	2.75
Third	....	....	2.60	2.84	3.43	2.72
First annual	....	....	....	1.49	2.61	2.38
Second annual	....	....	....	....	1.67	2.02
Third annual	....	....	....	....	....	2.20
Federal defense						
Advance	0.96	1.03	2.77	3.45	3.69	3.55
Second	....	0.34	2.70	3.37	3.69	3.43
Third	....	....	2.80	3.40	3.72	3.33
First annual	....	....	....	1.79	2.41	2.89
Second annual	....	....	....	....	1.68	2.77
Third annual	....	....	....	....	....	2.44
Federal nondefense						
Advance	1.95	1.97	4.80	4.81	5.36	4.22
Second	....	0.46	4.78	4.76	5.19	4.43
Third	....	....	4.75	4.70	5.27	4.56
First annual	....	....	....	3.11	4.40	4.05
Second annual	....	....	....	....	3.08	3.65
Third annual	....	....	....	....	....	3.95
State and local government						
Advance	0.76	0.95	1.32	1.50	1.79	2.10
Second	....	0.34	1.04	1.33	1.55	1.85
Third	....	....	1.04	1.29	1.58	1.89
First annual	....	....	....	0.81	1.31	1.58
Second annual	....	....	....	....	1.04	1.40
Third annual	....	....	....	....	....	1.24

those for all PCE but also show the same patterns. The MARs for PCE services also show similar patterns but are roughly half the size of the corresponding MARs for nondurable goods, and roughly one-third to one-fourth those of durable goods.

The MARs for the various vintages of gross private domestic investment have a generally similar pattern to those of GDP and PCE, but they are four to five times as large as those of GDP. The MARs for the various vintages of fixed investment follow roughly the same patterns but are about half the size of those of the corresponding vintage pairs of gross private domestic investment. The difference is the exclusion of change in private inventories, for which percent changes are not meaningful because the series of estimates switches sign from one quarter to the next. The MARs for the various vintage pairs of fixed nonresidential investment and its three components also show similar patterns but with somewhat larger sizes. The patterns of MARs for the various estimates of residential investment are similar to those for the various estimates of fixed nonresidential investment, and the MARs are of roughly similar sizes.

The pattern of MARs for the various vintages of both imports and exports to later vintages are roughly the same and are similar to the patterns for the other components of GDP. The MARs of the advance estimates to later vintages of imports estimates are considerably larger than those for the corresponding exports estimates. The MARs for later vintages of imports estimates to later intermediate vintages are, however, smaller than the corresponding MARs for exports. The MARs for both exports and imports estimates to the latest estimates, however, are similar in size for each vintage, including the advance estimates.

The MARs for the various vintages of estimates of government consumption expenditures and gross investment also show patterns similar to those for GDP, but they are typically roughly 0.5 percentage point larger. The patterns of MARs for the components and subcomponents of government are roughly similar to the aggregate but with somewhat larger values. The MARs for state and local government are somewhat smaller than those for the other components. This probably does not indicate greater reliability; relatively little new quarterly information comes in at the times of the later estimates, and the sizes of the revisions reflect this.

There are several characteristics of the pattern of the revisions of the various vintages to successive revisions that hold generally but not universally. The revisions from the second to the third vintages of estimates are typically the smallest for any adjacent pair of vintages.

For any given vintage, the MARs tend to increase as later vintages are used as the standards of revisions. For any vintage of later estimates, the MARs tend to decrease in size for all vintages (when later vintages of estimates are used as the earlier estimates). That is, for any row (vintage of earlier estimates), moving across columns of later estimates results in increasingly large MARs. Also, for any given column (vintage of later estimates), going down rows generally results in decreasing MARs.

Table 3 shows MARs for real GDP and its components. The sizes of the MARs are quite close to those of MARs for current-dollar GDP. The patterns are also very similar to the current-dollar patterns. These occur because the revisions to deflators used to construct the real estimates are quite small in comparison with the current-dollar revisions. Most estimates of the components of GDP are made in current dollars and then deflated.

Table 4 (page 12) provides additional information about the revisions from earlier vintages of estimates to the latest estimates. Columns 1 and 2 show the standard deviations of the latest estimates of real and current-dollar GDP and its components and subcomponents at the same level of detail as tables 1 and 2. These are measures of the volatility of the estimates. They range from somewhat less than 3 percentage points for real and current-dollar GDP to about 15 percentage points for current-dollar residential investment.

Columns 2 and 3 expand on columns 3 and 4 of table 1; they show standard deviations of the revisions of the same set of measures, including the three annual revision vintages of estimates. They show a wide variation in size, ranging from 0.9 percentage point for current-dollar GDP and 0.8 percentage point for real GDP to 12.1 percentage points for current-dollar exports and 7.0 percentage points for gross private domestic investment. The revision standard deviations may be scaled by the standard deviations of the estimates in order to facilitate comparisons among components. When the revision standard deviations are scaled by the standard deviations of the latest corresponding estimates, the results are much closer together. For the revisions, the standardized standard deviations have relatively small ranges, 3.1 scaled units for the current-dollar estimates and 1.8 scaled units for the real estimates. Thus, the more volatile series for GDP and components that have larger standard deviations also tend to have larger revision standard deviations.

Revisions around cyclical turning points

Comprehensive revisions have generally preserved the

Table 3. Mean Absolute Revisions, Changes in Real GDP and Its Major Components, 1993–2012
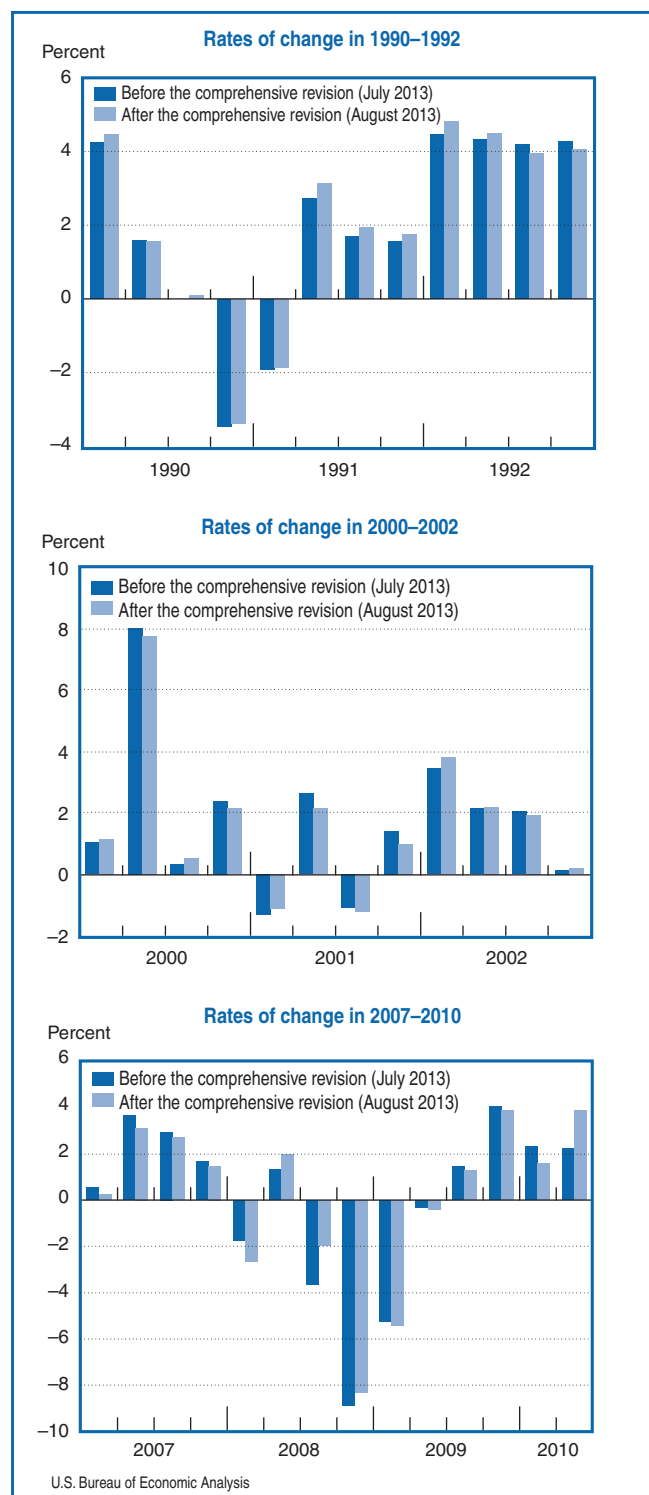
[Percentage points]

