



Revisions, Rationality, and Turning Points in GDP

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Abstract

The results presented in this paper are in line with the conclusions of past BEA studies of GDP revisions; they supplement the findings reported in Fixler and Grimm (2002). Some evidence that the revisions are predictable was found for the current quarterly estimates of GDP and final sales, but this finding has little practical application. Information about national income is found to significantly supplement final current quarterly estimates of GDP in explaining the revisions to the latest estimates of GDP. However, there is little evidence of the predictability of revisions in GDI or national income. Finally, both the advance and final current quarterly estimates are found to do a reliable job of measuring GDP and GDI around cyclical peaks, but a less reliable job around cyclical troughs, where they tend to overstate declines and understate the beginnings of recoveries.

Introduction

Over three and a half decades, in more than a dozen studies, BEA has found that early estimates of current-dollar GDP, real GDP, and gross domestic income (GDI) and their components are reliable and present a useful picture of economic activity. While the estimates do get revised, the early estimates—over the course of successive revisions—are usually able to consistently indicate whether growth is positive or negative, whether growth is accelerating or decelerating, whether growth is high or low relative to trend, and where the economy is in relation to the business cycle. The most recent study, Fixler and Grimm (2002), found some patterns for revisions that had not been detected in earlier studies. These included differences in average revisions in different quarters of the year, a tendency to understate recoveries around cyclical troughs, a tendency for revisions in seasonal factors to offset revisions in seasonally-unadjusted estimates, and that successive vintages of revisions are largely unrelated.

Section 1 of this paper presents a brief review of some of the results reported by Fixler and Grimm and looks more intensively at some issues raised in that paper. It reviews revisions to current-dollar GDP, real GDP, and GDI over the period 1983-2000.¹ Section 2 examines whether revisions owe more to getting new information (“news”) than correcting errors (“noise”), tests for rationality of the current quarterly estimates (that is, whether the estimates contain all contemporaneously-available information), and examines whether GDI estimates contain information about expenditures in the economy that supplements that contained in GDP estimates. Section 3 provides a detailed look at the movement of the economy during business cycles and revisions to current quarterly estimates around cyclical turning points. Section 4 provides some conclusions.

¹ 1983 was chosen as the starting point because it is the first year after a return to lower rates of inflation following a period of high inflation.

Section 1.—Background: Revisions to GDP and GDI

In order to present a timely picture of GDP, BEA produces current quarterly estimates that are based on a combination of preliminary results from Census Bureau surveys—such as those for retail sales and manufacturers’ shipments—and extrapolations for a number of other components—such as international trade and a large share of consumer spending on domestic services. As revised and more comprehensive survey data, or tax and other administrative data become available, the estimates are revised to reflect these more complete source data. However, because BEA’s data come from a wide range of data sources—including random and non-random surveys, administrative records, and indirect estimates—construction of confidence intervals and standard errors are not possible in a strict sense. Accordingly, it is not possible to exactly measure the accuracy of the estimates, except by reference to the later, and more complete and consistent estimates.

As with most studies of NIPA revisions, percent changes at annual rates are used here to describe changing economic conditions. In general, levels of GDP and other measures are less interesting to most users than changes, and using percent changes eliminates distortions associated with measures that increase over time. Two summary statistics about revisions are featured in this section. They are mean revision and mean absolute revision.² Because revisions can be positive or negative and thus may offset each other, it is useful to look at the mean absolute revision (that is, the mean revision without regard to sign).

Since the early 1980s, quarterly estimates of real and current-dollar GDP have had average revisions in their annual rates of change—without regard to sign—of somewhat more than one percentage point.³ A large share of the revisions from the advance (the first) to the latest estimates occurs at the time of the annual and, especially, comprehensive revisions, when new

² The revisions are from the advance, preliminary, and final current quarterly estimates to the latest-available estimates. Mean revision is the average of the revisions:

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

where E is the percentage change in the earlier quarterly estimate, L is the percentage change in the later (usually the latest-available) estimate and n is the number of quarters in the sample period over which the summation is calculated. The mean absolute revision is the average of the absolute values of the revisions:

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

³The rates of growth of current-dollar GDP average 6.3 percent from 1983:I to 2000:IV and range from 0.2 percent to 14.2 percent. The rates of growth for real GDP average 3.6 percent and range from -3.2 percent to 9.8 percent.

concepts, methods, and source data are introduced into the NIPA's. The 1999 comprehensive revision, for example, expanded the concept of investment to include computer software, which along with other definitional and statistical revisions revised up average GDP growth rates by 0.4 percent in the latter half of the 1990s.

When only current quarterly revisions are considered, they are smaller, with an average revision—without regard to sign—from the advance estimates to the second (or preliminary) estimates of 0.5 percentage point. At the time of the preliminary estimates, survey and customs data for the third month of the quarter on two of the more volatile components of GDP—international trade in goods, and inventories—are substituted for BEA's extrapolations used in the first estimates. Table 1 shows mean revisions and mean absolute revisions for the three vintages of current quarterly estimates of current-dollar and real GDP and their major components for the period 1983-2000.

A context for the revisions in GDP estimates can be obtained by comparing them to revisions in private forecasts of GDP. The data on private forecasts come from the Federal Reserve Bank of Philadelphia's series of median forecasts for the Survey of Professional Forecasters (formerly the ASA/NBER Economic Outlook Survey).⁴ This set of mean forecasts is based on private economists' forecasts—made at about the middle of each quarter—which are usually based on the advance NIPA estimates of GDP (GNP was the featured measure of the economy prior to 1991:IV) for the previous quarter. The mean revisions for 1983:I through 2000:IV, for forecasts of current-dollar and real GDP/GNP are 0.69 and 1.00 percentage points, respectively, and the mean absolute revisions for current-dollar and real GDP/GNP are 1.63 and 1.69 percentage points, respectively. Thus, the mean revisions in the advance GDP/GNP estimates are substantially smaller than those for the forecasts and the mean absolute revisions of the advance GDP estimates are roughly three-quarters the sizes of those for the median forecasts.⁵

GDI

Table 2 shows mean revisions and mean absolute revisions for the vintages of current quarterly estimates of GDI, national income, and their major components for 1983-2000. The mean absolute revisions for GDI are modestly larger than those for current-dollar GDP and the mean absolute revisions for national income are even larger. The smaller mean absolute revisions for GDI relative to national income reflect substantial but partially offsetting mean absolute

⁴ These forecasts may be found at the Bank's web site, <www.phil.frb.org>.

⁵ In contrast Allan Young, BEA's former director, reported that mean absolute revisions for "flash" estimates of real GNP—which were made about two weeks before the end of each quarter, and were discontinued in 1986—were about the same as those for the advance estimates (Young, 1996).

revisions for the components that are added to and subtracted from national income to obtain GDI.⁶

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

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

Section 2.—News, Noise, and Rationality

News versus noise

If an early GDP estimate is a rational forecast of a later estimate, then the revision cannot be forecast on the basis of data available at the time of the early estimate. Mankiw and Shapiro (1986) performed an analysis of successive revisions in GNP for the period 1975-82 and concluded "...that the revisions of GNP growth, both nominal and real, are more like unforecastable new information than like measurement error" (p. 25). Table 3 extends their table 4—that described the correlations between GNP growth rates and revisions—to the period 1983-95, adds the three annual revision vintage estimates, and replaces GNP with GDP. The individual entries are the correlations between a vintage of revision and a vintage of estimate; numbers in parentheses are the correlations' t-test statistics under the hypothesis that there is no correlation. As they stated, "...correlation between the revision and the provisional estimate would be evidence for the measurement error hypothesis; correlation between the revision and the revised

⁶ These components are consumption of fixed capital, business transfer payments, indirect business tax and nontax liability, current surplus of government enterprises less subsidies, and net receipts of factor income from the rest of the world. Some of these components were greatly affected by the incorporation of a new depreciation pattern into consumption of fixed capital and a new treatment of government investment that were introduced in the 1996 comprehensive revision of the NIPA's. The new depreciation patterns yielded revisions both to consumption of fixed capital and to the capital consumption adjustment for rental income, corporate profits and proprietors' income. The new treatment of government investment resulted in the addition of consumption of capital for government.

estimate would be evidence for the efficient forecast hypothesis” (p. 22). These hold because the former means that the provisional estimate contains information that helps explain the revision, and the latter means that the revised estimate has introduced new information.

There are two panels in the table, one each for current and real dollars. Each panel is divided into triangular sections. The lower triangles contain the correlations of the revisions with earlier-vintage estimates. These should be zero under the null hypothesis that revisions are errors generated by efficient forecasts. The upper triangles contain the correlations of the revisions with current-quarterly and later-vintage estimates. These should be zero under the hypothesis of measurement error. The numbers in parentheses are the absolute values of t-test statistics for the correlations under the hypothesis that there is no correlation.

The correlations of the current quarterly estimates modestly echo Mankiw and Shapiro’s findings that “...one cannot reject the hypothesis that the revisions are errors generated by efficient forecasts and can strongly reject the hypothesis that they are pure measurement errors” (p. 23). In particular, none of the correlations of advance-to-preliminary revisions to later-vintage estimates are statistically significant. However, nearly all of the correlations of preliminary-to-final revisions to later-vintage estimates are statistically significant. Also, the correlation of the preliminary-to-final revision with the advance estimate in real dollars is significant at the 5-percent level.⁷

The results for the vintages of annual revisions estimates are even more mixed. More of the correlations in the lower triangles are statistically significant than those in the upper triangles. In particular, all of the correlations of first to second annual revisions with previous-vintage estimates of current-dollar GDP are significant, although none are for real GDP. In addition, the correlations of third annual final revisions to first annual through third annual estimates are significant for real GDP. Thus, the results for the vintages of annual revisions estimates are modestly more supportive of the measurement errors hypothesis than of the efficient forecasts hypothesis.⁸

Another question that can be answered using correlations is whether a revision to the estimates of GDP is likely to be followed by similar revisions in succeeding vintages. Table 4 shows the correlations of each vintage of revisions with each succeeding vintage of revisions for current-dollar GDP in the period 1983-95.⁹ For example, the entry at the upper left shows a

⁷ Mankiw and Shapiro obtained some of their strongest results from the “flash” GDP estimates. Because these were discontinued at the beginning of 1986, they are not available for this analysis. Mankiw and Shapiro did not calculate correlations for the three vintages of annual revisions estimates.

⁸ These results may be affected by the strategy used in this study, of replacing the “missing” annual-revision vintage estimates in benchmark years with benchmark-revision estimates that are made around the end of those years.

⁹ After 1995, the third annual and latest estimates are the same. As a result, the shorter period was used for this analysis.

correlation of 0.01 between the advance-to-preliminary revisions and the preliminary-to-final revisions. As with the estimates in table 3, the t-test statistics in parentheses are for the hypotheses that the correlations are zero.

Generally, the correlations are quite small; seven are negative and eight are positive. Only one (negative) correlation is significant at the 5-percent level; this is about the number expected by chance with 15 observations. The correlations reflect several factors. One is that there is a nearly equal chance that a revision from one vintage to the next will be either up or down. In the 1983-95 period, there is no quarter for which all five vintages of revisions of current-dollar GDP are in the same direction. Thus, a revision of any given vintage contains very little information about any successive vintage of revision. That is, successive vintages of revisions do not have momentum.

Rationality

If current quarterly vintage estimates are rational, they contain all the economic information available at the time they are made. Some observers have found that there is contemporaneously-available, or “real time” information that help explain revisions to early-vintage estimates of GDP or some of its components. For example, Dynan and Elmendorf (2001) found that some real time measures, including measures of acceleration (changes in the rate of change) had statistically significant, but modest, explanatory power in explaining revisions from the advance estimates to the latest estimates of GDP, personal consumption expenditures for services, and imports.

Rationality can be examined by looking at revisions to the latest estimates of the three vintages of current quarterly GDP estimates, and drawing real time data for some explanatory variables readily available from the NIPA’s, from the Philadelphia Federal Reserve Bank’s data set for the median forecasts of the Survey of Professional Forecasters (SPF), and from its “Real Time Data Set for Macroeconomists.”¹⁰ If some of these readily-available contemporaneous economic measures are statistically significant in explaining revisions, then the current quarterly estimates did not contain all of the economic information available. It follows that additional real time information might further explain revisions. For example, some observers have suggested that some leading economic indicators, such as the stock market’s performance, might help explain revisions. However, the set of possible additional measures is very large. Because the focus of this analysis is to investigate potential improvements in revisions, it is restricted to the three readily-available real time data sets noted above.

