# How Large Are Economic Forecast Errors?

*Stephen K. McNees*

*Vice President and Economist, Federal Reserve Bank of Boston.* *The author gratefully acknowledges the research assistance of Kim Gilbo and Delia Sawhney. He is also indebted to the forecasters who so kindly provided their forecasts.*

Virtually everyone follows some forecaster's views, analyzing each pronouncement and eagerly awaiting the next. Opinion about the reliability of economic forecasts ranges widely, however—some argue that they are literally worthless, even though most forecasters typically can point to a sequence of predictions that virtually replicates the eventual outcome. How much confidence should one place in economic forecasts?

The answer would seem straightforward: To measure a forecast's reliability, one need simply compare it with what "actually" occurs. The diversity of opinion on reliability indicates the answer is not so simple. Two problems arise immediately, one philosophical and one practical. The philosophical problem is one of induction: Forecast accuracy cannot be measured until what actually happened is known, but the main interest typically lies in the accuracy of current forecasts for which, necessarily, no actual outcome is available. Despite many attempts to make headway with this problem, some form of assumption must be made that the future will resemble the present. Neither logic nor econometrics can provide assurance that this assumption will hold. In fact, the future is almost certain to differ at least somewhat from previous experience. Nevertheless, no alternative exists to blithely assuming that the reliability of today's forecasts will resemble the reliability of previous forecasts—that some forecaster (or model) has captured the essential lasting features of past and future behavior.

The practical problem in measuring the accuracy of past forecasts is that so many different forecasts are available—and, in some cases, so many different measures of what actually happened—that millions of different errors can be calculated, and this varied experience can be summarized in many different ways. The problem, in other words, is not the paucity of measures of reliability but their multiplicity or, more precisely, their variety. The errors vary with many factors, including (1) the economic series or variable predicted, (2) the forecaster, (3) the

time period being forecast, (4) the horizon of the forecast, and (5) the choice of "actual" data to measure what really happened.

Much attention focuses on the first three factors—the economic variable, the forecaster, and the forecast period. To illustrate the importance of the fourth and fifth factors, consider the accuracy of one prominent forecaster's predictions over the last 10 years of real GNP growth in the current quarter. The top panel of Table 1 describes the accuracy of the predictions as measured against the first official estimate of real growth ("preliminary actual data," or "advance" actual data); the bottom panel, the accuracy of the predictions when measured against the final revised estimate of real growth (prior to the benchmark revision). The first column shows the accuracy of forecasts made late in the first month of each quarter, just after the preliminary estimate of the prior quarter became available; these are called "early-quarter" forecasts. The second column shows "mid-quarter" forecasts, those made in the middle month of each quarter. The final column shows the errors of the forecasts made in the last month of the quarter, or "late-quarter" forecasts. These forecasts are customarily the expectations against which the press and financial market participants judge the preliminary GNP data release.

Table 1
*Accuracy of Current Quarter Forecasts of Annual Growth Rate of Real GNP, 1981:III to 1991:III*
Percentage Points unless Otherwise Specified

| Relative to PRELIMINARY Actual Data | Early (First month of quarter) | Mid (Second month of quarter) | Late (Third month of quarter) |
|---|---|---|---|
| RANGE | −5.2 to 4.7 | −3.2 to 2.8 | −2.1 to 1.9 |
| >1 | 59% | 41% | 29% |
| >2 | 15% | 17% | 2% |
| >3 | 10% | 5% | 0% |
| MAE | 1.4 | 1.0 | .8 |
| RMSE | 1.8 | 1.4 | .9 |
| MEAN | −.2 | −.1 | −.1 |
| Relative to REVISED Actual Data | | | |
| RANGE | −5.8 to 4.4 | −4.0 to 3.8 | −4.0 to 4.2 |
| >1 | 61% | 51% | 68% |
| >2 | 37% | 34% | 24% |
| >3 | 22% | 20% | 15% |
| MAE | 1.9 | 1.6 | 1.5 |
| RMSE | 2.4 | 2.0 | 1.9 |
| MEAN | −.4 | −.3 | −.3 |

Note: Preliminary Actual Data are the first estimates released in the month immediately following each quarter's end and are equivalent to what the U.S. Department of Commerce terms "advance" actual data. Revised Actual Data are the last estimates made prior to the benchmark revision. MAE = Mean Absolute Error, RMSE = Root Mean Squared Error, MEAN = Mean Error.