Vintage	Vintage of revision used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Gross domestic product						
Advance	0.52	0.56	0.94	1.09	1.22	1.29
Second	....	0.21	0.81	1.09	1.19	1.25
Third	....	....	0.79	1.05	1.12	1.20
First annual	....	....	....	0.73	0.91	1.00
Second annual	....	....	....	....	0.69	1.01
Third annual	....	....	....	....	....	0.62
Personal consumption expenditures						
Advance	0.31	0.38	0.78	0.85	0.94	0.95
Second	....	0.17	0.71	0.78	0.82	0.82
Third	....	....	0.67	0.78	0.85	0.82
First annual	....	....	....	0.52	0.62	0.74
Second annual	....	....	....	....	0.40	0.61
Third annual	....	....	....	....	....	0.51
Durable goods						
Advance	1.14	1.66	3.10	3.29	3.82	4.40
Second	....	0.88	2.72	3.47	3.76	4.42
Third	....	....	3.16	3.83	3.65	4.65
First annual	....	....	....	2.80	2.84	3.34
Second annual	....	....	....	....	2.17	3.45
Third annual	....	....	....	....	....	2.18
Nondurable goods						
Advance	0.72	0.64	1.10	1.42	1.56	1.68
Second	....	0.28	1.06	1.38	1.53	1.69
Third	....	....	0.93	1.36	1.52	1.61
First annual	....	....	....	1.03	1.23	1.55
Second annual	....	....	....	....	0.83	1.30
Third annual	....	....	....	....	....	1.08
Services						
Advance	0.29	0.43	0.71	0.90	0.89	0.81
Second	....	0.31	0.75	0.89	0.90	0.79
Third	....	....	0.70	0.84	0.83	0.76
First annual	....	....	....	0.50	0.66	0.67
Second annual	....	....	....	....	0.52	0.67
Third annual	....	....	....	....	....	0.56
Gross private domestic investment						
Advance	2.79	2.80	3.90	5.69	6.20	5.27
Second	....	1.06	2.39	5.27	6.23	5.87
Third	....	....	4.45	5.07	6.01	5.63
First annual	....	....	....	3.30	4.86	4.76
Second annual	....	....	....	....	3.29	3.70
Third annual	....	....	....	....	....	3.41
Fixed investment						
Advance	1.19	1.54	2.48	2.74	2.79	2.79
Second	....	0.72	2.14	2.58	2.88	2.85
Third	....	....	2.07	2.59	2.89	2.92
First annual	....	....	....	2.00	2.42	2.48
Second annual	....	....	....	....	1.51	1.94
Third annual	....	....	....	....	....	1.68
Fixed nonresidential investment						
Advance	1.61	1.95	3.16	3.55	3.47	3.51
Second	....	0.87	2.69	3.38	3.63	3.72
Third	....	....	2.64	3.29	3.65	3.75
First annual	....	....	....	2.72	3.25	3.16
Second annual	....	....	....	....	1.81	2.13
Third annual	....	....	....	....	....	1.97
Nonresidential structures investment						
Advance	3.75	4.28	6.57	6.84	7.03	7.10
Second	....	2.38	6.69	6.97	6.62	6.96
Third	....	....	5.52	5.74	6.01	5.89
First annual	....	....	....	3.52	4.13	4.56
Second annual	....	....	....	....	2.50	3.34
Third annual	....	....	....	....	....	3.03

Vintage	Vintage of revision used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Equipment and intellectual property investment						
Advance	1.76	2.27	3.64	3.86	3.95	4.63
Second	....	1.11	3.10	4.30	4.27	4.83
Third	....	....	3.17	4.22	4.37	4.98
First annual	....	....	....	3.36	3.98	4.54
Second annual	....	....	....	....	2.83	3.82
Third annual	....	....	....	....	....	2.60
Residential investment						
Advance	1.43	1.70	3.07	4.05	3.58	3.81
Second	....	0.79	2.60	3.82	3.73	3.48
Third	....	....	2.44	3.68	3.53	3.45
First annual	....	....	....	2.94	3.30	3.49
Second annual	....	....	....	....	2.37	3.10
Third annual	....	....	....	....	....	2.21
Exports						
Advance	2.11	2.51	2.97	3.41	3.59	3.69
Second		1.01	2.22	2.63	2.96	3.11
Third	....	....	2.27	2.60	2.91	3.00
First annual	....	....	....	1.70	2.06	2.35
Second annual	....	....	....	....	1.25	1.88
Third annual	....	....	....	....	....	1.32
Imports						
Advance	2.68	2.90	4.04	4.19	4.40	4.16
Second	....	0.96	2.60	2.84	2.98	3.00
Third	....	....	2.48	2.82	2.91	2.91
First annual	....	....	....	1.86	2.31	2.37
Second annual	....	....	....	....	1.48	2.37
Third annual	....	....	....	....	....	1.67
Government consumption expenditures and gross investment						
Advance	0.68	0.73	1.09	1.32	1.53	1.52
Second	....	0.25	0.92	1.24	1.52	1.48
Third	....	....	0.87	1.22	1.52	1.45
First annual	....	....	....	0.75	1.25	1.23
Second annual	....	....	....	....	0.95	1.00
Third annual	....	....	....	....	....	0.95
Federal government						
Advance	1.11	1.02	2.27	2.48	2.73	2.60
Second	....	0.38	2.10	2.48	2.83	2.76
Third	....	....	2.15	2.53	2.89	2.71
First annual	....	....	....	1.52	2.13	2.05
Second annual	....	....	....	....	1.42	1.85
Third annual	....	....	....	....	....	1.74
Federal defense						
Advance	1.01	1.07	2.59	3.51	3.10	3.39
Second	....	0.39	2.25	3.31	2.97	3.18
Third	....	....	2.21	3.33	2.94	3.04
First annual	....	....	....	2.46	2.60	2.86
Second annual	....	....	....	....	1.75	2.51
Third annual	....	....	....	....	....	2.18
Federal nondefense						
Advance	1.90	1.98	4.48	4.84	4.82	4.16
Second	....	0.62	4.36	4.77	4.82	4.38
Third	....	....	4.46	4.71	4.94	4.61
First annual	....	....	....	2.59	3.41	3.92
Second annual	....	....	....	....	2.35	3.59
Third annual	....	....	....	....	....	3.87
State and local government						
Advance	0.68	0.95	1.08	1.41	1.67	1.59
Second	....	0.45	0.89	1.33	1.52	1.61
Third	....	....	0.87	1.23	1.52	1.64
First annual	....	....	....	0.78	1.34	1.34
Second annual	....	....	....	....	1.04	1.09
Third annual	....	....	....	....	....	0.94

Table 4. Standard Deviations of Revisions, Early Vintages to the Latest Estimates,
Changes in Current-Dollar GDP and Its Components, 1993–2012

[Percentage points]

Vintage	Standard deviation of estimates Current dollar	Real	Standard deviation of revisions Current dollar	Real	Scaled standard deviation Current dollar	Real
Gross domestic product	**2.79**	**2.59**	....	....	....	....
Advance	....	....	1.685	1.611	0.603	0.622
Second	....	....	1.562	1.534	0.559	0.593
Third	....	....	1.534	1.485	0.549	0.574
First annual	....	....	1.259	1.270	0.451	0.491
Second annual	....	....	1.089	1.206	0.390	0.466
Third annual	....	....	0.907	0.765	0.325	0.295
Personal consumption expenditures	**2.64**	**2.07**				
Advance	....	....	1.269	1.187	0.480	0.572
Second	....	....	1.131	1.047	0.428	0.505
Third	....	....	1.150	1.050	0.435	0.506
First annual	....	....	0.985	0.991	0.373	0.478
Second annual	....	....	0.981	0.710	0.371	0.342
Third annual	....	....	0.941	0.581	0.356	0.280
Durable goods	**8.98**	**9.23**				
Advance	....	....	5.504	5.525	0.613	0.598
Second	....	....	5.353	5.383	0.596	0.583
Third	....	....	5.284	6.001	0.588	0.650
First annual	....	....	4.212	4.268	0.469	0.462
Second annual	....	....	3.627	5.394	0.404	0.584
Third annual	....	....	2.739	3.201	0.305	0.347
Nondurable goods	**5.38**	**2.66**				
Advance	....	....	2.592	2.313	0.482	0.870
Second	....	....	2.389	2.315	0.444	0.871
Third	....	....	2.450	2.254	0.456	0.848
First annual	....	....	2.317	2.121	0.431	0.798
Second annual	....	....	1.738	1.698	0.323	0.639
Third annual	....	....	1.501	1.435	0.279	0.540
Services	**1.94**	**1.53**				
Advance	....	....	1.138	0.992	0.586	0.648
Second	....	....	1.087	1.003	0.560	0.655
Third	....	....	1.048	1.008	0.540	0.658
First annual	....	....	0.861	0.830	0.444	0.542
Second annual	....	....	0.855	0.825	0.441	0.539
Third annual	....	....	0.841	0.693	0.433	0.453
Gross private domestic investment	**12.94**	**12.82**				
Advance	....	....	6.627	6.973	0.512	0.544
Second	....	....	7.153	7.202	0.553	0.562
Third	....	....	6.879	8.899	0.532	0.538
First annual	....	....	5.620	6.225	0.434	0.486
Second annual	....	....	4.851	4.870	0.375	0.380
Third annual	....	....	3.697	5.845	0.286	0.456
Fixed investment	**8.45**	**8.01**				
Advance	....	....	3.465	3.543	0.410	0.442
Second	....	....	3.435	3.525	0.406	0.440
Third	....	....	3.530	3.495	0.418	0.436
First annual	....	....	3.151	3.220	0.373	0.402
Second annual	....	....	2.416	2.459	0.286	0.307
Third annual	....	....	2.307	2.111	0.273	0.264
Fixed nonresidential investment	**8.61**	**8.25**				
Advance	....	....	4.355	4.393	0.508	0.532
Second	....	....	4.476	4.461	0.520	0.541
Third	....	....	4.457	4.428	0.519	0.537
First annual	....	....	3.893	4.041	0.452	0.490
Second annual	....	....	2.993	2.615	0.347	0.317
Third annual	....	....	3.171	2.490	0.368	0.302
Structures investment	**15.44**	**13.73**				
Advance	....	....	10.807	9.171	0.700	0.668
Second	....	....	10.620	9.456	0.688	0.689
Third	....	....	10.171	7.923	0.659	0.577
First annual	....	....	6.046	5.701	0.392	0.415
Second annual	....	....	4.600	4.345	0.298	0.316
Third annual	....	....	4.259	3.837	0.276	0.279