Revisions to current-dollar and real GDP, current-dollar final sales, GDI, and national income are examined in order to evaluate rationality of the NIPA estimates. Rationality is examined by regressing the revisions from a given vintage of current quarterly estimates to the latest estimates on a linear function of explanatory variables that were available by the time the

¹⁰ These data sets are available on the Bank’s web site <www.phil.frb.org>.

current quarterly estimates were made for the preceding quarter. (For example, the three vintages of current quarterly estimates for 1993:III were made in October, November, and December 1993, so estimates of the unemployment rate for 1999:III were available at the time that the current quarterly estimates were made.) If equations explaining revisions are statistically significant, they indicate a lack of rationality because the real time information could have, in principle, been used to produce estimates that were closer to the latest estimates than the current quarterly estimates.

Real GDP

In comparison to the advance and preliminary vintages of current quarterly estimates, final vintage estimates incorporate revised source data and have replaced judgment with data. The most clear-cut tests of rationality are those done using the final estimates. Thus, the initial tests of rationality used revisions from the final to the latest estimates of real GDP as the dependent variables.

A dozen possible explanatory variables were evaluated. These were selected from readily-available data contained in the NIPA's or in the two data sets from the Philadelphia Federal Reserve Bank. The variables were evaluated in three sequential groupings. The first grouping included three summary measures of economic activity. The first summary measure was the median SPF forecast; it is a measure of forecasters' expectations of real GDP conditioned on all information available to them. If the forecasts incorporated useful information that was not in the final current quarterly estimates, the coefficient of the forecast variable should be significant and positive. The second summary measure was the final estimate of real GDP, which provides a measure of whether the economy is growing more or less rapidly than average.¹¹ Some observers have suggested that early estimates of aggregate activity tend to get revised toward longer-run averages. If this is correct, the coefficient of this variable should be significant and negative. The third summary measure was the change in the final real GDP estimate from the previous quarter. It provides a measure of acceleration, and allows for systematic failures to capture whether the economy is speeding up or slowing down, like those found by Dynan and Elmendorf (op. cit.). If the final estimates systematically fail to capture acceleration or deceleration, the coefficient of the first difference in real GDP should be significant and positive.

The second grouping retained the two summary measures that were found to have statistically significant coefficients. It added quarterly dummy variables that were used to look for systematic tendencies to over- or under-estimate real GDP in specific quarters within years. They were included because Fixler and Grimm (2002) found that the mean revisions in different quarters of years varied noticeably. Significant coefficients for the dummy variables would

¹¹ Although the rate of change of real GDP was used as the explanatory variable, it could have been renormalized to be the rate of change less the long-term trend. This renormalization would only affect the value of the equations' constant terms.

indicate that there were systematic revisions in estimates of real GDP in different quarters. As discussed below, one quarterly dummy variable had a statistically significant coefficient.

The final grouping retained the two summary measures and the significant dummy variable. The other economic measures were added one at a time to the basic equation specification from the first two groupings. The six additional explanatory variables were chosen because they portray policy responses to economic conditions. Significant coefficients would indicate that these effects have had systematic relationships to revisions. Percent changes in the money supply, either M1 or M2, provide measures of whether monetary policy is expansionary or contractionary. The unemployment rate proxies for either monetary or fiscal policy incentives. The 10-year Treasury bond interest rate, the 90-day Treasury bill interest rate, and change in the spread between the two also portray monetary policies. In particular, the change in the spread between the two interest rates is a rough measure of yield curve changes; a narrowing spread is consistent with a loosening monetary policy, and conversely for an increasing spread.

Table 5 presents the results of regressions explaining the revisions from the final to the latest real GDP estimates, in percentage points, for the period 1983-2000. As shown in the first column of table 5 (equation 5.1), the coefficient of the median SPF forecast, used alone as an explanatory variable, has the expected positive sign but is not significant. In other equations, the negative coefficients of final real GDP estimates are statistically significant in explaining revisions from the final current quarterly estimates to the latest estimates (all equations beginning with equation 5.2).¹² The positive coefficients of the median SPF forecast—when it is combined and the final real GDP estimate—are significant, and the equations' F-test statistics are significant (all equations beginning with equation 5.4). As indicated above, the positive coefficients of the median SPF forecasts variable are consistent with information from the forecasts supplementing that in the final estimates. Also as indicated above, the negative coefficients of the final estimates variable are consistent with a tendency to revise down higher than average estimates and revise up lower than average estimates. However, the coefficients of acceleration—the change in final real GDP measure—are not significant in explaining the revisions (equations 5.3 through 5.5).

Equation 5.5 adds three quarterly dummy variables to the variables of equation 5.4. Only the coefficient for one of the three, the dummy variable for fourth quarters, is statistically significant. Equation 5.6 removes the change in final estimates variable as well as the two statistically insignificant quarterly dummy variables; the fourth-quarter dummy variable is significant with a positive coefficient (all equations beginning with 5.5). Equations adding as explanatory variables the money stock measures, the unemployment rate, and the two interest rates all fail to find statistically significant coefficients for them (equations 5.7 through 5.11).¹³

¹² A 5-percent significance level was chosen as the threshold of significance to limit the possibility of misinterpreting the results of chance relationships that might occur with a less demanding threshold. This also corresponds to the Mankiw-Shapiro threshold used earlier in this section.

¹³ Following completion of estimates of the regressions reported here, one quarter lags and first differences for the policy variables were also tried in alternative equation specifications, but none yielded

However, the change in the spread between the 10-year Treasury bond interest rate and the 90-day Treasury bill interest rate is significant and has a positive coefficient (equation 5.12).¹⁴ As noted above, this is consistent with upward revisions in GDP estimates at times when short-term interest rates—which are controllable by the Federal Reserve—are declining relative to long-term interest rates, and conversely. Equation 5.12 is also the most successful. All of its explanatory variables are statistically significant, and it explains the largest share of the variance of the revisions.¹⁵

Current-dollar GDP

Table 6 presents the results of regressions explaining revisions from the final current quarterly estimates to the latest estimates of current-dollar GDP that use the same set of explanatory variables as table 5, but with current-dollar measures substituted for real measures of GDP. The results are qualitatively similar to those reported in table 5. R-bar-squares and F-statistics are roughly the same, but standard errors are 0.1 to 0.2 percentage point lower than those for the real GDP estimates. Both the median SPF forecast of current-dollar GDP and the final current-dollar GDP estimates' coefficients are statistically significant at the 5-percent level or better in most of the equations. The fourth quarter dummy variable is always significant. Neither the change in final current-dollar GDP estimates measure nor the other two quarterly dummy variables are significant. The change in the spread between the 10-year Treasury bond interest rate and the 90-day Treasury bill interest rate is again statistically significant and has a positive coefficient. None of the other real time measures are significant.

Table 7 also presents the same set of regressions, but uses the revision from the preliminary current-dollar GDP estimates to the latest current-dollar GDP estimates as the dependent variable and substitutes the preliminary GDP estimates for the final estimates as explanatory variable. The equations indicate fewer statistically significant relationships between the explanatory variables and the revisions. Although the fourth quarter dummy variable is significant in all equations where it appears, the median SPF forecasts of GDP and the preliminary GDP estimates variable are statistically significant only in equation 7.12, which also contains a statistically significant parameter for the change in the spread between the 10-year Treasury bond interest rate and the 90-day Treasury bill interest rate. The F-statistics are significant beginning with equation 7.5.

significant coefficients.

¹⁴ The finding that changes in the interest rate spread help to explain revisions in GDP estimates is consistent with findings by other researchers that the interest rate spread contains useful information about future growth in real GDP. See, for example Dotsey (1998). As noted below, this finding also holds for current-dollar GDP and GDI.

¹⁵ No correction for heteroskedasticity were made to the t-test statistics. White heteroskedasticity tests did not indicate statistically significant heteroskedasticity; p-values against the null hypothesis of no heteroskedasticity were a bit above 0.4. Further, if Newey-West corrected t-test statistics had been used, the explanatory variables would have had the same levels of significance as those indicated for equation 5.12.

Table 8 again presents the same set of regressions, but uses the revision from the advance to the latest GDP estimates as the dependent variable and substitutes the advance GDP estimates for the preliminary estimates in explanatory variables. The equations indicate even fewer statistically significant relationships between the explanatory variables and the revisions. Although the fourth quarter dummy is significant in all equations where it appears, the median SPF forecast and advance estimates variables are never statistically significant. The change in spread variable is also significant. The F-statistics are again significant, beginning with equation 8.5.

Thus, all of the three vintages of current-quarterly GDP estimates lack rationality because there is real-time information that statistically significantly explains the revisions from these estimates to the latest estimates. However, the revisions from the advance estimates are less well explained than those from the preliminary estimates, and the revisions from the preliminary estimates are less well explained than those from the final estimates.¹⁶ In general, the summary statistics for the various equations for the later current quarterly vintages indicate closer relationships to the revisions. For all 12 equation specifications, the R-bar-squares increase, standard errors decrease, and F-statistics generally increase progressing from advance to preliminary to final estimates. This occurs as the later estimates incorporate additional and revised data.

The predictability of revisions suggests the question “What difference does it make?” If real time information can be used to predict revisions, it might be employed to improve the current quarterly estimates. An experiment was done to estimate the amount of reduction in the mean absolute revision with full use of the real time information used as explanatory variables in tables 5 through 8.¹⁷ Equation 6.12, the most successful equation for final current-dollar GDP estimates, is of the functional form

$$\text{Latest} - \text{Final} = a_0 + a_1 * \text{Final} + \dots$$

For convenience, this equation may be renormalized as

$$\text{Latest} = a_0 + (1 + a_1) * \text{Final} + \dots$$

In the experiment, the equation’s sample period was first truncated to 1983:I to 1992:IV and the

¹⁶ This is consistent with the view that the earlier-vintage estimates contain more noise that is replaced by new or better data in later-vintage estimates.

¹⁷ The estimates provide an upper limit because the latest estimates are used to estimate the parameters of the equations. These estimates are not available until after the end years of the sample periods of the regressions. The latest estimates are used in this experiment because they are also the standards used here for computing revisions.

equation reestimated. Then the same equation was reestimated over the period 1983:I to 1993:IV. And so on, adding one year at a time to the sample period. Next, the estimated parameters in the equation for 1983:I to 1992:IV were used with real-time variables for 1993 to construct modified estimates for the four quarters of 1993. The equation for 1983:I to 1993:IV was then used with real-time variables for 1994 to construct modified estimates for the four quarters of 1994. And so on through 2000:IV.¹⁸

Using the modified estimates, the decrease in revision size was quite modest. The mean absolute revision from the modified final estimates to the latest estimates is 0.85 percentage point for 1993:I to 2000:IV. This is only 0.06 percentage point less than the mean absolute revision, from the unmodified final estimates to the latest estimates, of 0.91 percentage point.¹⁹ Making the modifications would require allocating the adjustments among the components of GDP, and this allocation might degrade the accuracy of the components. Thus, it is not at all clear that any adjustments would ever be useful, even in the presence of mild irrationality.

Final sales

Although the sizes of mean absolute revisions of GDP and final sales shown in table 1 are very similar, CIPI—which is subtracted from GDP to obtain final sales—is very volatile and appears to be subject to large revisions in comparison to other major components of GDP. In order to determine if CIPI revisions are masking revisions in the rest of GDP that are related to real time information, regressions were estimated that explained revisions in final sales. Table 9 shows equations explaining current-dollar final sales and using the same specifications as those in tables 5 through 8, but substituting final sales for GDP in the explanatory variable set. Although standard errors for the equations for final sales estimates are only slightly higher than those for GDP in table 6, the R-bar-squares and F-statistics are up to double those for comparable equations.