Vintage	Standard deviation of estimates Current dollar	Real	Standard deviation of revisions Current dollar	Real	Scaled standard deviation Current dollar	Real
Equipment and intellectual property products	**11.65**	**12.24**	....	....	....	....
Advance	....	....	6.104	5.724	0.524	0.468
Second	....	....	6.444	5.837	0.553	0.473
Third	....	....	6.621	6.081	0.568	0.497
First annual	....	....	5.489	5.761	0.471	0.471
Second annual	....	....	5.428	5.178	0.466	0.423
Third annual	....	....	3.296	3.428	0.283	0.280
Residential investment	**14.94**	**13.67**				
Advance	....	....	6.022	4.876	0.403	0.357
Second	....	....	5.286	4.515	0.354	0.330
Third	....	....	5.341	4.468	0.357	0.327
First annual	....	....	4.338	5.036	0.290	0.368
Second annual	....	....	3.374	4.333	0.226	0.317
Third annual	....	....	3.641	3.138	0.177	0.230
Net exports of goods and services[1]	....	....	....	....	....	....
Exports	**11.91**	**9.08**				
Advance	....	....	12.067	4.638	1.013	0.511
Second	....	....	5.225	3.999	0.439	0.440
Third	....	....	4.277	3.810	0.359	0.420
First annual	....	....	3.938	3.138	0.331	0.346
Second annual	....	....	3.810	2.629	0.320	0.290
Third annual	....	....	2.652	2.315	0.223	0.255
Imports	**13.31**	**9.02**				
Advance	....	....	5.529	5.088	0.415	0.564
Second	....	....	4.623	3.868	0.347	0.429
Third	....	....	4.134	3.777	0.310	0.419
First annual	....	....	3.482	3.131	0.262	0.347
Second annual	....	....	2.523	2.698	0.190	0.299
Third annual	....	....	2.129	2.116	0.160	0.235
Government consumption expenditures and gross investment	**3.62**	**3.27**				
Advance	....	....	2.018	1.878	0.558	0.575
Second	....	....	2.055	1.903	0.568	0.582
Third	....	....	2.066	1.851	0.572	0.566
First annual	....	....	1.700	1.556	0.470	0.476
Second annual	....	....	1.525	1.301	0.422	0.398
Third annual	....	....	1.382	1.181	0.382	0.361
Federal	**7.96**	**7.10**				
Advance	....	....	3.399	3.292	0.427	0.464
Second	....	....	3.581	3.470	0.450	0.489
Third	....	....	3.513	3.391	0.442	0.478
First annual	....	....	3.032	2.949	0.381	0.416
Second annual	....	....	2.537	2.461	0.319	0.347
Third annual	....	....	4.107	2.202	0.516	0.310
Defense	**10.22**	**9.99**				
Advance	....	....	4.605	4.556	0.451	0.456
Second	....	....	4.458	4.333	0.436	0.434
Third	....	....	4.387	4.241	0.429	0.425
First annual	....	....	3.738	4.103	0.366	0.411
Second annual	....	....	3.994	3.436	0.391	0.344
Third annual	....	....	3.530	2.795	0.345	0.280
Nondefense	**6.64**	**6.36**				
Advance	....	....	5.793	5.484	0.872	0.862
Second	....	....	6.137	5.810	0.924	0.913
Third	....	....	6.168	5.892	0.929	0.926
First annual	....	....	5.189	4.922	0.781	0.773
Second annual	....	....	4.730	4.582	0.712	0.720
Third annual	....	....	4.920	4.908	0.741	0.771
State and local	**3.38**	**2.81**				
Advance	....	....	2.670	2.077	0.790	0.738
Second	....	....	2.521	2.003	0.746	0.712
Third	....	....	2.545	2.142	0.753	0.761
First annual	....	....	2.004	1.720	0.593	0.611
Second annual	....	....	1.763	1.406	0.521	0.500
Third annual	....	....	1.542	1.313	0.456	0.467

patterns of change in and around recessions. The 2013 revision did so, despite the large upward revisions in levels yielded by the inclusion of research and development and artistic originals in investment. Panel 1 of chart 4 shows the rates of change in real GDP before, during, and after the 1990–91 recession. Only minor revisions to the rates of change were introduced, in

Chart 4. Rates of Change in Real GDP Near Recessions

Rates of change in 1990–1992

Percent

- Before the comprehensive revision (July 2013)
- After the comprehensive revision (August 2013)

Rates of change in 2000–2002

Percent

- Before the comprehensive revision (July 2013)
- After the comprehensive revision (August 2013)

Rates of change in 2007–2010

Percent

- Before the comprehensive revision (July 2013)
- After the comprehensive revision (August 2013)

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comparison with the overall pattern of change in GDP. Panels 2 and 3 show the revisions to real GDP before, during, and after the 2000 and 2007–2009 recessions. The revisions in and around the 2000 recession are very minor in comparison with the quarter-to-quarter variations in the rates of change in real GDP. The revisions in the 2007–2009 recession are somewhat larger, but the largest is only 1.7 percentage points in third quarter of 2008; this compares with a range of rates of change from 4 percentage points to more than –8 percentage points.

The 2013 comprehensive revision preserved the pattern of volatility of GDP, including the effects of business cycles. Chart 5 shows the paths of eight-quarter moving variances of GDP over the entire period since the ebbing, in the mid-1980s, of a period of higher volatility that has been commented on by a number of observers.[11] Both the prerevision and postrevision estimates closely resemble one another. The large movements, indicating increased volatility during and after the three recessions since the mid-1980s are quite similar. In addition, the smaller fluctuations around the larger movements are largely the same. The most notable change is that the comprehensive revision estimates have modestly lower volatility during and immediately after the sharp 2007–2009 recession. (The lags in the volatility patterns following recessions reflect that a given quarter's percent change stays in the variance calculations for the seven following quarters.) On average, the variances were revised little; the average value was 4.51 percentage points before the comprehensive revision and 4.47 percentage points after the comprehensive revision, for an average

11. The eight-quarter moving average is an adaptation of the method used by Blanchard and Simon (2001) in their study of the volatility of GDP. The value for 1984:IV is the variance of GDP for 1983:I–1984:IV, the value for 1985:I is the variance for 1983:II–1985:I, and so on.

Chart 5. Eight-Quarter Moving Variances of Real GDP, 1984–2012

Percentage points

- Before the comprehensive revision (July 2013)
- After the comprehensive revision (August 2013)

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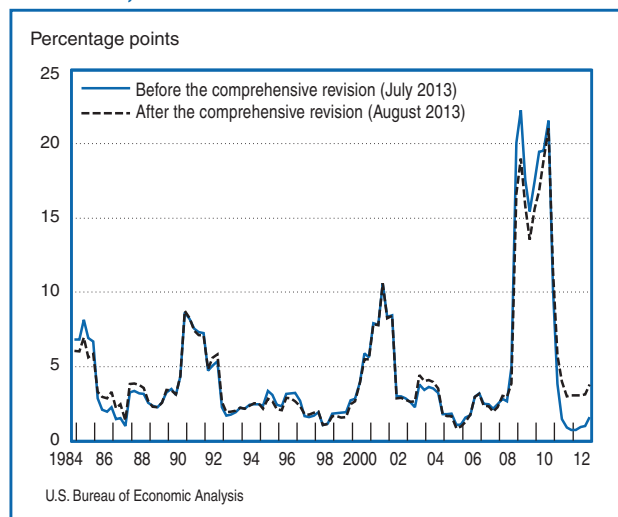
revision of –0.04 percentage point. Without regard to sign, the average revision in variances was 0.57 percentage point. These compare with variances that range from 1 percentage point to 22 percentage points.

Revisions to Annual Estimates of GDP

Summary statistics for revisions of annual frequency estimates of real and current-dollar GDP and its major components to the latest estimates are shown in table 5. As with the quarterly frequency estimates, the mean revisions are small and are both positive and negative.

Table 5. Average Revisions of Annual Estimates, Changes in Current-Dollar GDP and Its Components, Annual Vintages to Latest Estimates, 1993–2012

[Percentage points]

Vintage	Mean revision		Mean absolute revision	
	Current dollar	Real	Current dollar	Real
Gross domestic product				
Early annual [1]	–0.04	–0.08	0.46	0.56
First annual	–0.01	0.06	0.35	0,41
Second annual	0.10	0.23	0.31	0.34
Third annual	0.13	0.27	0.23	0.29
Personal consumption expenditures				
Early annual [1]	–0.03	0.02	0.41	0.41
First annual	–0.06	0.09	0.30	0.32
Second annual	0.07	0.24	0.30	0.36
Third annual	0.15	0.30	0.26	0.34
Gross private domestic investment				
Early annual [1]	–0.27	–0.80	1.83	2.05
First annual	–0.11	–0.47	1.74	1.77
Second annual	0.34	0.29	1.25	1.15
Third annual	0.35	0.45	1.19	1.19
Fixed investment				
Early annual [1]	–0.35	–0.80	1.26	1.47
First annual	–0.25	–0.54	1.11	1.19
Second annual	0.38	0.38	1.02	0.89
Third annual	0.26	0.31	0.81	0.79
Change in private inventories [2]				
Net exports of goods and services [2]				
Exports				
Early annual [1]	0.21	0.30	0.57	0.80
First annual	0.28	0.18	0.45	0.63
Second annual	0.05	–0.07	0.39	0.47
Third annual	0.02	–0.15	0.36	0.52
Imports				
Early annual [1]	0.16	0.04	0.47	0.64
First annual	0.11	–0.06	0.24	0.33
Second annual	0.03	0.19	0.26	0.66
Third annual	0.07	–0.47	0.17	0.57
Federal government				
Early annual [1]	0.01	0.13	0.48	0.75
First annual	–0.29	–0.03	0.51	0.47
Second annual	–0.30	–0.09	0.44	0.36
Third annual	–0.26	0.02	0.43	0.32
State and local government				
Early annual [1]	0.13	–0.16	0.93	0.85
First annual	0.19	0.07	0.77	0.69
Second annual	0.13	0.00	0.66	0.63
Third annual	–0.03	–0.06	0.49	0.31

1. Early annual estimates are available in late April of the following year.
2. Percent changes cannot be calculated because of the presence of both positive and negative values.

The early annual estimates of GDP are those available in March of the following year and are mostly composed of third current quarterly estimates, and their mean revisions are therefore similar to those of those estimates.

The mean absolute revisions are fractions of the sizes of those for the current quarterly estimates for both real and current-dollar GDP. One reason for this is that annual frequency estimates are not subject to revisions to seasonal adjustment factors. The MARs decline with the successive annual estimates of both current-dollar and real GDP. MARs also decline steadily for most vintages of most components of GDP. Exceptions are increases from the previous vintage for the second annual vintage of real personal consumption expenditures, the second annual vintage of both current-dollar and real imports, and the third annual vintage of real exports. As with total GDP, the MARs of components are much smaller than those for quarterly frequency estimates.

Definition changes as part of comprehensive NIPA revisions may change both the levels and growth rates of GDP; for example, the introduction of software as investment in the 1999 comprehensive revision raised both the levels and the growth rates of GDP. The introduction of R&D and artistic originals as investment in the 2013 comprehensive revision raised the levels of GDP but did little to change the growth rates. The ratio of private fixed investment to GDP increased by 0.016 to 0.019, but the pattern of movements of the ratio of private fixed investment to GDP was essentially unchanged (chart 6).

Chart 6. Ratio of Real Fixed Investment to Real GDP, 1993–2012

U.S. Bureau of Economic Analysis
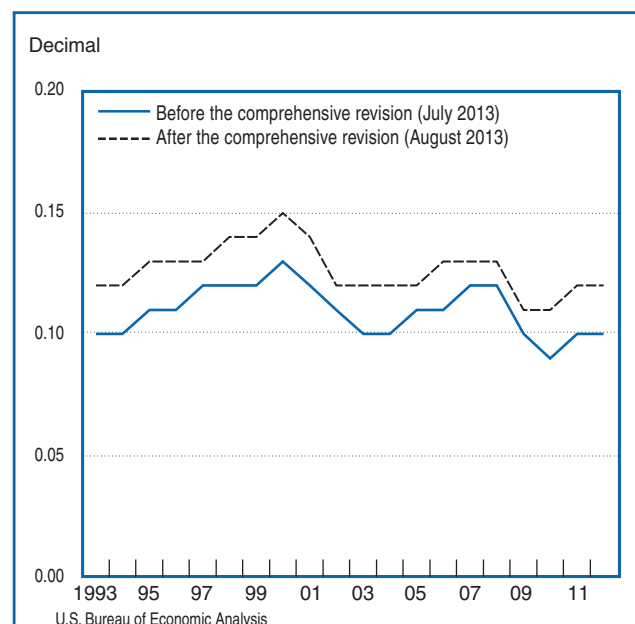
Revisions to Quarterly Estimates of GDI

Advance estimates of GDI are not prepared, and since 1995, second current quarterly estimates of GDI in the fourth quarter of each year have not been prepared. These estimates of GDI are not prepared mainly because of a lack of source data for estimating corporate profits. Estimates are prepared for the other major components of GDI, such as compensation of employees and proprietors' income. Starting with the first quarter of 2002, a "fourth" vintage of estimates of the previous quarter has been prepared using information from the Bureau of Labor Statistics' quarterly census of employment and wages (QCEW). It is used to revise the estimates of compensation of employees, national income, and GDI. It is released at the time of the second quarterly estimate of the following quarter.

The MAR to the latest estimates from the third estimates of GDI is the same as that for the third estimate to the latest estimate of GDP (table 6), at 1.2 percentage points. The MAR increases in the first annual estimate then declines with the second and third annual estimates. Only the MAR for the third annual estimates is lower than that for the third current quarterly estimate. The MARs for the various vintages of national income are all moderately and increasingly larger than those for GDI with successive vintages, but they also decline steadily with successive vintages. The MARs for compensation of employees increase slightly with successive vintages of current quarterly estimates, reaching 2.9 percentage points for the third estimates, then decrease steadily to 1.3 percentage points for the third annual vintage. MARs for the other components of GDI are larger to much larger, depending on the component. They show little or no tendency to decrease with successive vintages of estimates, but all decline with successive vintages of annual estimates.

The MRs of GDI and its major components are much smaller than the corresponding MARs and have both positive and negative signs. An exception is corporate profits; the MRs are negative for all vintages, and show no tendency to decline with successive vintages of estimates. Standard deviations for the various components and vintages are all larger to much larger than those for GDI and generally tend to diminish in size with successive vintages (table 7). As with the components of GDP, these MRs are not statistically significant.

Table 8 shows the MARs for GDI and most components from each vintage to each subsequent vintage. Entries also include the fourth current quarterly estimates for compensation, national income, and GDI; these incorporate information from the QCEW. Fourth estimates of most other components of GDI are not made, and the missing vintage pairs for the fourth

Table 6. Revisions, Earlier Vintages to the Latest Estimates, Changes in GDI and Its Major Components, 1993–2012

[Percentage points]

Vintage	Mean revision	Mean absolute revision	Standard deviation
Gross domestic income			
Advance	....	....	....
Second	....	....	....
Third	−0.10	1.21	1.85
First annual	−0.01	1.57	1.99
Second annual	0.22	1.24	1.65
Third annual	0.21	0.94	1.29
Private consumption of fixed capital			
Advance	−0.10	8.05	20.20
Second	−0.15	7.91	20.22
Third	−0.89	8.46	24.73
First annual	−1.87	9.05	26.40
Second annual	−2.11	9.23	27.30
Third annual	−1.86	8.95	26.92
Taxes on production and imports			
Advance	−0.08	2.67	3.68
Second	0.00	2.62	3.53
Third	0.09	2.46	3.40
First annual	0.30	2.03	2.99
Second annual	0.25	1.78	2.79
Third annual	0.18	1.58	3.03
National Income			
Advance	....	....	....
Second	....	....	....
Third	−0.32	2.33	3.12
First annual	0.06	2.17	2.96
Second annual	0.22	1.89	2.87
Third annual	0.15	1.61	2.71
Compensation of employees			
Advance	0.15	2.55	3.63
Second	−0.02	2.80	3.92
Third	0.09	2.89	4.14
First annual	−0.12	1.68	2.26
Second annual	0.05	1.34	2.29
Third annual	0.07	1.32	1.83
Proprietors' income			
Advance	0.45	7.42	9.14
Second	0.42	7.66	9.57
Third	0.48	7.54	9.55
First annual	0.86	7.79	9.83
Second annual	0.93	6.42	8.52
Third annual	0.69	4.91	6.06
Nonfarm proprietors' income			
Advance	0.45	6.12	7.93
Second	0.41	6.01	7.84
Third	0.45	6.00	7.86
First annual	1.16	6.36	7.91
Second annual	0.47	6.88	10.97
Third annual	0.18	5.05	7.83
Corporate profits with IVA and CCAdj			
Advance	....	....	....
Second	....	....	....
Third	−2.28	18.35	26.09
First annual	−1.99	15.05	20.77
Second annual	−2.23	11.75	19.36
Third annual	−3.05	10.36	17.65
Net interest and miscellaneous payments			
Advance	−0.06	9.42	26.57
Second	0.43	13.21	20.74
Third	−0.32	13.35	20.09
First annual	1.00	9.57	13.06
Second annual	0.85	7.27	9.08
Third annual	−1.35	6.44	8.91

CCAdj Capital consumption adjustment
IVA Inventory valuation adjustment

Table 7. Standard Deviations, Revisions to Latest Estimates, Changes in GDI and Its Components, 1993–2012

[Percentage points]

Vintage	Standard deviation of estimates	Standard deviation of revisions	Scaled standard deviation
Gross domestic income	3.18	....	....
Advance	....	....	....
Second	....	....	....
Third	....	1.853	0.583
First annual	....	1.989	0.626
Second annual	....	1.651	0.520
Third annual	....	1.291	0.406
Private consumption of fixed capital	2.83	....	....
Advance	....	20.201	7.127
Second	....	20.218	7.133
Third	....	24.734	8.726
First annual	....	26.395	9.132
Second annual	....	27.298	9.631
Third annual	....	26.920	9.497
Taxes on production and imports	3.40	....	....
Advance	....	3.675	1.082
Second	....	3.532	1.040
Third	....	3.396	1.000
First annual	....	2.988	0.880
Second annual	....	2.786	0.820
Third annual	....	3.027	0.891
National Income	3.64	....	....
Advance	....	....	....
Second	....	....	....
Third	....	3.115	0.857
First annual	....	2.953	0.815
Second annual	....	2.870	0.789
Third annual	....	2.711	0.746
Compensation of employees	3.81	....	....
Advance	....	3.631	0.952
Second	....	3.920	1.026
Third	....	4.138	1.086
First annual	....	2.289	0.601
Second annual	....	1.830	0.480
Third annual	....	1.828	0.480
Proprietors' income	8.30	....	....
Advance	....	9.144	1.101
Second	....	9.566	1.152
Third	....	9.550	1.150
First annual	....	9.827	1.184
Second annual	....	8.515	1.025
Third annual	....	6.061	0.730
Nonfarm proprietors' income	7.55	....	....
Advance	....	7.934	1.051
Second	....	7.843	1.039
Third	....	7.864	1.042
First annual	....	7.912	1.048
Second annual	....	10.972	1.454
Third annual	....	7.825	1.037
Corporate profits with IVA and CCAdj	24.33	....	....
Advance	....	....	....
Second	....	....	....
Third	....	26.093	1.072
First annual	....	20.773	0.854
Second annual	....	19.360	0.796
Third annual	....	17.649	0.725
Net interest and miscellaneous payments	16.29	....	....
Advance	....	26.574	1.632
Second	....	20.737	1.273
Third	....	20.094	1.234
First annual	....	13.057	0.802
Second annual	....	9.083	0.558
Third annual	....	8.908	0.547