Equation 9.1 makes the revision a function of the median GDP forecast (information about the median SPF forecasts does not include current-dollar final sales estimates).²⁰ Equation 9.2 makes the revisions a function of the final estimates of final sales. Equation 9.3 adds the first

¹⁸ The modified estimates are those that would be produced for each successive post-sample year if the latest estimates for all sample-period years were available following the ends of each year.

¹⁹ In comparison, the mean absolute revision for the median SPF forecasts for the period is 1.63 percentage points. The mean revisions are 0.01 percentage point for the modified final estimates, 0.15 percentage point for the unmodified final estimates, and 0.64 percentage point for the median SPF forecasts.

²⁰ The data set of median SPF forecasts of real GDP contains information needed to calculate forecasts of real final sales only through the third quarter of 1995. Thereafter, the adoption of chain index methodology makes such calculations meaningless because, as indicated in NIPA table 1.4, the residual between real GDP and the sum of real final sales and real CIPI is very volatile.

difference in final sales to the explanatory variable list. Equation 9.4 also includes the median GDP forecast. Equation 9.5 removes the first difference in final sales variable. These equations indicate that the final estimates of final sales are statistically significant and either of the other two measures are significant in combination with them, but not when both are used. As with the equations in table 6, the final vintage final sales estimates has a negative coefficient and the median GDP forecasts variable has a positive coefficient. The first difference in final vintage final sales estimates has a negative sign, consistent with the hypothesis that the current quarterly estimates tend to overstate accelerations and decelerations in final sales.

Although the median GDP forecast yielded a modestly better fit, it was dropped in favor of the first difference in final sales variable in order to investigate the latter's significance in combination with other real time measures. Equation 9.6 adds the three quarterly dummy variables. In contrast to the equations in table 6, none of the quarterly dummy variables are significant, and the coefficient of the fourth quarter dummy variable is negative, rather than positive as in the equations in tables 6, 7 and 8. Thus, the strong positive revision in the fourth quarters for real GDP must be related to systematic revisions in CIPI. Equations 9.7 through 9.12 drop the quarterly dummy variables and insert, one by one, the other real time measures evaluated in the previous estimates of equations for GDP. Variable coefficients for the real time variables are larger than the corresponding equations in table 6, and t-test statistics are also higher, but only the coefficient of the 10-year Treasury bond interest rate is statistically significant. The coefficient of the spread between the 10-year Treasury bond interest rate and the 90-day Treasury bill interest rate is not significant. The coefficients of the first difference in final sales are all negative in equations 9.6 through 9.12, and are significant in five of the seven equations.

Thus, the indications of the predictability of revisions are slightly stronger for final sales than they are for GDP. The revisions in final sales, however, are not significantly related to any of the four quarters of the year. Also, there is evidence of a significant tendency to understate accelerations and decelerations in final sales.

Gross domestic income

Gross domestic income (GDI) provides an alternative summary measure of the performance of the U.S. economy by summing up the income-related measures arising from production, such as profits and employee compensation, to measure the same total as GDP. In principle, the two measures should produce the same values, but such factors as differing sources of data underlying much of the estimates of the two measures typically lead to different totals for the two concepts. The difference is the statistical discrepancy, which is added to GDI to provide a measure that matches the values GDP. Recently, GDI has often outpaced GDP, leading to increasingly large negative values for the statistical discrepancy. This has led some observers to suggest that GDI is providing information that economic activity has been expanding more rapidly than indicated by GDP.

Table 10 explores the rationality of GDI estimates. It shows the results of equations explaining revisions from the final current quarterly to the latest estimates of GDI. The equations are similar to those in tables 5 through 9 that describe the results of equations that examine the rationality of GDP estimates. The principal difference in the GDI equations occurs because there is no time series for median forecasts of GDI. On the hypothesis that, if there were such a forecast, it would have GDI move in ways similar to GDP, the consensus forecast of current-dollar GDP was included in the set of explanatory variables.²¹

The equations find little evidence of the predictability of revisions to GDI estimates. The final current quarterly estimates and the constant term are statistically significant in some equations. As with GDP, this may indicate a tendency to revise back toward the average rate of change. Because the parameters of the relationship of the final estimates to the latest estimates cannot be known before the latest estimates are available, this statistical significance is not evidence of a lack of rationality. None of the other real-time explanatory variables are statistically significant, although the 10-year Treasury bond interest rate just fails to be statistically significant at the 5-percent level. The fits of the equations, as measured by the summary statistics, are generally much looser than those in table 6. For example, the highest R-bar-square, for equation 10.10, is just 0.082, roughly one-third the size of the most successful equation for revisions in final current quarterly estimates of GDP, 0.229 for equation 6.12.

National income includes compensation of employees, profit-type income (corporate profits and proprietors' income), rental income of persons, and net interest. It excludes other components of GDI (see footnote 4). Some of these may be only distantly related to short-run fluctuations of U.S. economic activity. It is possible that the real-time measures of U. S. economic conditions might better explain revisions in national income estimates than those of GDI. In order to examine this possibility, regression equations explaining revisions from final to latest estimates of national income were estimated using the same specifications as those in table 10, but using final current quarterly estimates of national income and its first difference as explanatory variables. However, although not shown, none of the equations had any statistically significant variable coefficients, and none of the F-statistics were significant. Only an alternative equation containing one explanatory variable, the change in the spread between the 10-year Treasury bond interest rate and 90-day Treasury bill interest rate, was statistically significant at the 5-percent level. Thus, there is even less evidence of a lack of rationality of national income estimates than there is for GDI.

²¹ Prior to the discontinuation of BEA's quarterly econometric model in 1990, BEA participated in cooperative studies with a number of other econometric-model-based forecasters. In the course of the studies, it was found that many model-based forecasts held the statistical discrepancy constant and estimated profits as a residual. This procedure would have produced similar movements in GDP and GDI forecasts.

Information in GDP and GDI about each other

Some observers have suggested that GDP and GDI contain information that supplement each other. Table 11 shows the results of equations that explain revisions from final to latest estimates of current-dollar GDP, final sales, GDI, and national income. Each equation includes the variables in the most successful equation (that is, the equation with the highest F-statistic) from tables 6-10 for each summary measure and supplements the variables with one of the two economic aggregates from the opposite “side” of the national income and product account. Thus, for example, equation 11.1, for revisions in GDP, has the same set of explanatory variables as equation 6.12, but adds GDI as an explanatory variable. Equation 11.2 adds national income rather than GDI.

In equation 11.1, GDI has a very low t-test statistic and a negative sign, the opposite of what is expected under the hypothesis that GDI contains information that will affect revisions to GDP. In addition, the coefficient of GDP is statistically insignificant and the F-statistic is about one-fifth smaller than that for equation 6.12. In contrast, equation 11.2 shows that the coefficient of national income is statistically significant and its coefficient has the expected positive sign. All of the other explanatory variables are also statistically significant, and the F-statistic is somewhat larger than that of equation 6.12. Thus, national income contains information that is statistically significant in explaining GDP revisions. GDI does not, presumably because the national income information is masked by the other components that are added to national income to obtain GDI.²²

Equations 11.3 and 11.4, which explain revisions to final sales, also find that GDI is not statistically significant but national income is statistically significant with the expected positive sign. The summary statistics indicate somewhat better fits than the corresponding equation without the income-side measures. Equation 11.4 explains more than 35 percent of the variance of the revisions in final sales. Thus, there is evidence that income-side summary measures do contain some information about revisions to summary measures of the product side, particularly final sales.

Equations 11.5 and 11.6, which explain revisions to GDI, add GDP and final sales as explanatory variables, respectively, to the variables in equation 10.10. Neither coefficient is statistically significant, and final sales has a negative coefficient. In addition, most of the other explanatory variables' coefficients are no longer statistically significant. The summary statistics

²² Renormalizing equation 11.2 to make the latest estimates a function of the other explanatory variables indicates that a weighted sum of $3/4 * \text{GDP}(\text{final}) + 1/4 * \text{national income}(\text{final})$ yields the best prediction of the latest estimates. Other regressions using the latest as the dependent variable and using various other independent variables returned similar results, with weights for national income up to $1/3$, depending on the other explanatory variables.

indicate a somewhat looser relationship than that of equation 10.10. Thus, there is no evidence that contemporaneous product-side measures contain information about future revisions to GDI.

Equations 11.7 and 11.8, which explain revisions to national income, add GDP and final sales, respectively, as explanatory variables to the change in the spread between 10-year Treasury bond rates and 90-day Treasury bill rates, the only real time measure found to be significant in explaining revisions to national income. Both product-side measures are not statistically significant and have negative coefficients. The coefficients of the change in the spread measure remain statistically significant, but the summary statistics indicate a looser relationship than for the equation without product-side variables. Thus, there is no evidence that product-side measures contain information about future revisions to national income.

Section 3.—Recessions: Patterns and Revisions to Real GDP

Quarterly estimates of real GDP are presently published beginning with the first quarter of 1947. From 1947 through 2001, there have been ten recessions. According to the latest estimates, the recessions have varied considerably in length—from two to five quarters—and depth—with real GDP cumulatively declining between 0.6 and 3.7 percent.²³ Five of the ten recessions had one or more quarters when real GDP increased between their peaks and troughs. In all of the recessions, real inventory stocks declined in at least one quarter.²⁴

Despite the recessions' diverse features and irregularities, patterns may be discerned by smoothing the rates of change of real GDP. Charts 1-10 show real GDP in quarters around recessions and two smoothed versions of real GDP; a three-quarter centered moving average (CMA), and a Hodrick-Prescott (H-P) filtered series, with a smoothing parameter of 5.²⁵ The unsmoothed real GDP estimates exhibit rather erratic patterns of increases prior to peak quarters, and irregular patterns of decreases prior to trough quarters, often including quarters of positive change between peaks and troughs. The three-quarter CMA estimates typically begin to decline several quarters before cyclical peaks, have maximum negative values up to several quarters before cyclical troughs, then increase. The series smoothed by the Hodrick-Prescott filter—which minimizes a function that takes into account both the difference between the unsmoothed and smoothed series and the second differences of the smoothed series times a smoothing parameter,

²³ Because NIPA estimates are quarterly in frequency, the timing of cyclical peaks and troughs, and the duration of recessions may differ slightly from those established by the NBER dating committee, which relies on monthly-frequency data.

²⁴ Real change in private inventories estimates are presently published beginning in 1987. This statement relies on real change in business inventories estimates published prior to 1996, when chain price indexes were adopted.

²⁵ The parameter was chosen by experimentation and reflects the authors' judgment about the tradeoffs between amplitude and smoothness of the filtered series when graphing the smoothed series around recessions.

and using all time periods for the series to be smoothed—has patterns generally similar to the CMA series, but is even smoother. Thus, the two smoothed series indicate a rather regular underlying pattern for all recessions that has a gradual but steady slowing, then declines, and followed by a usually monotonic initial recovery.

Revisions to estimates of recessions

Some observers have suggested that recessions tend to get revised away as time goes on. A closer look, however, fails to provide a strong indication of such trends in revisions for most recessions.

There have been 8 recessions since the advent of estimates of real GNP in 1955.²⁶ Estimates of the most recent recession, that of 2001, have only undergone one annual revision and it is excluded from this analysis. The mean decline in real GNP from peak to trough for the other 7 recessions—at the times that the final current-quarterly estimates for the trough quarter were made—was 3.09 percent. The latest-available estimates (from the 1999 comprehensive revision) indicate a mean decline of 2.21 percent. Thus, the mean upward (less negative) revision is 0.88 percentage point. If the “great” recession of 1973-75 is excluded, however, the average upward revision is just 0.34 percentage point. Further, although the first four recessions were revised upward, the most recent three—beginning with the 1980-81 recession—were revised downward (larger total declines).

It is possible to indirectly evaluate the effects of revisions in prices by comparing mean revisions of current-dollar GDP with those of real GDP. For the seven revisions, the mean upward revision in current-dollar GNP was 0.45 percentage point, suggesting that revisions in prices accounted for about half of the mean revision in real GNP. The adoption of chain price indexes—in the January 1996 comprehensive revision of the NIPA’s—removed further price impacts due to changes in the base period, and can be expected to noticeably reduce revisions in prices because the chain methodology eliminates increasing distortions to real GNP growth rates in years increasingly far from the base year that were characteristic of the effects of the fixed-weight price index methodology used previously.

Thus, because the mean upward real revision is dominated by one outlier and because the adoption of chain price indexes eliminated a substantial source of distortion to growth rates, there is little evidence that the estimates of past recessions or the estimates of future recessions are likely to be systematically revised toward smaller cumulative declines in the future.

²⁶ GNP was the featured summary measure of the economy until the release of a comprehensive revision of NIPA estimates in December 1991, and thus was the featured measure of the economy for all but the 2001 recession. The first estimates of real GDP were for annual values. Publication of real quarterly estimates began in 1958.

Performance of various measures of economic activity around cyclical turning points

The attention of some observers has been directed toward the performance of various NIPA measures around turning points. In particular, some observers have suggested that GDI estimates might contain information about the economy at and near cyclical turning points that would augment our understanding of fluctuations in the economy. However, table 11 suggests that GDI does not contain information that generally supplements GDP estimates. It is possible, however, that GDI may provide additional information at certain times, such as in and around cyclical turning points. In order to focus on turning points, table 12 shows mean and mean absolute revisions to final current-quarterly vintage estimates of real and current-dollar GDP, as well as GDI, around the peaks and troughs of the last five recessions. (The 1957-58 and 1960 recessions are not included because published data do not exist to support the calculation of final current quarterly vintage estimates of either GDI or GNI.). The table also includes a 50-50 weighting of GDP and GDI, which some observers use as an analytical tool.

In table 12, “peak” identifies the last quarter with a positive change in real GDP before a recession, and “trough” identifies the last quarter of negative change before the beginning of a recovery. “Previous” identifies the quarter immediately before a peak or trough quarter, and “next” identifies the quarter immediately following a peak or trough quarter. Comparison of the sizes of the average revisions around peaks and troughs must be interpreted cautiously because only 5 observations are included, and averages—especially mean revisions—tend to be sensitive to the period examined.

At cyclical peaks, the mean absolute revision for real GDP estimates, 0.5 percentage point, is less than half the mean absolute revision of 1.2 percentage point for 1983-2000, and it is well below the range of 1.4 to 2.4 percentage points found in earlier BEA revisions studies that evaluated the 1960s and 1970s. The mean revision of 0.1 percentage point at cyclical peaks is also smaller than the mean revision of 0.4 percentage point for 1983-2000. However, for previous quarters, the mean absolute revision is double that for 1983-2000, but the mean revision is considerably smaller, and negative. For the next quarters, the mean absolute revision is considerably larger than its value for 1983-2000, but the mean revision is again smaller. Thus, the final estimates show little tendency to over- or understate growth in real GDP around cyclical peaks, and their mean absolute revisions are roughly in line with the revisions that a number of BEA studies have found over the period from the 1960s through the 1990s.

At cyclical troughs, the mean absolute revision for real GDP estimates, 2.9 percentage points, is noticeably larger than that of the peak, and more than double the corresponding revision for the 1983-2000 period. Mean absolute revisions for both the previous and the next quarters are nearly as large. The mean revisions for both the previous and trough quarters are both 1.5 percentage points, and 2.4 percentage points for the next quarters. These substantial upward revisions indicate a tendency for the final current quarterly estimates to overstate declines just before and at troughs, and understate growth at the beginnings of recoveries.

In sum, the final estimates do a substantially better job of indicating fluctuations in real GDP around cyclical peaks than they do around cyclical troughs. This is in line with an earlier BEA study that found that current-quarterly estimates correctly indicated the timing of peaks in four of the five recessions, but only two or three of the troughs (Grimm and Parker, 1998, p. 12).

The average revisions for current-dollar GDP around cyclical turning points are qualitatively similar those for real GDP. Again, the final estimates present a generally accurate picture around cyclical peaks, although there is a modest upward revision to current-dollar GDP increases in peak quarters. For the next quarters after peaks, the mean absolute revision is noticeably smaller than was observed for real GDP. Around cyclical troughs, however, there is a somewhat larger tendency toward upward mean revisions than was found for real GDP. The mean absolute revisions are also upward and somewhat larger than those for real GDP in trough and “next” quarters.

The estimates of GDI around cyclical turning points may be compared to those for current-dollar GDP. Around both peaks and troughs, the mean revisions to GDI are larger than those for GDP. Around peaks, the mean revision for GDI in the previous quarter is negative, and several times the size of the small positive mean revision for GDP. In the peak quarter, the positive mean revision for GDI is nearly twice that for GDP, and in the next quarter, it has three times as large a negative value as that for GDP. The mean absolute revision to GDI for the previous quarter is slightly smaller than that for GDP, but the mean absolute revisions for the peak and next quarters are slightly larger.

Around troughs, mean revisions for GDI are all positive, and somewhat larger than those for GDP in the previous and trough quarters. Mean absolute revisions for GDI are modestly smaller than those for GDP in the trough and next quarters. Thus, the tendency for upward revisions around cyclical troughs holds for GDI as well as current-dollar and real GDP.

The weighted sum of GDP and GDI produces mean and mean absolute revisions around cyclical turning points that are qualitatively similar to those for GDP and GDI. Mean revisions for the weighted sum lie between those for GDP and GDI for all six of the quarters around peaks and troughs. Likewise, mean absolute revisions of the weighted sum lie between those for GDP and GDI in all six quarters. A reason for this is that the weighted sum derives almost no benefit from offsetting revisions in GDP and GDI; the revisions differ in sign in only four of the 30 quarters included in the sample. Thus, GDI yields little or no information to supplement that from GDP around cyclical peaks and troughs.

Another key question is whether advance current-quarterly estimates give reliable forecasts of the final current quarterly estimates of real GDP around cyclical turning points. This is of key importance to policy makers when they only have advance estimates for the most recent quarter. The final two rows of the table shows mean and mean absolute revisions from advance to final estimates. The mean revisions are generally small, and range from -0.3 to 0.3 percentage point and

averaging 0.05 percentage point in the six quarters around turning points, with three being positive and three being negative. These compare to a mean revision from advance to final estimates of 0.08 in the period 1983-2000. The mean absolute revisions range from 0.22 to 1.02 percentage point and average 0.62 percentage point. These compare to a mean absolute revision from the advance to the final estimates of 0.58 for the period 1983-2000. In none of the quarters around turning points was the advance estimate revised to a final estimate with opposite sign, and a change in occurs in only one quarter during any of the 5 recessions, the third quarter of 1983. Thus, the advance estimates of real GDP around turning points may be viewed as reliable forecasts of the direction in sign of final estimates, with mean and mean absolute revisions similar to those of all quarters in the 1983-2000 period.

Revisions to estimates of GDP in the 1990-91 recession

Some observers have suggested that the “miss” in identifying the beginning of the 1990-91 recession led to significant policy errors. The beginning of the recession in 1990:III, following a peak in 1990:II, was not correctly identified until the second annual revision that was published in July 1992. Previously, 1990:III had been identified as the peak. The latest estimate shows that real GDP declined 0.7 percent in 1990:III; the current quarterly estimates showed increases ranging from 1.9 percent in the advance estimate to 0.7 percent in the final estimate. The final current quarterly estimate understated the rate of decline in 1990:IV by about 1 percentage point and overstated the rate of decline by a similar amount in 1991:I. All three current quarterly estimates correctly identified the beginning of the recovery in 1991:II and roughly indicated the pace of the initial recovery.

An important question that arises is whether the current quarterly estimates took into account all of the real time information available. As a test of this, the parameters of equation 11.2 (the most successful) were used to modify, ex post, the final estimates for GDP in the period 1990-I through 1991-II.²⁷ The revisions for the modified estimates of GDP were all the same directions as those for the final estimates, and their absolute values averaged 1.28 percentage point, slightly higher than the 0.92 percentage point average for the final estimates. In the first “down” quarter following the peak and in the first “up” quarter following the trough, the revisions for the modified estimates are larger than those for the final estimates. Thus, the estimates are not helped by the incorporation of the additional real time information.

²⁷ This period covers the quarter prior to the peak through the quarter following the trough, which allows the estimates to be compared with those shown in table 12. The experiment was repeated using the parameters of equation 6.12 for GDP and those of equation 5.12 for real GDP. The patterns were very similar to those shown, but with somewhat larger revisions.

Revisions From Final and Modified Final Estimates to the Latest GDP Estimates

(Percentage points)

Quarter	Final	Modified
1990-I	2.54	2.14
1990-II (peak)	-0.32	-0.66
1990-III	-1.38	-1.83
1990-IV	-0.19	-1.96
1991-I (trough)	0.75	0.58
1991-II	0.36	0.49
Mean abs. revision	0.92	1.28

A detailed review of the underlying details (not shown) found that revisions to different components were most prominent in each of the three quarters of decreases in real GDP, but revisions to CIPI played major roles in all three. In particular, the revision from an increase to a decrease in real CIPI in 1990:III was more than half the size of the overall GDP revision.²⁸ A downward revision to the GDP price index was nearly as large as the revision to real GDP in 1990:IV; in the other two recession quarters, the price revisions were much smaller. The modest upward revision (that is, reduction in the decline) in 1991:I occurred as upward revisions to both private fixed investment and CIPI more than offset a downward revision to personal consumption expenditures.

As discussed above, revisions to seasonal adjustments act on average to reduce revisions in seasonally-adjusted estimates.²⁹ The text table shows the revisions to estimates of seasonally-adjusted and seasonally-unadjusted current-dollar GDP and the effects of revisions to seasonal factors, in percentage points at annual rates, from the first to third annual revisions. Although revisions to seasonal factors partially offset revisions in seasonally unadjusted estimates in 1990:II and 1990:IV, in 1990:III the revision to the effects of seasonal factors was negative, and more than offset an upward revision in the seasonally-unadjusted estimates. 1990:III is the “miss” quarter in which real GDP was revised from 0.3 percent in the first annual estimate to -0.9 percent in the

²⁸ CIPI was revised up in both 1990:II and 1990:III, but the second-quarter revision was larger than the third quarter revision, so the quarter-to-quarter change in CIPI was down.

²⁹ BEA publishes seasonally unadjusted quarterly estimates of current-dollar GDP and its components about 2 months after annual and comprehensive revisions; the estimates correspond to the first through the third annual revision vintage estimates. Data on seasonally-unadjusted data were first published beginning in 1982. As a result, no seasonally-unadjusted data are available for earlier recessions.

third annual estimate. On a seasonally-adjusted basis, the revision of current-dollar GDP in each of the three recession quarters are in the same direction as those of real GDP.

Despite the limitation of being able to examine only the effects of revisions in current-dollar revisions, and not having estimates of seasonal factors for the final current-quarterly estimates, it is clear that revisions in seasonal factors had an important role in explaining the revisions in real GDP. The effects of revising the seasonal factors are in the same direction as the revisions to real GDP in 1990:III and 1991:I (from final current-quarterly to latest estimates) and are larger in magnitude than those revisions.

Revision from the First Annual to Third Annual Estimates

(Percent change at annual rates)

Period	Current-dollar GDP			Real GDP
	Seasonally adjusted	Seasonally unadjusted	Seasonal factors	Seasonally adjusted
1990-I	2.78	1.04	1.74	-0.38
1990:II	-0.30	-1.86	1.56	-0.07
1990:III	-1.74	0.68	-2.42	-1.11
1990:IV	1.94	3.42	-1.48	0.08
1991:I	1.04	-0.28	1.32	0.98
1991-II	-0.25	-2.43	2.18	0.17

Thus, the revisions to GDP in the three recession quarters were not due to any consistent underlying factors. No GDP component played a consistent role in the revisions. Further, revisions to seasonal factors played major roles in revisions to the first two recession quarters. The interplay of a number of the aspects of the revisions, some of which offset one another, led to the overall revisions.

To put the revisions into perspective, at the time that the final current-quarterly estimates of the first quarter of 1991 were made, the cumulative decline of real GDP was 1.30 percent. In the latest estimates, the decline is 1.49 percent. This downward cumulative revision, -0.19 percent, compares with the mean upward revision of 0.45 percent for current-dollar GDP in the 7 recessions evaluated earlier in this section.