CCAdj Capital consumption adjustment
IVA Inventory valuation adjustment

Table 8. Mean Absolute Revisions, Changes in GDI and Its Components, 1993–2012

[Percentage points]

Vintage	Second	Third	Fourth [1]	First annual	Second annual	Third annual	Latest
Gross domestic income							
Third	....	....	1.31	0.88	1.08	1.34	1.21
Fourth	....	....	....	1.05	1.35	1.56	1.27
First annual	....	....	....	....	0.99	1.31	1.57
Second annual	....	....	....	....	....	0.79	1.24
Third annual	....	....	....	....	....	....	0.94
Private consumption of fixed capital							
Advance	0.43	1.29	....	4.36	4.57	4.49	8.05
Second	....	0.96	....	4.28	4.49	4.42	7.91
Third	....	....	....	3.73	3.91	3.77	8.46
First annual	....	....	....	....	2.89	3.79	9.05
Second annual	....	....	....	....	....	3.01	9.23
Third annual	....	....	....	....	....	....	9.95
Taxes on production and imports							
Advance	0.64	1.07	....	1.93	1.95	1.88	2.67
Second	....	0.78	....	1.74	1.83	1.88	2.46
Third	....	....	....	1.58	1.68	1.80	2.62
First annual	....	....	....	....	1.17	1.48	2.03
Second annual	....	....	....	....	....	0.96	1.78
Third annual	....	....	....	....	....	....	1.58
National income							
Third	....	....	1.86	1.25	1.53	1.72	2.33
Fourth	....	....	....	1.86	2.22	2.41	3.41
First annual	....	....	....	....	1.14	1.79	2.17
Second annual	....	....	....	....	....	1.17	1.89
Third annual	....	....	....	....	....	....	1.61
Compensation of employees							
Advance	0.77	0.97	2.48	1.94	1.81	1.94	2.55
Second	....	0.28	2.98	1.22	1.85	1.94	2.89
Third	....	....	3.15	2.09	1.95	1.50	2.89
Fourth	....	....	....	0.85	0.78	1.50	1.72
First annual	....	....	....	....	1.05	1.22	1.68
Second annual	....	....	....	....	....	0.77	1.34
Third annual	....	....	....	....	....	....	1.32
Proprietors' income							
Advance	0.90	1.13	....	4.67	6.68	5.89	7.42
Second	....	0.60	....	4.63	7.01	6.23	7.66
Third	....	....	....	5.15	6.88	6.21	7.54
First annual	....	....	....	....	5.57	6.41	7.79
Second annual	....	....	....	....	....	4.43	6.42
Third annual	....	....	....	....	....	....	4.91
Nonfarm proprietors' income							
Advance	0.54	0.71	....	3.82	5.70	5.45	6.12
Second	....	0.37	....	3.72	5.67	5.32	6.01
Third	....	....	....	3.77	5.61	5.32	5.00
First annual	....	....	....	....	4.94	5.80	6.36
Second annual	....	....	....	....	....	5.67	6.88
Third annual	....	....	....	....	....	....	5.05
Corporate profits with IVA and CCAdj							
Third	....	....	....	12.43	13.37	16.29	18.35
First annual	....	....	....	....	7.58	13.17	15.05
Second annual	....	....	....	....	....	9.56	11.75
Third annual	....	....	....	....	....	....	10.36
Net interest and miscellaneous payments							
Advance	0.88	2.16	....	4.82	7.70	8.73	9.42
Second	....	2.74	....	7.39	11.44	12.70	13.21
Third	....	....	....	7.60	11.50	12.87	13.33
First annual	....	....	....	....	7.17	10.23	9.57
Second annual	....	....	....	....	....	6.63	7.27
Third annual	....	....	....	....	....	....	6.44

CCAdj Capital consumption adjustment   IVA Inventory valuation adjustment
1. Fourth estimates begin in 2002 and apply only to GDI, national income, and compensation of employees.

estimates are left blank. One must view the fourth estimates with caution because there were no fourth estimates prior to the first quarter of 2002, and the statistics are not fully comparable with the rest of the entries, which are for 1993–2012. Thus, the fourth estimates' MARs are not further discussed.

The patterns of MARs for successive vintages of GDI estimates and vintages of standards are, at most, roughly similar to those found for GDP. For example, there is a decline in the MARs for GDI from the third estimates to the third annual estimates, but the MAR for the first annual estimate to the latest is larger than for any other vintage of estimates. The increases in MARs for the various vintages of GDI estimates are not monotonic with increasingly later vintages of estimates used as standards. The whole set of MARs for GDI tends to be modestly larger than the comparable ones for GDP.

The various MARs for compensation of employees are the smallest for any of the other components of GDI but larger than those of several components of GDP. There are sharp drops in MARs for the fourth and later vintages of estimates, relative to those of the earlier vintages of estimates; the MAR to the latest estimates drops by 40 percent from the third estimates to the fourth estimates. There are, however, the same patterns of increasing MARs with increasingly later vintages of target estimates. The patterns of MARs for national income are roughly similar to those for GDI, but are larger for each vintage/standard pair in the table.

The MARs for other components of GDI are generally larger than those for compensation, and sometimes very much larger. At the extreme, the MARs for the various estimates of corporate profits are several to many times as large as the corresponding ones for compensation (table 6). The MARs for some GDI components are not shown, because definition changes have caused excessive changes in the time series for the components.

The patterns of increases and decreases described for current-dollar GDP hold generally for GDI and components, but there are deviations from them; that is, MARs sometimes decrease from vintage to vintage used as the standards, or increase from vintage to vintage of the estimates for any given standard. Nevertheless, there is a tendency for increases across rows of table 8 and decreases down columns. In general, the MARs for the various components and vintages tend to be larger than those for the various GDP components.

Revisions to Annual Estimates of GDI

Summary statistics for revisions of annual frequency estimates of real and current-dollar GDI and its major components are shown in table 9.[12] The estimates of revisions are expressed in percent changes of the annual estimates. As with the quarterly frequency estimates, the mean revisions are small and both positive

12. Early annual estimates of GDI are available in May of the following year.

Table 9. Average Revisions, Annual Vintages to Latest Estimates, Change in GDI and Its Major Components, 1993–2012

[Percentage points]

Vintage	Mean revision	Mean absolute revision
Gross domestic income		
Early annual	0.03	0.56
First annual	0.05	0.55
Second annual	0.14	0.33
Third annual	0.20	0.40
Private consumption of fixed capital		
Early annual	0.56	2.07
First annual	0.62	1.97
Second annual	0.80	1.69
Third annual	−0.37	1.53
Taxes on production and imports		
Early annual	0.34	1.27
First annual	0.22	0.87
Second annual	0.13	0.77
Third annual	0.02	0.54
National income		
Early annual	−0.05	0.60
First annual	0.07	0.65
Second annual	0.66	0.92
Third annual	0.23	0.41
Compensation of employees		
Early annual	−0.16	0.73
First annual	−0.01	0.35
Second annual	0.04	0.35
Third annual	0.04	0.40
Proprietors' income		
Early annual	1.15	2.69
First annual	0.95	3.95
Second annual	1.07	3.63
Third annual	1.47	3.19
Nonfarm proprietors' income		
Early annual	0.80	3.12
First annual	0.98	3.81
Second annual	1.02	3.76
Third annual	1.50	3.27
Corporate profits with IVA and CCAdj		
Early annual	−0.25	5.98
First annual	−0.48	4.78
Second annual	−0.49	2.70
Third annual	0.57	3.04
Net interest and miscellaneous payments		
Early annual	−0.44	7.79
First annual	0.42	7.16
Second annual	0.12	3.53
Third annual	−1.74	3.97

CCAdj Capital consumption adjustment   IVA Inventory valuation adjustment

and negative. The early annual estimates are mostly composed of third current quarterly estimates, and their mean revisions are therefore similar to those of those estimates.

The mean absolute revisions for annual GDI and its components are fractions of the sizes of those for the current quarterly estimates for both real and current-dollar GDI. One reason for this is that annual frequency estimates are not subject to revisions to seasonal adjustment factors. The MARs decline for the successive annual estimates of GDI. The declines also reflect the incorporation of later annual frequency source data that is more complete or revised from earlier data. In particular, the second annual estimates are the first vintage to incorporate data from the *Statistics of Income* from the Internal Revenue Service. MARs also decline steadily for most vintages of most components of GDI.

The MARs for GDI decline 40 percent from the first to second annual estimates, then increase modestly to the third annual estimate. In contrast, the MARs for national income increase 41 percent from the first to the second annual estimates before declining by more than half to the third annual estimate. The MARs for the vintages of the components show little tendency to decline with successive vintages and, with the exception of proprietors' income are lower for the third annual estimates than for the early annual estimates.