Revisions and the 2001 recession

The revised NIPA estimates that were released in July 2002 indicated that the recession began in the first quarter of 2001, as real GDP began to decline. Although it is too soon to do an analysis comparable to the foregoing analysis of the 1990-91 recession, an initial review of the

revisions is possible. As shown in table 13, a comparison of the revised and unrevised estimates for rates of change in real GDP indicates that they were revised down 0.7 to 0.9 percentage point in the last three quarters of 2000, down 1.9 percentage points in the first two quarters of 2001, and up 1.0 percentage point in the last two quarters of 2001.³⁰ The downward revisions in the first two quarters of 2001 were large enough to turn what had previously been small increases in real GDP into decreases; these decreases brought the real GDP estimates more in line with the NBER dating committee's designation of March as a cyclical peak.

There were no steady underlying patterns of revisions to GDP components around the 1990-91 recession; the largest revisions to components in any given quarter are generally not important in the preceding or succeeding quarters. In contrast, the downward revisions in 2000-01 resulted largely from multi-quarter downward revisions in some major GDP components. Downward revisions in the growth of PCE for services helped to lower real GDP estimates in all but one quarter from 2000:II to 2001:III. The lower contributions of PCE for services was by and large the result of revisions in PCE for "other" services. This, in turn, reflected downward revisions in personal business services that were primarily due to new source data, but also due to the adoption of improved methodology.

Downward revisions in fixed investment contributed to lower real GDP in all but one quarter in 2000 and in the first half of 2001. In 2000, this contribution was almost entirely due to the computers and software components of information processing equipment and software. In 2001:I, the contribution was due to downward revisions in structures investment, industrial and transportation equipment, and "other" nonresidential fixed investment. The structures contribution was due to downward revisions in all four of its components. In 2000:II, the contribution was due to downward revisions in transportation equipment and "other" nonresidential fixed investment.

Revisions to CPI generally acted to increase the growth of real GDP, but contributed about a third of the lowering of growth in 2000:I and 2000:II. The effects of revisions in exports and imports on real GDP growth were of opposite signs in most quarters, and their net contributions had no general trend over the eight quarters of 2000-01, but did contribute to lower real GDP growth in the first half of 2001. The revisions of the contributions of government were also small and had no particular pattern. As with PCE for "other" services and fixed investment, these revisions reflect the incorporation of new source data.

Thus, the multi-quarter lowering of the growth rates of real GDP largely reflect multi-quarter downward revisions in PCE for "other" services and in fixed investment. In addition, the large downward revisions of the growth rates of real GDP in the first half of 2001 also reflect downward revisions in the contributions of change in private inventories. Upward revisions in real

³⁰ The string of five consecutive downward revisions of real GDP in the first annual revision is quite unusual. In the 1978-2000 period, there were two strings of four consecutive downward revisions and one string of six upward revisions.

GDP growth in the second half of 2001 reflect smaller negative contributions of PCE for “other” services and upward revisions in the contribution of both fixed investment and change in private inventories.

Section 4.–Conclusions

The principal findings of this study are consistent with those of previous BEA studies of revisions of quarterly NIPA estimates. Some findings, however, either amplify previous findings or are new. They are as follows.

- Estimates of revisions to current-dollar GDP and many of its major components are statistically unbiased. However, revisions to a number of major components can not be evaluated because they are not normally distributed.
- Estimates from 1983 to 2000, based on current quarterly vintages of estimates, provide modest confirmation of Mankiw and Shapiro’s result that revisions to GDP are more like unforecastable new information than measurement error.³¹ Annual revisions vintages of estimates do not have this property; and by and large, act like neither.
- Echoing Mankiw and Shapiro, GDP revisions of any vintage contain very little information about subsequent revisions. That is, revisions have no momentum.
- There are statistically significant revisions to fourth-quarter GDP estimates that are traceable to revisions in CIPI. Revisions in the other individual quarters do not have statistically significant patterns. No quarterly patterns are statistically significant for final sales, GDI, or national income.
- Revisions to final current quarterly estimates of real GDP and all three current quarterly vintages of current-dollar GDP are, in part, predictable and revisions to the final current quarterly estimates are the most predictable.
- Revisions to final current quarterly vintage estimates of current-dollar final sales are even more predictable. Up to one-third of the variance of the revisions from the final to the latest estimates may be explained by equations that use only real time information to explain revisions.
- Despite the predictability of revisions, adding other real time information about the economy to make adjusted final estimates of GDP reduces mean absolute revisions only slightly, even though the parameters used to make the adjustments are estimated using the

³¹ The time period for the Mankiw and Shapiro study was 1976:I to 1982:IV and looked only at the current quarterly vintage estimates.

latest estimates. Thus, although there is some lack of rationality, adjusting for it would make very little difference in the reliability of the estimates.

- There is little evidence of the predictability of revisions to final current quarterly estimates of GDI. No statistically significant effects of seasonal patterns or real time measures of economic conditions were found, and summary statistics indicate relatively poor fits for equations explaining the revisions. Only a variable that indicates a tendency to revise estimates towards long-run averages is ever statistically significant.
- There is no evidence of the predictability of revisions to final current quarterly estimates of national income.
- There is evidence that income-side measures contain information about both GDP and final sales. National income is statistically significant in explaining revisions from final current quarterly to the latest estimates of both measures. A weighted mixture of two-thirds to three-quarters GDP and the remainder national income was found to better predict the latest GDP estimates than either measure alone.
- Conversely, there is no evidence that product-side measures contain information about revisions to GDI and national income. Neither GDP nor final sales are significant in equations explaining their revisions.
- Although the patterns of real GDP in the ten postwar recessions have been erratic, and the recessions of varying length, smoothing real GDP reveals underlying patterns of peak rates of growth prior to individual peak quarters, then generally steady declines to lows that typically occur before troughs, followed by usually monotonic initial recoveries.
- There is little evidence that recessions tend to get systematically revised away over time.
- There is no particular tendency for current quarterly estimates to over- or underestimate GDP or GDI around cyclical peaks, and the sizes of the revisions are in line with the average sizes of revisions in all quarters.
- Around cyclical troughs, however, current quarterly GDP and GDI estimates typically get revised up (towards more positive values), and sizes of the revisions are larger than the average sizes of revisions in all quarters.
- The revisions from the final current quarterly to the latest estimates of the 1990-91 recession resulted from a variety of factors, none of which occurred systematically in all three recession quarters. Among other factors, the downward revision to GDP in 1990-III—which was mistaken as the peak in the estimates until the time of the second annual revision estimates—was smaller than the downward revision due to the effects of the revision to the seasonal factor alone. The cumulative absolute revision of the decline in real GDP in 1990-91 is in line with the sizes of revisions to other recessions.

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Chart 1

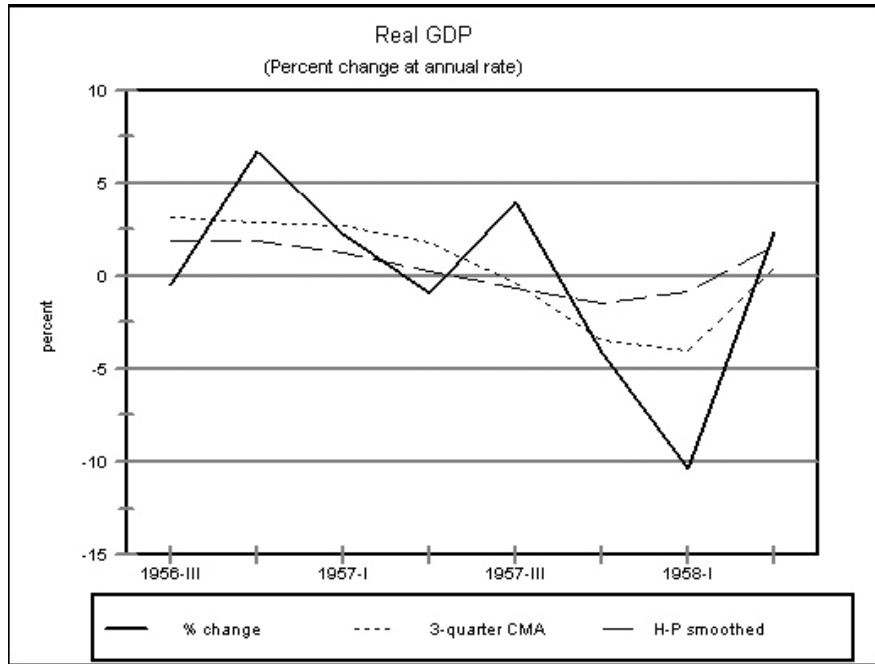


Chart 2

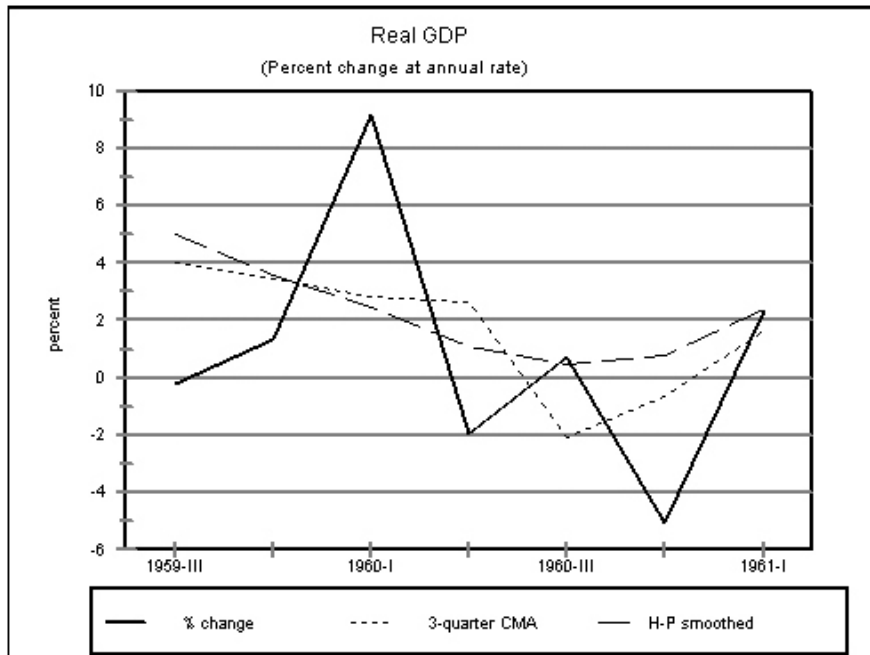


Chart 3

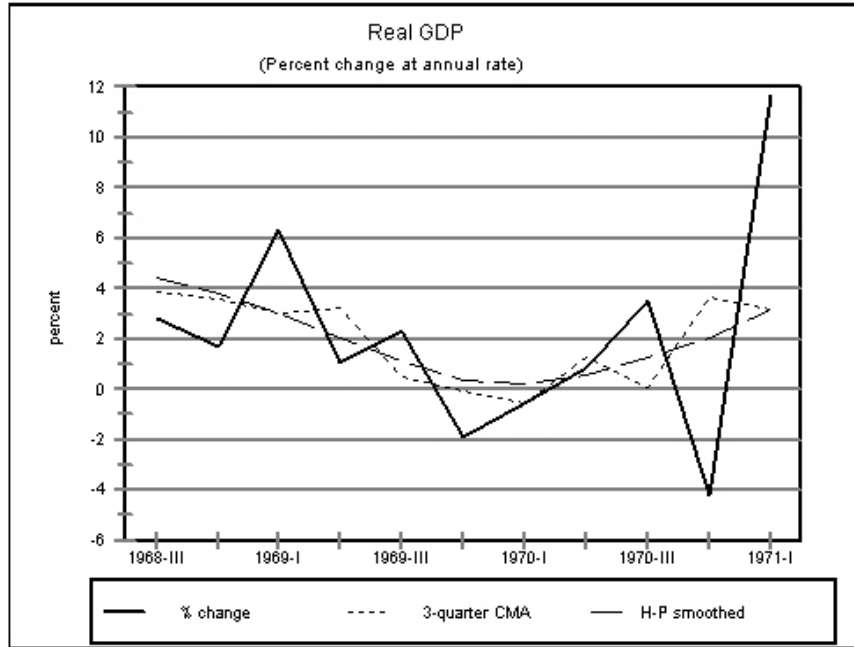


Chart 4

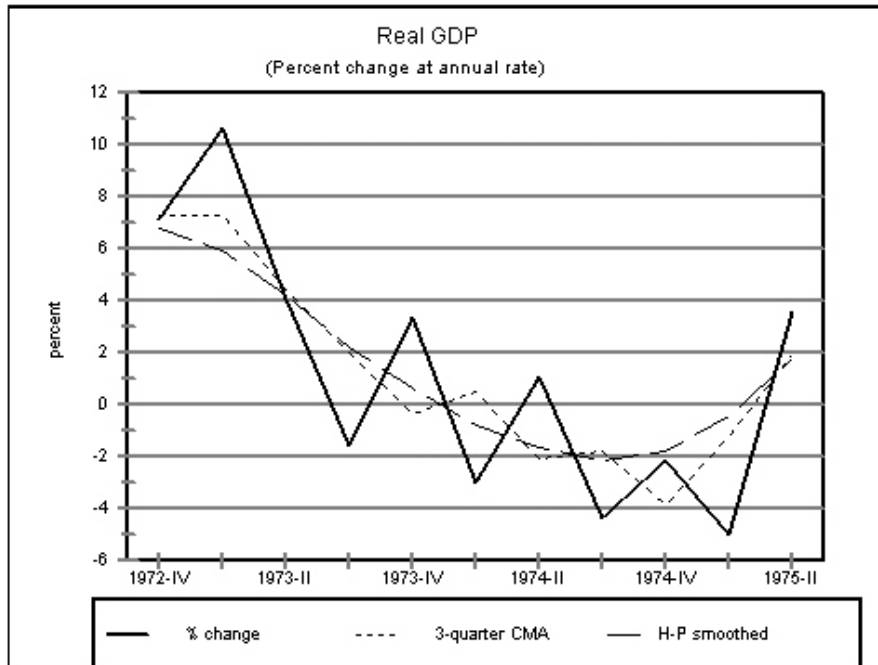


Chart 5

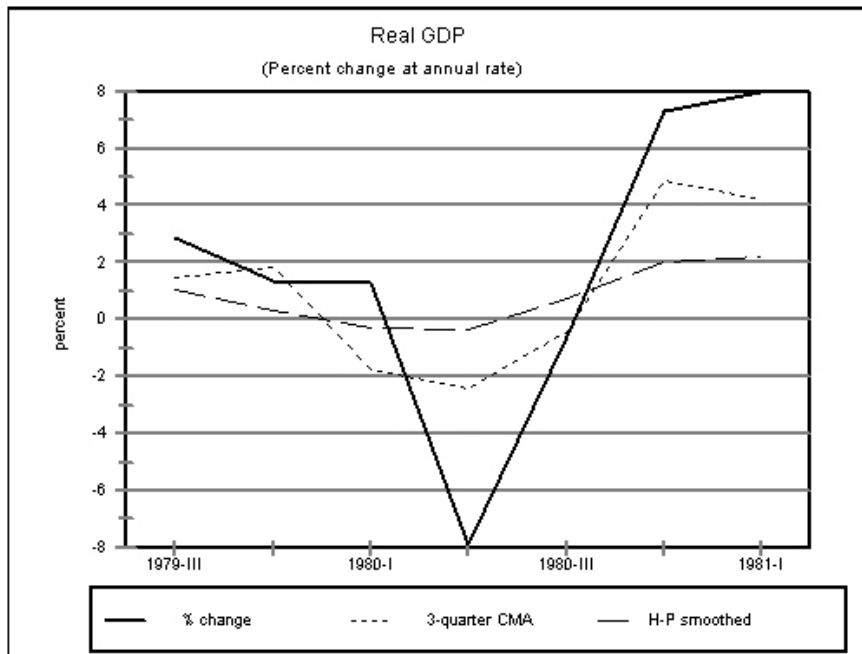


Chart 6

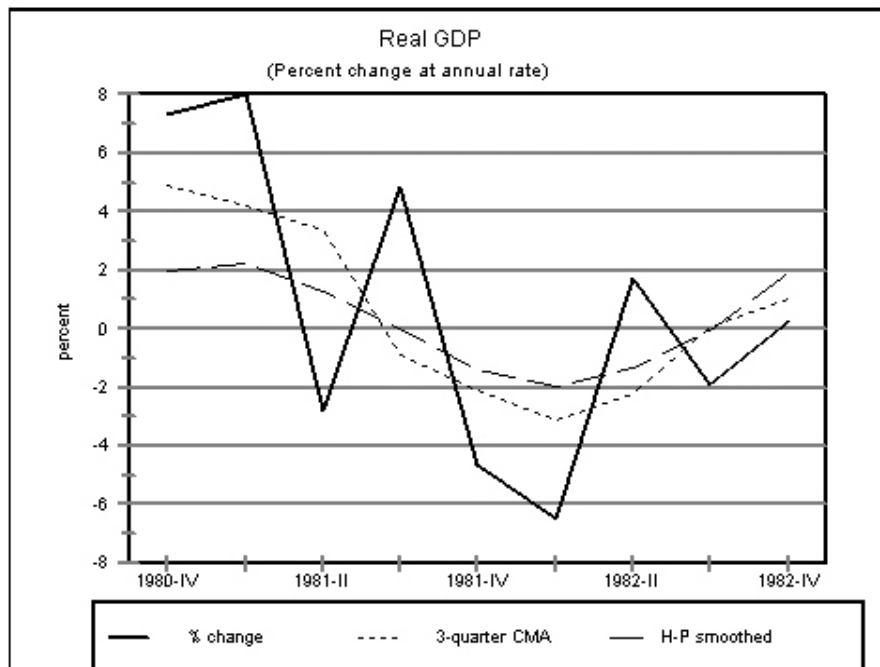


Chart 7

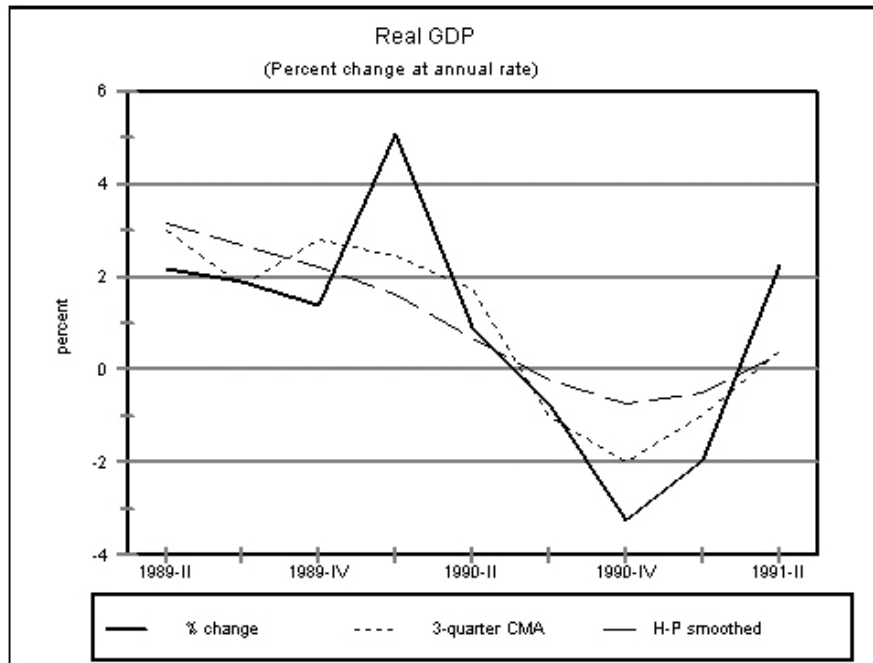
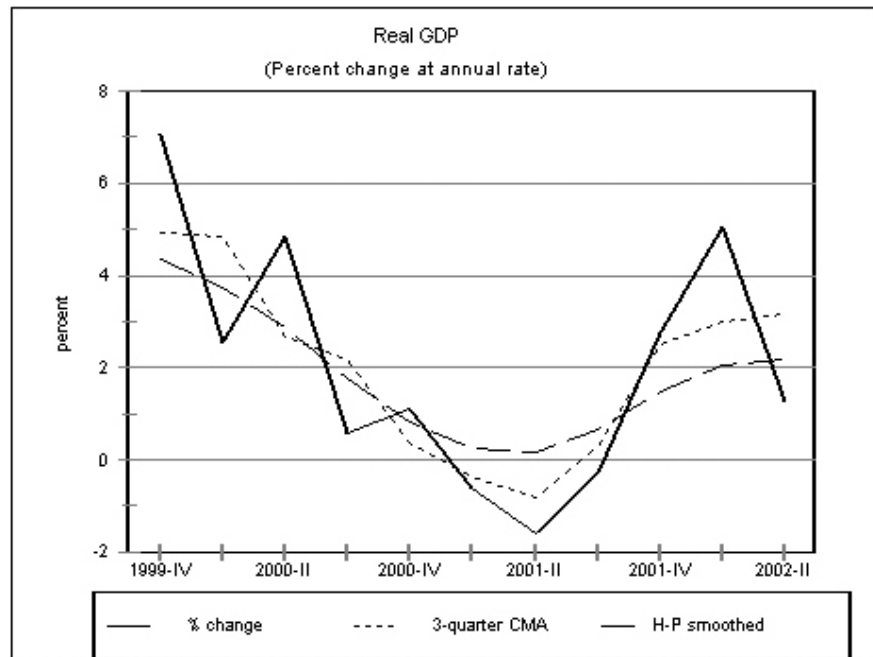


Chart 8



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

[Percentage points]

	Mean revisions		Mean absolute revisions	
	Current-dollar estimates	Real estimates	Current-dollar estimates	Real estimates
Gross domestic product				
Advance	0.48	0.46	1.10	1.28
Preliminary	0.32	0.36	1.05	1.21
Final	0.34	0.38	1.05	1.23
Personal consumption expenditures				
Advance	0.52	0.41	1.09	1.15
Preliminary	0.38	0.27	1.07	1.14
Final	0.42	0.31	1.05	1.13
Durable goods				
Advance	0.63	0.55	3.79	3.89
Preliminary	0.53	0.40	3.58	3.58
Final	0.47	0.31	3.59	3.60
Nondurable goods				
Advance	0.81	1.07	1.60	2.06
Preliminary	0.49	0.76	1.18	1.76
Final	0.55	0.82	1.22	1.72
Services				
Advance	0.31	0.10	1.16	1.11
Preliminary	0.24	0.04	1.18	1.06
Final	0.31	0.16	1.22	1.15
Gross private domestic investment				
Advance	-0.81	-1.05	7.99	8.01
Preliminary	-0.48	-0.68	7.98	7.95
Final	-0.82	-1.17	7.91	7.75
Fixed investment				
Advance	0.17	-0.48	2.75	3.25
Preliminary	-0.32	-0.80	2.54	3.15
Final	-0.50	-1.11	2.56	3.28
Nonresidential				
Advance	0.27	-0.52	3.36	3.82
Preliminary	-0.46	-1.12	3.40	3.78
Final	-0.69	-1.49	3.28	3.94

Table 1. (Continued) -- Mean Revisions and Mean Absolute Revisions to Quarterly Changes in GDP and Its Major Components, Latest Estimates Less Current Quarterly Estimates, 1983-2000
[Percentage points]

	Mean revisions		Mean absolute revisions	
	Current-dollar estimates	Real estimates	Current-dollar estimates	Real estimates
Structures				
Advance	0.96	0.55	5.75	5.44
Preliminary	0.22	0.18	5.07	4.92
Final	0.34	0.17	5.11	4.84
Equipment and software/1/				
Advance	0.18	-0.60	3.69	4.40
Preliminary	-0.73	-1.46	4.05	4.65
Final	-1.22	-1.97	4.11	4.86
Residential				
Advance	-0.10	-0.45	4.64	4.66
Preliminary	-0.09	0.03	4.45	4.64
Final	-0.11	-0.15	4.53	4.55
Change in private inventories/2/	---	---	---	---
Net exports of goods and services/2/	---	---	---	---
Exports				
Advance	2.58	2.10	4.71	4.71
Preliminary	1.07	0.84	3.95	4.05
Final	0.70	0.49	4.21	4.31
Imports				
Advance	0.87	-0.35	5.92	7.00
Preliminary	0.12	-1.31	4.75	6.41
Final	-0.36	-1.67	4.82	6.56
Government consumption expenditures and gross investment/3/				
Advance	0.39	0.80	2.65	3.08
Preliminary	0.13	0.52	2.68	2.92
Final	0.27	0.76	2.71	3.00
Federal				
Advance	0.21	0.30	5.84	6.64
Preliminary	-0.18	-0.04	6.07	6.64
Final	0.18	0.47	6.03	6.70