The overall size of GDI has changed noticeably due to the recognition of intellectual property products as capital investment; these changes were introduce to the accounts in two phases. Software was introduced to the accounts in 1999, and research and development and artistic originals were introduced in 2013. This may be seen in chart 7, which shows the third current quarterly estimates of GDI, the estimates in place immediately before the 2013 revision, and the latest estimates. The dotted line links the third estimates (but is not a time series). It is consistently lower than the later estimates until the second half of 2009. The solid line shows the latest estimates after the 2013 comprehensive revision; it is consistently above the dashed line of the immediately previous estimates, by somewhat less than 3 percent in 1993 and somewhat less than 4 percent in 2012. Although other definition revisions also occurred, the intellectual property additions to GDI account for the bulk of the revisions to GDI (and GDP).

The effects of capitalizing intellectual property products in the accounts have tended to somewhat lower the ratios of the components of GDI to aggregate GDI simply by increasing the size of the denominator. Among the components, there has been considerable smoothing of the patterns of the ratios over time, but the basic patterns of increases and decreases over time

have been largely maintained. The three panels of chart 8 show the ratios for compensation of employees, corporate profits, and consumption of fixed capital. All three vintages of estimates of the ratios for compensation show a general decline over 1993–2012, with temporary increases around the times of the 2001 and 2007–2009 recessions (panel 1). The shorter-term fluctuations, however, are considerably more pronounced for the third estimates than for the later two sets of estimates. The estimates for the most recent two vintages—immediately before and after the comprehensive revision—have very similar patterns over time, with differences in levels that reflect the increased size of GDI.

The three vintages of estimates of corporate profits likewise show very similar general movements, and again there is a good deal less short-term volatility in the later two vintages (panel 2). The ratios of consumption of fixed capital have two distinct revisions in patterns (panel 3). Until about 2009, the third estimates were much more volatile than either of the later sets of estimates. The smoother pattern thereafter is similar to the later vintages. This reflects a revised treatment of capital losses associated with natural disasters that was introduced in the 2009 comprehensive revision; this included the elimination of a spike in the third quarter of 2005 that was due to the destruction associated with hurricane Katrina. The general upward revision in level in the post-2013 comprehensive estimates is largely due to the introduction of new types of intellectual property, as discussed above. This general upward revision is the income-side twin to the product-side revisions due to the new types of intellectual property.
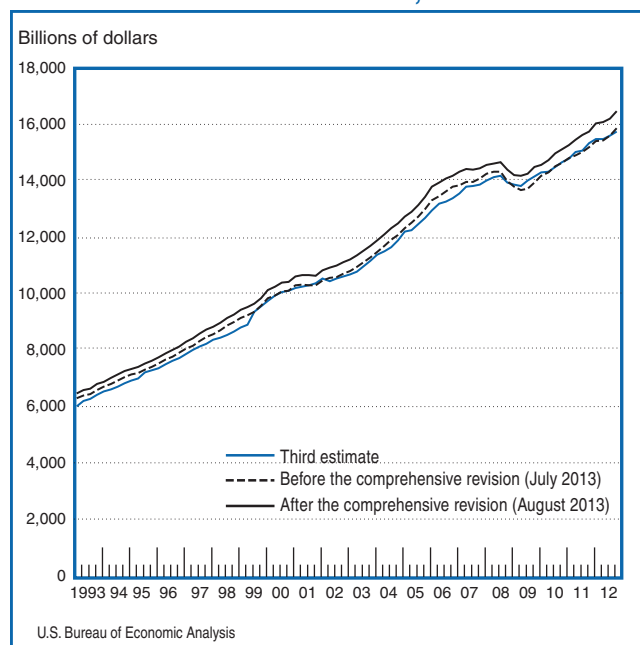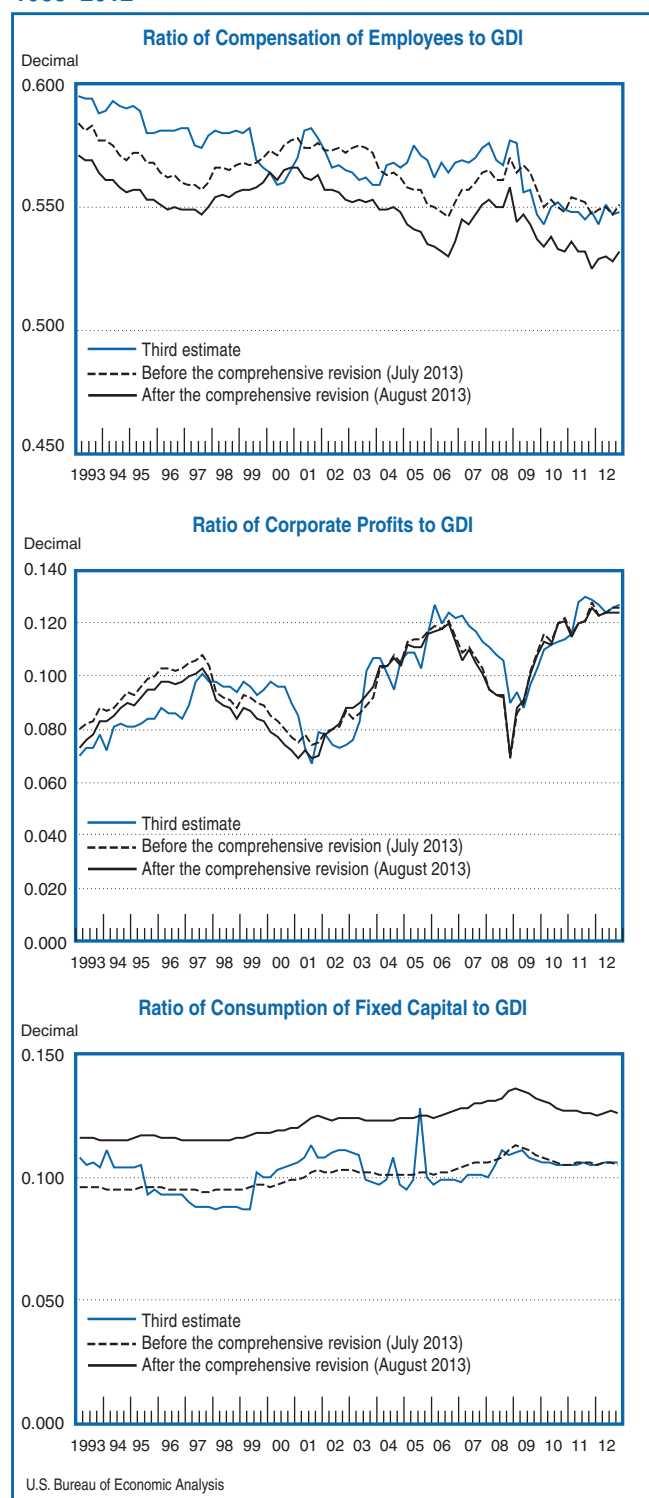
Chart 7. Gross Domestic Income, 1993–2012

Billions of dollars

- Third estimate
- Before the comprehensive revision (July 2013)
- After the comprehensive revision (August 2013)

U.S. Bureau of Economic Analysis

Chart 8. Ratio of Selected Components of GDI, 1983–2012

Ratio of Compensation of Employees to GDI

Decimal

Third estimate
Before the comprehensive revision (July 2013)
After the comprehensive revision (August 2013)

Ratio of Corporate Profits to GDI

Decimal

Third estimate
Before the comprehensive revision (July 2013)
After the comprehensive revision (August 2013)

Ratio of Consumption of Fixed Capital to GDI

Decimal

Third estimate
Before the comprehensive revision (July 2013)
After the comprehensive revision (August 2013)

U.S. Bureau of Economic Analysis

Comparing GDP and GDI revisions

At the time of the advance NIPA estimates, data are available to allow BEA to calculate estimates of GDP and its major components. Data are also available to allow BEA to calculate estimates of most GDI components. For corporate profits, however, the data are from a too small and unrepresentative sample to per-

mit the estimation. As a result, advance estimates of aggregate GDI are not prepared.

Second estimates of GDP are published for each quarter, and for GDI in the first three quarters of each calendar year. In the fourth quarter of each year, profits reports are delayed sufficiently that no second estimates of profits or GDI are made.

Third estimates of both GDP and GDI are published for each quarter. At the time of the third estimates, about 67 percent of the source data for GDP components are based on comprehensive data or direct indicators, 21 percent on indirect indicators, and 12 percent on trend-based estimates. In comparison, about 14 percent of the source data for the third estimates of GDI components is from direct sources, 56 percent from indirect sources, and 30 percent from trend-based estimates.[13] As a result, considerably more judgment goes into the construction of the third estimates of GDI than into the third estimates of GDP.

Annual revision estimates are made each year for both GDP and GDI. These use annual frequency data that are superior to the quarterly frequency data that are available to support the current quarterly estimates. Of particular importance, at the time of the second annual revision estimates, data are available from the Internal Revenue Service *Statistics of Income* to support the estimates of GDI. As a result, the second annual estimates of GDI no longer contain trend-based estimates, very little is based on indirect sources, and most direct indicators have also been replaced by comprehensive data, which make up 94 percent of the estimates.

As mentioned earlier, about every 5 years there is a comprehensive revision to GDP. However, no corresponding benchmark estimates of GDI are made because of a lack of information to produce them. As a result, there are statistical discrepancies between GDP and GDI in the benchmark years.