Table 1. (Continued) -- Mean Revisions and Mean Absolute Revisions to Quarterly Changes in GDP and Its Major Components, Latest Estimates Less Current Quarterly Estimates, 1983-2000
[Percentage points]

	Mean revisions		Mean absolute revisions	
	Current-dollar estimates	Real estimates	Current-dollar estimates	Real estimates
Defense				
Advance	0.18	-0.30	3.43	4.38
Preliminary	0.17	-0.38	3.25	3.81
Final	0.21	-0.49	3.28	3.86
Nondefense				
Advance	-4.35	6.19	21.77	25.12
Preliminary	-5.98	7.92	22.35	25.32
Final	-4.47	6.13	21.76	24.82
State and local				
Advance	0.44	0.97	1.55	1.65
Preliminary	0.29	0.79	1.52	1.59
Final	0.30	0.81	1.52	1.63
Addendum:				
Final sales				
Advance	0.59	0.57	1.18	1.29
Preliminary	0.30	0.34	0.95	1.19
Final	0.34	0.39	1.04	1.30

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

Table 2.--Mean Revisions and Mean Absolute Revisions to Quarterly Changes in Gross Domestic Income, National Income, and Its Major Components, Latest Estimates Less Current Quarterly Estimates, 1983-2000

[Percentage points]

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

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

Table 3--Correlation Between GDP Growth Rates and Revisions, 1983-95

Revisions by vintage	Estimate of GDP growth by vintage						
	Advance	Preliminary	Final	1st annual	2nd annual	3rd annual	Latest
Current dollars							
Advance to preliminary	-0.11 (1.51)	0.14 (0.14)	0.17 (0.30)	0.13 (0.02)	0.11 (0.07)	0.04 (0.56)	0.01 (0.74)
Preliminary to final	0.17 (1.50)	0.24 (1.98)	0.36 **(2.90)	0.37 **(2.95)	0.34 **(2.77)	0.32 *(2.61)	0.24 (2.00)
Final to 1st annual	-0.04 (0.44)	-0.05 (0.54)	-0.04 (0.44)	0.36 *(2.24)	0.33 *(2.04)	0.26 (1.54)	0.18 (0.94)
1st annual to 2nd annual	-0.32 *(2.31)	-0.35 *(2.53)	-0.36 *(2.59)	-0.42 **(3.06)	-0.14 (1.04)	-0.12 (0.86)	-0.15 (1.08)
2nd annual to 3rd annual	0.24 (1.25)	0.17 (0.78)	0.16 (0.71)	0.07 (0.10)	0.10 (0.35)	0.33 (1.93)	0.26 (1.43)
3rd annual to latest	0.06 *(2.09)	0.03 (1.01)	0.00 (1.16)	-0.10 (1.72)	-0.14 (1.46)	-0.18 *(2.02)	0.16 (1.73)
Real dollars							
Advance to preliminary	0.14 (0.19)	0.41 (1.79)	0.38 (1.87)	0.28 (0.85)	0.28 (0.89)	0.20 (0.42)	0.21 (0.64)
Preliminary to final	0.27 *(2.06)	0.25 (1.89)	0.38 **(2.75)	0.30 *(2.20)	0.29 *(2.12)	0.28 *(2.06)	0.25 (1.93)
Final to 1st annual	-0.07 (0.54)	-0.12 (0.77)	-0.13 (0.83)	0.36 (1.92)	0.37 (1.96)	0.37 *(2.01)	0.20 (1.07)
1st annual to 2nd annual	-0.25 (1.20)	-0.23 (1.06)	-0.23 (1.01)	-0.22 (0.92)	0.08 (0.71)	0.05 (0.52)	-0.03 (0.09)
2nd annual to 3rd annual	0.02 (0.55)	-0.06 (1.02)	-0.06 (1.03)	-0.03 (0.92)	-0.07 (1.11)	0.21 (0.40)	0.11 (0.06)
3rd annual to latest	-0.01 (1.43)	-0.01 (1.45)	-0.02 (1.57)	-0.21 *(2.66)	-0.26 **(2.99)	-0.32 **(3.39)	0.14 (0.56)

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t-test statistics shown in parentheses.

Table 4.--Correlations of Different Vintages of Revisions to Current-Dollar GDP Estimates, 1983-95

Vintage of subsequent revision	Vintage of revision				
	Advance to preliminary	Preliminary to final	Final to first annual	First annual to second annual	Second annual to third annual
Preliminary to final	0.01 (0.06)				
Final to first annual	-0.07 (0.46)	-0.22 (1.61)			
First annual to second annual	-0.11 (0.82)	0.09 (0.66)	-0.21 (1.50)		
Second annual to third annual	-0.28 *(2.03)	-0.02 (0.16)	-0.20 (1.45)	0.09 (0.62)	
Third annual to latest	0.09 (0.66)	-0.01 (0.01)	0.26 (1.87)	0.10 (0.69)	0.21 (1.52)

* Significant at the 5-percent level

Absolute values of t-test statistics shown in parentheses

**Table 5.--Equations Explaining Revisions in Real GDP Estimates;
Latest Estimates Less Final Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Constant	0.2493 (0.646)	0.9572 **(3.360)	0.9348 **(2.944)	0.4109 (1.144)	0.0706 (0.168)	0.1567 (0.428)	-0.1633 (0.403)	-0.1651 (0.408)	-0.9061 (1.235)	-0.2298 (0.386)	-0.7432 (1.336)	0.0482 (0.134)
Median SPF GDP forecast	0.0494 (0.377)			0.4727 **(2.734)	0.5374 **(3.250)	0.3917 *(2.639)	0.3695 *(2.517)	0.3685 *(2.509)	0.3291 *(2.175)	0.3589 *(2.330)	0.3193 *(2.086)	0.4732 **(3.190)
Final GDP estimate		-0.1775 *(2.502)	-0.1705 *(2.049)	-0.3927 **(3.453)	-0.4243 **(3.928)	-0.3078 **(3.764)	-0.3204 **(3.865)	-0.3200 **(3.863)	-0.2984 **(3.599)	-0.3017 **(3.577)	-0.2974 **(3.583)	-0.3321 **(4.051)
Delta final GDP estimate			-0.0129 (0.165)	0.0990 (1.161)	0.1259 (1.558)							
Second quarter dummy					0.6521 (1.517)							
Third quarter dummy					-0.4375 (1.009)							
Fourth quarter dummy					0.8733 *(2.038)	0.7761 *(2.140)	0.8065 *(2.251)	0.8065 *(2.254)	0.8117 *(2.263)	0.7802 *(2.146)	0.7992 *(2.229)	0.8240 *(2.338)
M1 /1/							7.479 (1.741)					
M2 /1/								7.5310 (1.752)				
Unemployment rate									0.1954 (1.665)			
90-day T-bill rate										0.0764 (0.826)		
10-year T-bond rate											0.1348 (1.646)	
Delta T-bond-T-bill spread												0.8699 *(2.294)
R-bar square	-0.012	0.069	0.056	0.137	0.234	0.175	0.199	0.200	0.196	0.171	0.195	0.224
Standard error	1.474	1.414	1.424	1.362	1.282	1.331	1.311	1.311	1.314	1.340	1.314	1.291
F-statistic	0.142	*6.258	3.099	**4.751	**4.624	**6.028	**5.414	**5.426	**5.332	**4.671	**5.312	**6.120

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 6.--Equations Explaining Revisions in GDP Estimates;
Latest Estimates less Final Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Constant	0.0694 (0.124)	0.9252 (2.388)	0.7650 (1.718)	0.1125 (0.208)	-0.2316 (0.418)	-0.2080 (0.402)	-0.2777 (0.520)	-0.2779 (0.521)	-0.4916 (0.733)	-0.1907 (0.342)	-0.4235 (0.724)	-0.3522 (0.700)
Median SPF GDP forecast	0.4640 (0.494)			0.2952 *(2.048)	0.3078 *(2.261)	0.2349 *(2.095)	0.2343 *(2.079)	0.2342 *(2.078)	0.1979 (1.576)	0.2414 (1.790)	0.1588 (1.076)	0.2995 **(2.688)
Final GDP estimate		-0.0977 (1.650)	-0.0711 (1.030)	-0.2434 *(2.250)	-0.2392 *(2.324)	-0.1739 *(2.349)	-0.1823 *(2.453)	-0.1823 *(2.454)	-0.1716 *(2.355)	-0.1742 *(2.383)	-0.1709 *(2.349)	-0.2062 *(2.896)
Delta final GDP estimate			-0.0449 (0.738)	0.0412 (0.525)	0.0509 (0.679)							
Second quarter dummy					0.3991 (0.997)							
Third quarter dummy					-0.3873 (0.969)							
Fourth quarter dummy					0.9729 *(2.449)	0.9870 **(3.082)	0.9910 *(3.078)	0.9913 *(3.079)	1.0005 *(3.105)	0.987 *(3.059)	0.9965 *(3.100)	1.0089 *(3.261)
M1 /1/							2.2292 (0.571)					
M2 /1/								2.2458 (0.575)				
Unemployment rate									0.0787 (0.667)			
90-day T-bill rate										-0.0089 (0.087)		
10-year T-bond rate											0.081 (0.796)	
Delta T-bond-T-bill spread												0.8077 *(2.444)
R-bar square	0.003	0.024	0.017	0.061	0.187	0.172	0.164	0.164	0.166	0.160	0.168	0.229
Standard error	1.288	1.266	1.270	1.242	1.155	1.165	1.171	1.171	1.170	1.174	1.169	1.125
F-statistic	0.244	2.271	1.624	2.530	**3.725	**5.933	*4.487	*4.489	**4.524	**4.387	**4.584	**6.269

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 7.--Equations Explaining Revisions in GDP Estimates;
Latest Estimates Less Preliminary Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Constant	-0.7137 (0.131)	0.6576 (1.654)	0.4632 (1.006)	-0.011 (0.021)	-0.3476 (0.632)	-0.3314 (0.641)	-0.3570 (0.668)	-0.3581 (0.670)	-0.4864 (0.724)	-0.2164 (0.390)	-0.4304 (0.734)	-0.4611 (0.913)
Median SPF GDP forecast	0.0679 (0.743)			0.2452 (1.644)	0.2686 (1.917)	0.2049 (1.802)	0.2053 (1.793)	0.2053 (1.792)	0.1266 (1.466)	0.2461 (1.837)	0.1709 (1.159)	0.2689 *(2.361)
Preliminary GDP estimate		-0.0561 (0.921)	-0.0240 (0.333)	-0.1779 (1.513)	-0.1838 (1.655)	-0.1263 (1.649)	-0.1301 (1.643)	-0.1303 (1.646)	-0.1257 (1.630)	-0.1261 (1.640)	-0.1259 (1.634)	-0.1606 *(2.118)
Delta preliminary GDP estimate			-0.0570 (0.842)	0.0226 (0.274)	0.0417 (0.534)							
Second quarter dummy					0.4493 (1.137)							
Third quarter dummy					-0.4408 (1.119)							
Fourth quarter dummy					0.9466 *(2.409)	0.9563 **2.992)	0.9576 **2.974)	0.9578 **2.975)	0.9632 **2.989)	0.9566 **2.978)	0.9600 **2.983)	0.9768 **3.147)
M1 /1/							0.8405 (0.213)					
M2 /1/								0.8825 (0.224)				
Unemployment rate									0.0430 (0.365)			
90-day T-bill rate										-0.0595 (0.589)		
10-year T-bond rate											0.0374 (0.366)	
Delta T-bond-T-bill spread												0.7586 *(2.280)
R-bar square	-0.006	-0.002	-0.006	0.018	0.160	0.131	0.119	0.119	0.120	0.123	0.120	0.182
Standard error	1.253	1.251	1.253	1.238	1.145	1.164	1.173	1.173	1.172	1.170	1.172	1.130
F-statistic	0.552	0.847	0.777	1.433	**3.249	**4.574	*3.394	*3.395	*3.420	*3.484	*3.420	**4.941

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 8.--Equations Explaining Revisions in GDP Estimates;
Latest Estimates Less Advance Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Constant	0.4177 (0.707)	0.8468 (1.982)	0.7954 (1.631)	0.3942 (0.668)	-0.1687 (0.278)	0.0875 (0.153)	0.1342 (0.227)	0.1341 (0.226)	-0.0625 (0.084)	0.3525 (0.580)	-0.0234 (0.036)	-0.0867 (0.156)
Median SPF GDP forecast	0.0104 (0.105)			0.2108 (1.201)	0.2220 (1.318)	0.1300 (0.963)	0.1261 (0.925)	0.1262 (0.925)	0.1109 (0.747)	0.2165 (1.428)	0.0915 (0.536)	0.2058 (1.540)
Advance GDP estimate		-0.0626 (0.932)	-0.0539 (0.689)	-0.1909 (1.382)	-0.1899 (1.418)	-0.1023 (1.104)	-0.0930 (0.952)	-0.0930 (0.953)	-0.1016 (1.089)	-0.0939 (1.014)	-0.1017 (1.090)	-0.1406 (1.551)
Delta advance GDP estimate			-0.0172 (0.224)	0.0499 (0.526)	0.0944 (1.021)							
Second quarter dummy					0.8435 (1.873)							
Third quarter dummy					-0.0976 (0.219)							
Fourth quarter dummy					1.2231 **(2.762)	0.9918 **(2.797)	0.9912 **(2.777)	0.9910 **(2.776)	0.9985 **(2.792)	0.9969 **(2.822)	0.9610 **(2.790)	1.0164 **(2.972)
M1 /1/							-1.4372 (0.324)					
M2 /1/								-1.4376 (0.324)				
Unemployment rate									0.0418 (0.320)			
90-day T-bill rate										-0.1372 (1.234)		
10-year T-bond rate											0.042 (0.372)	
Delta T-bond-T-bill spread												0.9039 *(2.485)
R-bar square	-0.014	-0.002	-0.016	-0.009	0.126	0.091	0.079	0.079	0.079	0.098	0.080	0.156
Standard error	1.361	1.353	1.362	1.358	1.264	1.288	1.297	1.297	1.297	1.283	1.297	1.242
F-statistic	0.011	0.868	0.453	0.786	*2.707	*3.377	*2.526	*2.526	*2.525	*2.933	*2.535	**4.269

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 9.--Equations Explaining Revisions in Final Sales Estimates;
Latest Estimates Less Final Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Constant	-0.07 (0.111)	2.0505 **(5.508)	1.2957 **(2.682)	0.8390 (1.523)	0.8874 (1.627)	1.6280 **(2.954)	1.1710 *(2.436)	1.1737 *(2.442)	0.2001 (0.275)	0.9548 (1.729)	0.5783 (0.976)	1.3056 **(2.690)
Median SPF GDP forecast	0.072 (0.676)			0.2027 (1.657)	0.2618 **(2.810)							
Final final sales estimate		-0.2881 **(5.001)	-0.1627 *(2.105)	-0.2805 **(2.689)	-0.3451 **(5.890)	-0.1652 *(2.114)	-0.2093 *(2.604)	-0.2097 *(2.605)	-0.1897 *(2.467)	-0.2275 *(2.457)	-0.2668 **(2.909)	-0.1627 *(2.097)
Delta final final sales estimate			-0.1303 *(2.349)	-0.0537 (0.749)		-0.1215 *(2.152)	-0.1135 *(2.048)	-0.1131 *(2.039)	-0.1167 *(2.132)	-0.0922 (1.463)	-0.0735 (1.201)	-0.1379 *(2.424)
Second quarter dummy						-0.4961 (1.206)						
Third quarter dummy						-0.2486 (0.607)						
Fourth quarter dummy						-0.5216 (1.271)						
M1 /1/							7.3107 (1.791)					
M2 /1/								7.2996 (1.784)				
Unemployment rate									0.2067 (1.987)			
90-day T-bill rate										0.1231 (1.258)		
10-year T-bond rate											0.1719 *(2.007)	
Delta T-bond-T-bill spread												0.2382 (0.657)
R-bar square	-0.008	0.253	0.298	0.315	0.320	0.289	0.320	0.320	0.327	0.304	0.328	0.292
Standard error	1.459	1.257	1.218	1.203	1.199	1.226	1.199	1.199	1.193	1.213	1.192	1.223
F-statistic	0.457	**25.012	**16.073	**11.902	**17.685	**6.768	**12.127	**12.115	**12.490	**11.334	**12.529	**10.771

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 10.--Equations Explaining Revisions in GDI Estimates;
Latest Estimates less Final Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	1	2	3	4	5	6	7	8	9	10	11
Constant	0.6915 (1.044)	1.1620 *(2.502)	0.8229 (1.583)	0.7219 (1.120)	1.0202 (1.694)	1.1407 *(2.312)	1.1408 *(2.312)	1.1869 (1.432)	0.6457 (0.988)	0.1205 (0.171)	1.1762 *(2.570)
Median SPF GDP forecast	-0.0767 (0.690)			0.1149 (0.985)							
Final GDI estimate		-0.1459 *(2.115)	-0.0914 (1.162)	-0.2085 *(2.223)	-0.1336 (1.884)	-0.1484 *(2.064)	-0.1484 *(2.063)	-0.1452 *(2.001)	-0.1461 (1.915)	-0.2105 **(2.788)	-0.1429 *(2.103)
Delta final GDI estimate			-0.1115 (1.412)								
Second quarter dummy					-0.0592 (0.118)						
Third quarter dummy					-0.1476 (0.294)						
Fourth quarter dummy					0.4657 (0.917)						
M1 /1/						0.6748 (0.136)					
M2 /1/							0.6695 (0.135)				
Unemployment rate								-0.0049 (0.364)			
90-day T-bill rate									0.0825 (0.759)		
10-year T-bond rate										0.1854 (1.929)	
Delta T-bond-T-bill spread											0.7368 (1.769)
R-bar square	0.007	0.047	0.060	0.046	0.030	0.033	0.060	0.033	0.023	0.082	0.075
Standard error	1.526	1.484	1.474	1.482	1.497	1.494	1.494	1.495	1.502	1.456	1.462
F-statistic	0.476	*4.475	*3.266	2.721	1.544	2.215	2.215	2.206	1.834	*4.186	*3.870

1. Annual rates of growth, in percent.

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 11.--Equations Explaining Revisions in Income and Product Estimates;
Latest Estimates Minus Final Current Quarterly Estimates;
1983-I to 2000-IV**

Variable	Gross domestic product		Final sales		Gross domestic income		National income	
	1	2	3	4	5	6	7	8
Constant	-0.3493 (0.690)	-0.1294 (0.262)	0.6156 (1.099)	0.6555 (1.148)	0.1349 (0.190)	0.1375 (0.191)	0.7958 (1.449)	0.613 (1.125)
Median SPF GDP forecast	0.3043 *(2.647)	0.2728 *(2.526)						
Final GDP estimate	-0.1759 (1.017)	-0.4135 **(3.802)			0.1116 (0.511)		-0.0863 (1.030)	
Final final sales estimate			-0.4181 **(5.880)	-0.4104 **(6.367)		-0.0156 (0.177)		-0.0567 (0.676)
Final GDI estimate	-0.034 (0.193)		0.1228 (1.645)		-0.3137 (1.455)	-0.2011 *(2.170)		
Final national income estimate		0.1971 *(2.458)		0.106 *(2.059)				
Fourth quarter dummy	1.0004 **(3.179)	0.7753 *(2.476)						
10-year T-bond rate			0.1822 *(2.318)	0.1863 *(2.445)	0.1797 (1.848)	0.1876 (1.923)		
Delta T-bond-T-bill spread	0.7968 *(2.361)	0.1971 **(2.682)					1.0463 *(2.052)	1.0903 *(2.092)
R-bar square	0.218	0.283	0.340	0.354	0.072	0.069	0.042	0.033
Standard error	1.133	1.085	1.182	1.169	1.464	1.466	1.789	1.796
F-statistic	**4.951	**6.601	**13.168	**13.947	*2.848	*2.762	2.547	2.227

* Significant at the 5-percent level

** Significant at the 1-percent level

Absolute values of t statistics shown in parentheses.

**Table 12.--Revisions to Changes in Various Measures of U.S. Economic Activity at Cyclical Turning Points:
Latest Estimates Less Final Current-Quarterly Estimates**
(Percentage points)

Measure /1/	Quarters around peaks			Quarters around troughs		
	Previous	Peak	Next	Previous	Trough	Next
<i>Revisions to Own Measures</i>						
Real GDP:						
Mean revision	-0.10	0.13	0.28	1.50	1.50	2.37
Mean absolute revision	2.51	0.50	2.04	2.04	2.86	2.37
Current-dollar GDP:						
Mean revision	0.06	0.57	-0.31	1.45	1.52	2.93
Mean absolute revision	2.40	0.70	0.76	1.53	3.77	2.93
GDI:						
Mean revision	-0.45	0.94	-1.06	1.74	1.90	2.22
Mean absolute revision	2.37	1.19	1.06	1.83	3.15	2.22
National income:						
Mean revision	1.01	1.03	-1.09	0.96	0.67	1.16
Mean absolute revision	2.02	1.77	1.33	1.62	2.51	1.66
<i>Revisions to current-dollar GDP</i>						
½ GDP + ½ GDI:						
Mean revision	-0.19	0.76	-0.68	1.60	1.71	2.57
Mean absolute revision	2.39	0.95	0.77	1.60	3.71	2.57
½ GDP+ ½ national income:						
Mean revision	0.16	0.39	-0.03	1.98	-0.77	2.62
Mean absolute revision	2.28	1.40	0.76	2.12	1.52	2.62
Addenda:						
Real GDP, final less advance:						
Mean revision	-0.30	0.36	0.05	-0.08	-0.03	0.27
Mean absolute revision	0.54	0.62	0.53	0.22	0.59	1.02

1. GNP and GNI for the 1969-70 and 1973-75 recessions.

Note.--The cyclical peaks are 1969:III, 1973:IV, 1980:I, 1981:I, and 1990:II. The cyclical troughs are 1970:IV, 1975:I, 1980:III, 1982:III, and 1991:I. Preliminary estimates are used for the first two recessions (there were no final estimates).

Table 13.--Revisions in Contributions to Percent Changes in Real Gross Domestic Product
(Seasonally adjusted at annual rates)

	2000				2001			
	I	II	III	IV	I	II	III	IV
Gross domestic product	0.3	-0.9	-0.7	-0.8	-1.9	-1.9	1.0	1.0
Personal consumption expenditures	-0.50	-0.39	-0.34	-0.77	-0.52	-0.80	0.30	-0.09
Durables	-0.10	-0.09	-0.02	-0.27	0.04	-0.14	0.29	-0.39
Nondurables	-0.56	0.04	-0.44	0.40	-0.04	-0.13	0.13	0.23
Services	0.27	-0.32	0.21	-0.90	-0.52	-0.53	-0.13	0.07
Other	0.32	-0.28	0.06	-0.74	-0.50	-0.39	-0.20	0.16
Fixed investment	-0.09	0.34	-0.40	-0.50	-0.71	-0.21	0.25	0.47
Information processing equipment and software	-0.07	-0.11	-0.41	-0.56	0.15	0.09	-0.02	0.08
Change in private inventories	0.55	0.01	0.17	0.36	-0.66	-0.72	0.72	0.77
Exports	-0.13	0.11	0.12	0.00	-0.56	-0.05	0.19	0.15
Imports	0.27	-0.70	-0.13	0.16	0.50	-0.25	-0.16	-0.30
Government	0.00	0.05	0.14	-0.07	0.07	-0.13	-0.26	0.09

Source: Derived from NIPA table 8.2; changes from the table published in late June 2002 to the table published in late July 2002.