The reliability of the various vintages of quarterly estimates of GDP and GDI is examined in table 10, which shows the MARs of each vintage to the latest-available estimates of GDP and GDI. Smaller MARs indicate greater reliability. Column 1 shows the MARs to the latest GDP estimates for the successive vintages of GDP estimates. They get steadily smaller with the successive vintages and are half as large for the third annual vintage as they are for the advance vintage. Column 4 shows the MARs of the latest GDI estimates to the successive vintages of GDI estimates. They have no tendency to get smaller with successive vintages, although the third current quarterly vintage's MAR is smaller than those of the three annual vintages. The

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13. For a discussion of the source data available to estimate GDP and GDI, see Grimm and Weadock (2006), Holdren and Grimm (2008), and Holdren (2014).

MARs for third current quarterly estimates of both GDP and GDI are the same size. The MARs for the three annual vintages of estimates of GDP, however, are noticeably smaller than those for the annual vintages of estimates of GDI.

Table 10. Mean Absolute Revisions, Earlier Vintages to Latest Estimates, Changes in GDP and GDI, 1993–2012

[Percentage points]

Vintage	Latest GDP		Latest GDI	
	Earlier GDP	Earlier GDI	Earlier GDP	Earlier GDI
Advance	1.35	....	1.75	....
Second	1.26	....	1.74	....
Third	1.21	1.07	1.71	1.21
First annual	0.99	1.22	1.69	1.57
Second annual	0.89	1.31	1.73	1.24
Third annual	0.68	1.38	1.95	1.29
Latest	....	1.75	1.75	....

NOTE. For example, the mean absolute revision of the third estimates of GDI to the latest estimates of GDP is 1.07

Column 2 of table 10 shows the MARs of the vintages of GDI estimates to the latest estimates of GDP, and column 3 shows the MARs for the vintages of GDP estimates to GDI. The MARs for successive vintages of GDI to GDP increase. The MARs for successive vintages of GDP to the latest estimates of GDI show no particular tendency to increase or decrease. The MARs for GDP and GDI to their latest vintages are, by definition, the same.

In addition to examining revisions to GDP and GDI in isolation, one may also use ordinary least squares regressions to explain the latest estimates. Table 11 shows this using the third current quarterly estimates of both measures as explanatory variables. Although constant terms are used in half of the regressions, they are never statistically significant and have very little impact on the coefficients of other variables. The first panel shows equations explaining the latest estimates of GDP. The first equation explains the latest estimates of GDP by the third current quarterly estimates of GDP. The regression coefficient of the third estimates is just below one, it is highly statistically significant (t-test statistics are in parentheses below the estimated coefficients), and the R-square indicates that it explains just under seven-tenths of the variance of the latest estimates. Equation 3 uses the third estimate of GDI as the explanatory variable for GDP and finds only marginally different results, with an R-square just 0.017 lower than that of equation 1. This suggests that the third estimate of GDI is only slightly less good as a forecast of the latest estimate of GDP as the third estimate of GDP. Equation 5 uses the third estimates of both GDP and GDI as explanatory variables. Both are statistically significant, with the coefficient of GDP being about one-quarter larger than that of GDI. The R-square of the

equation is modestly larger than those of the equations with only one of the measures as an explanatory variable. This finding is consistent with the hypothesis that the third estimates of GDI contain explanatory power that is in addition to that of the contemporaneous estimates of GDP.

The second panel shows equations explaining the latest estimates of GDI. Equation 7 estimates the latest estimate of GDI as a function of the third estimate of GDI. As with GDP in equation 1, the coefficient of GDI is close to one and highly significant. The R-square is only slightly lower than that for equation 1. Thus, the third estimates of GDI are about as accurate as the latest estimates of GDI, as the third estimates of GDP are about as accurate as the latest estimates of GDP.

Equation 9 estimates of GDI as a function of the third estimates of GDP. GDP is statistically highly significant, but the equation's R-square is about one-sixth lower than those of either equation 7 or equation 1. Thus, although GDP is a good estimator of the latest estimates of GDI, it is less successful than GDI as an estimator of GDP.

Equation 11 estimates GDI as a function of the third estimates of both GDP and GDI. GDP is not statistically significant, but the R-square is only slightly below that for equation 7. The results of equations 9 and 11 together suggest that the third estimates of GDP do not

Table 11. Equations Explaining the Latest Estimates of Changes in GDP Using the Third Estimates of GDP and GDI in 1993–2012

	Constant	GDP (third estimate)	GDI (third estimate)	R square
		GDP		
Equation 1		0.9729 (30.00)		0.6998
Equation 2	0.1466 (0.39)	0.9485 (13.50)		0.7004
Equation 3			0.9353 (29.20)	0.6828
Equation 4	0.2866 (0.76)		0.8896 (13.03)	0.6851
Equation 5		0.5245 (3.83)	0.4248 (3.11)	0.7295
Equation 6	−0.0413 (0.11)	0.5467 (−3.72)	0.4276 (3.06)	0.7330
		GDI		
Equation 7			0.9827 (26.03)	0.6595
Equation 8	−0.0634 (0.89)		0.9928 (12.29)	0.6596
Equation 9		1.0016 (22.42)		0.5569
Equation 10	0.2317 (0.45)	0.9630 (9.92)		0.5580
Equation 11		0.1306 (0.72)	0.8598 (4.92)	0.6617
Equation 12	−0.1507 (0.33)	0.1456 (0.77)	0.8697 (4.87)	0.6622

NOTE. The t-test statistics are in parentheses.

contain useful information about GDI once estimates of GDI are available.

A further evaluation of the usefulness of early estimates of GDP and GDI as estimators of GDP can be made by calculating the MARs of the latest estimates of GDP and GDI relative to estimators composed of the weighted sums of the third estimates GDP and GDI.

Table 12 shows MARs to the latest estimates of GDP and GDI of the third estimates of GDP, GDI, and three weighted sums.[14] The weights are chosen for illustrative purposes, and are loosely based on the relative coefficient sizes of the two measures reported as equations 5 and 6 of table 10. The first line shows MARs for the latest estimates of GDP from the third estimates of GDP, GDI, two weighted sums of the measures, and an unweighted average of the two measures. The lower MARs of the weighted sums of GDP and GDI are reflective of the additional information about GDP that is contained in GDI. The MARs reinforce the regression finding that the third estimates of GDI have predictive power for the latest estimates of GDP that is in addition to that of those of the corresponding vintage of GDP. This, in turn, may reflect the notion that the estimates of GDP incorporate judgments that are based on more than just the available source data and that the estimates of GDP and GDI are not made in isolation from one another.[15]

The second line shows MARs to the latest estimates of GDI from the third estimates of GDP, GDI, and the same three weighted sums of the two measures. The larger the weight of GDI, the smaller the resulting MARs are. The weighted sums have smaller MARs than those of GDP. These results, combined with the lower R-squares of equations for GDI that include GDP, suggest that there is little or no useful information about the latest estimates of GDI in the third estimates of GDP; that is, the third estimate of GDP does not add to the information provided by the third estimate of GDI.

Weighted averages of GDP and GDI have smaller variances than those for either measure alone. This oc-

curs because the unknown measurement errors in the vintages are unlikely to be perfectly correlated. Table 13 shows the variances of the third and the latest vintages of estimates of GDP, GDI, and selected weighted sums of the two measures. For both vintages, the estimates of GDI have the largest variances (bold), and weighted sums of the two, with weights favoring GDP, have the smallest variances (shaded). Line 3 shows the MARs of the measures and of weighted sums of the third to the latest estimates. The smallest MARs (shaded) are for weighted sums, with weights ranging from half to two-thirds for GDP, and the rest for GDI. All of the weighted sums have smaller MARs than that for GDP, but GDI (bold) has the largest MAR of all those shown. If both GDP and GDI are each interpreted as the sums of the unobserved true economic activity and of measurement errors, it is possible to infer that the weighted averages are more accurate measures of activity than either GDP or GDI alone. This occurs because some of the measurement errors are averaged out, reducing subsequent revisions in the weighted averages.

Another way of comparing GDP and GDI is to look at their performance near turning points. This is done in table 14, which shows MARs from the third to the latest estimates of GDP, GDI, and selected weighted averages of GDP and GDI in the most recent six recessions. The first line shows the MARs for all of the quarters from those immediately before to those

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14. The weighted sums are of growth rates of GDP and GDI. The weighted sums of levels would yield somewhat different growth rates.

15. Allan Young reported that estimates of GDP made a month earlier than the advance estimates had a MAR of similar size to those of the advance estimates (Young 1996). This finding is also reflective of the quality of judgmental inputs into GDP estimates in the presence of progressively less accurate source data.

Table 12. Mean Absolute Revisions Third to the Latest Estimates, Changes in GDP and GDI, 1993–2012

[Percentage points]

Latest	Third				
	GDP	.67GDP+33GDI	.6GDP+.4GDI	.5GDP+.5GDI	GDI
GDP	1.21	1.16	1.16	1.17	**1.39**
GDI	**1.71**	1.58	1.55	1.52	1.45

NOTE. Shaded backgrounds indicate the weighted sums that yield the smallest MARs.

Table 13. Variances and Mean Absolute Revisions, Changes in Current-Dollar GDP and GDI, 1993–2012

[Percentage points]

	Variances						
	GDP	.75P+.25I	.67P+.33I	.5P+.5I	.33P+.67I	.25P+.75I	GDI
Third	2.46	2.44	2.44	2.46	2.49	2.51	**2.59**
Latest	2.79	2.73	2.73	2.78	2.87	2.93	**3.18**

	Mean absolute revisions to the latest estimates						
Third	1.21	1.06	1.04	1.04	1.12	1.20	**1.45**

NOTES. The variances and mean absolute revisions are for the third estimates to the latest estimates. P is GDP and I is GDI. Shaded backgrounds indicate the weighted sums that yield the smallest MARs.

Table 14. Mean Absolute Revisions Around Cyclical Turning Points, Changes in Current-Dollar GDP and GDI

[Percentage points]

	GDP	.75P+.25I	.67P+.33I	.5P+.5I	.33P+.67I	.25P+.75I	GDI
All quarters	1.48	1.32	1.26	1.17	1.20	1.29	1.59
Prior quarter	1.03	0.87	0.85	0.88	0.95	1.03	1.29
Peak quarter........	1.25	1.04	0.98	1.05	1.40	1.57	2.09
After quarter	1.87	1.37	1.21	0.94	0.73	0.74	0.80
Prior quarter	1.12	1.12	1.12	1.19	1.31	1.37	1.56
Trough quarter	1.31	1.28	1.22	1.08	1.25	1.48	2.20
After quarter	1.89	1.78	1.76	1.73	1.69	1.71	1.82

NOTES. The data provide mean absolute revisions for the third estimates to the latest estimates for the six most recent recessions. P is GDP and I is GDI. Shaded backgrounds indicate the weighted sums that yield the smallest MARs.

immediately after the turning points of the recessions. All of the weighted averages have MARs of 0.2 percentage point or more below those of GDP and GDI alone, and the 50–50 weighted average has the lowest MAR, 0.3 percentage point less than that of GDP and 0.4 percentage point less than that of GDI. This is consistent with the suggestion that weighted averages of GDP and GDI are superior estimators of the path of economic activity around turning points at the time of the third estimates.

The remaining lines of the table disaggregate the MARs by the quarters of the turning points and those

Table 15. Standard Deviations of Revisions to Changes in Real GDP and Its Major Components, 1993–2012
[Percentage points]

Vintage	Vintage used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Gross domestic product						
Advance	0.654	0.688	1.193	1.376	1.562	1.611
Second	....	0.277	1.031	1.281	1.446	1.534
Third	....	....	1.003	1.229	1.393	1.485
First annual	....	....	....	0.929	1.159	1.270
Second annual	....	....	....	....	0.937	1.206
Third annual	....	....	....	....	....	0.765
Personal consumption expenditures						
Advance	0.276	0.832	0.812	1.206	1.307	1.269
Second	....	0.464	0.981	1.033	1.165	1.131
Third	....	....	0.858	1.065	1.174	1.150
First annual	....	....	....	0.972	0.985	
Second annual	....	....	....	....	0.633	0.981
Third annual	....	....	....	....	....	0.941
Gross private domestic investment						
Advance	3.710	3.815	6.253	6.528	7.067	6.627
Second	....	1.292	5.560	6.757	7.154	7.153
Third	....	....	5.029	6.321	6.740	6.879
First annual	....	....	....	4.219	4.658	5.620
Second annual	....	....	....	....	3.905	4.851
Third annual	....	....	....	....	....	3.783
Fixed investment						
Advance	1.566	2.251	3.328	3.310	3.676	3.465
Second	....	1.775	2.687	3.119	3.652	3.436
Third	....	....	2.931	3.313	3.777	3.530
First annual	....	....	....	2.214	2.894	3.151
Second annual	....	....	....	....	2.137	2.416
Third annual	....	....	....	....	....	2.307
Exports						
Advance	2.670	2.960	4.647	5.598	6.072	5.225
Second	....	1.394	3.676	4.537	5.039	4.277
Third	....	....	3.677	4.339	5.009	3.938
First annual	....	....	....	4.230	5.371	3.810
Second annual	....	....	....	....	1.758	2.652
Third annual	....	....	....	....	....	2.225
Imports						
Advance	3.681	3.509	4.560	4.943	5.073	5.529
Second	....	2.281	3.894	4.147	4.042	4.623
Third	....	....	3.016	3.608	3.485	4.134
First annual	....	....	....	2.818	2.970	3.482
Second annual	....	....	....	....	1.471	2.523
Third annual	....	....	....	....	....	2.129
Federal government						
Advance	1.889	1.764	3.352	3.340	4.745	3.399
Second	....	0.568	3.268	3.444	4.972	3.581
Third	....	....	3.247	3.456	4.969	3.513
First annual	....	....	....	2.043	4.435	3.032
Second annual	....	....	....	....	3.881	2.537
Third annual	....	....	....	....	....	4.107
State and local government						
Advance	1.037	1.218	1.554	1.762	2.157	2.670
Second	....	0.422	1.207	1.650	1.928	2.521
Third	....	....	1.182	1.568	1.932	2.545
First annual	....	....	....	1.060	1.661	2.004
Second annual	....	....	....	....	1.424	1.763
Third annual	....	....	....	....	....	1.542

Table 16. Mean Revisions to the Latest Estimates, Changes in Real GDP and Its Components, 1993–2012
[Percentage points]

Vintage	Vintage of revision used as standard					
	Second	Third	First annual	Second annual	Third annual	Latest
Gross domestic product						
Advance	0.10	0.13	–0.04	–0.32	–0.35	–0.06
Second	....	0.03	–0.14	–0.46	–0.46	–0.17
Third	....	....	–0.17	–0.25	–0.48	–0.19
First annual	....	....	....	–0.25	–0.28	–0.03
Second annual	....	....	....	....	–0.02	0.23
Third annual	....	....	....	....	....	0.26
Personal consumption expenditures						
Advance	0.03	0.05	–0.03	–0.11	–0.20	–0.06
Second	....	0.02	–0.06	–0.15	–0.24	–0.09
Third	....	....	–0.08	–0.17	–0.26	–0.10
First annual	....	....	....	–0.08	–0.15	–0.01
Second annual	....	....	....	....	–0.07	–0.07
Third annual	....	....	....	....	....	0.14
Gross private domestic investment						
Advance	0.71	0.84	0.87	–0.01	0.06	0.59
Second	....	0.13	0.16	–0.56	–0.53	–0.11
Third	....	....	0.03	–0.69	–0.60	–0.24
First annual	....	....	....	–0.69	–0.47	–0.29
Second annual	....	....	....	....	0.17	0.42
Third annual	....	....	....	....	....	0.15
Fixed investment						
Advance	0.64	0.71	1.26	0.15	–0.01	0.70
Second	....	0.07	0.62	–0.47	–0.61	0.06
Third	....	....	0.55	–0.50	–0.60	–0.01
First annual	....	....	....	–0.99	–0.94	–0.59
Second annual	....	....	....	....	0.03	0.42
Third annual	....	....	....	....	....	0.42
Exports						
Advance	0.19	–0.38	–0.13	–0.69	–0.05	–0.05
Second	....	1.28	0.90	0.93	0.82	1.29
Third	....	....	–0.19	–0.11	–0.26	0.19
First annual	....	....	....	–0.32	–0.51	0.22
Second annual	....	....	....	....	–0.38	0.42
Third annual	....	....	....	....	....	0.05
Imports						
Advance	0.58	0.60	0.51	1.03	1.05	0.71
Second	....	0.02	–0.06	0.40	0.40	0.14
Third	....	....	–0.09	0.30	0.19	0.11
First annual	....	....	....	0.27	0.17	0.21
Second annual	....	....	....	....	–0.08	–0.02
Third annual	....	....	....	....	....	0.06
Federal government						
Advance	0.10	0.07	0.38	0.42	–0.01	0.10
Second	....	–0.03	0.38	0.32	–0.12	0.00
Third	....	....	0.32	0.36	–0.08	0.03
First annual	....	....	....	0.06	–0.43	–0.30
Second annual	....	....	....	....	–0.50	–0.39
Third annual	....	....	....	....	....	0.13
State and local government						
Advance	0.32	0.31	0.23	0.25	0.73	0.45
Second	....	–0.01	–0.09	–0.11	0.36	0.12
Third	....	....	–0.08	–0.09	0.37	0.13
First annual	....	....	....	–0.11	0.37	0.23
Second annual	....	....	....	....	0.43	0.35
Third annual	....	....	....	....	....	–0.08

immediately before and after peaks and troughs. The weighted averages generally have lower MARs, with those before and those at turning points generally favoring greater weights for GDP. Weights favoring GDI do best in quarters immediately following troughs. The largest MARs before and at turning points are for GDI, but the largest MARs after turning points are for GDP.

Based on the foregoing, measures of GDP as well as those of GDI should yield improved understanding of the recent course of the economy. The better reliability observed using weighted averages of GDP and GDI will not, however, improve understanding of the detailed workings of the economy because there is no obvious way of distributing the averaging among the major components of GDP and GDI. Thus, averages can only provide supplemental summary information about the recent course of the aggregate economy.

Summary and Conclusions

The results of this review are fully consistent with those of previous BEA studies. The finding that GDI has additional information about GDP is stronger in this study than was previously reported. In summary:

- The estimates of GDP and GDI are accurate; the MARs for early vintages of both measures are somewhat above 1 percentage point.
- The MRs for both GDP and GDI are near zero and reflect the improvements in measures of economic activity and the expansions of the definition of what is included in economic activity that have been introduced in the comprehensive NIPA revisions that have adapted the NIPAs to an evolving economy. Nonzero values are not indications of bias.
- The quarterly estimates are accurate indicators of whether the economy is growing at rates above, near, or below the long-term trend.
- The MARs for the annual estimates of GDP, GDI, and their major components are less than half of those for the current quarterly estimates; they decline steadily in size from the early annual estimates to the third annual estimates.
- The fourth estimates of GDI, national income, and compensation of employees, which are published 5 months after the end of each quarter, reduce the MAR for compensation, but not the MARs for GDI or national income.
- GDI provides additional and reliable information about the course of true economic activity, which is never observed.

Although not discussed here, the finding of the previous study that "revisions in the major components of GDP and GDI have preserved the trends found in the early estimates" still holds.

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