The table documents two obvious points: (1) The forecasts are much more accurate predictions of the preliminary data, which are based largely on information also available to the forecaster, than they are of the final revised data, which are based on information that does not become available until much later. (2) Forecasts made later in the quarter, when the forecaster has more information, are more accurate than earlier forecasts. Note, however, that the improvement in forecast accuracy is much greater compared to the preliminary than to the revised actual data. For example, 10 percent of the forecasts of real growth made in the first month of the quarter were off the mark by more than 3 percentage points, while none of the forecasts made during the last month of the quarter missed the preliminary estimate by more than 2.1 percentage points. The elimination of the large outliers, through the incorporation of incoming high-frequency data, cuts the root mean square error (RMSE) in half between the first and third months. In contrast, relative to the revised actuals, the proportion of errors exceeding 3 percentage points falls only from 22 percent of the forecasts made in the first month of the quarter to 15 percent of the forecasts made in the last month of the quarter; the proportion of forecast errors exceeding 1 percentage point was actually somewhat larger for the forecasts made in the last month of the quarter. The RMSE falls only by about 20 percent over the quarter. Thus, while the incoming high-frequency data shed a lot of light on what the preliminary estimate of real GNP will be, they provide relatively little new information on what the final revised number will be.

Table 2 presents comparable information for forecasts of the current-quarter rate of growth of the consumer price index (CPI). Note first that little difference can be seen in the accuracy of the predictions whether compared to the preliminary or the revised data. Unlike real GNP, where additional information is collected to improve the estimates, the CPI is based on a survey conducted each month, which cannot be repeated; all revisions come solely from changing the seasonal adjustment factors. Note also that the timing of the forecast is even more

Table 2
*Accuracy of Current Quarter Forecasts of Annual Growth Rate of CPI, 1980:I to 1992:I*
Percentage Points unless Otherwise Specified

| Relative to PRELIMINARY Actual Data | Early (First month of quarter) | Mid (Second month of quarter) | Late (Third month of quarter) |
|---|---|---|---|
| RANGE | −5.0 to 4.8 | −2.7 to 2.2 | −3.5 to 1.2 |
| >1 | 35% | 20% | 4% |
| >2 | 22% | 8% | 2% |
| >3 | 12% | 0% | 2% |
| MAE | 1.2 | .7 | .3 |
| RMSE | 1.8 | 1.0 | .6 |
| MEAN | .1 | .1 | −.0 |
| Relative to REVISED Actual Data | | | |
| RANGE | −5.2 to 4.0 | −2.9 to 2.8 | −1.7 to 2.1 |
| >1 | 39% | 22% | 14% |
| >2 | 22% | 10% | 2% |
| >3 | 10% | 0% | 0% |
| MAE | 1.2 | .8 | .5 |
| RMSE | 1.7 | 1.1 | .7 |
| MEAN | .1 | .1 | −.0 |

Note: See Table 1.

important for the CPI than for real GNP; this reflects the fact that CPI data are collected and released monthly so that by the time the late-quarter forecast is made, forecasters know the actual outcome for two of the three months of the quarter.

Forecasters have often been accused of bias. However, none of these forecasts shows a systematic tendency to either overestimate or underestimate the actual outcome. The mean errors are essentially zero, whatever the forecast horizon and whichever actual data are used.

Should forecast accuracy be assessed relative to the preliminary or to the revised actuals? The answer depends entirely on the purposes of the forecast. If the objective is to understand what influences behavior at the time—for example, if one is interested in the reaction of investors in financial markets—the preliminary data are the obvious choice, as the revised data are not available until much later. However, if the objective is to measure how close the forecast comes to what actually occurred—what nonfinancial decisionmakers, modelbuilders, and policymakers presumably would want to know—it is equally clear that the revised data, based on the most complete information set, provide a better estimate of reality.

This is particularly true for comparative evaluations: If forecaster A provides the most accurate predictions of what was initially thought to have happened (preliminary data), but forecaster B provides the best forecasts of what turns out to have actually occurred, once all the facts are in, it would seem odd to call A the better forecaster of the economy, even though forecaster A clearly is a superior forecaster of the social accountants who produce GNP estimates. Fortunately, the distinction between preliminary and revised data becomes less important for forecasts of longer time spans, such as one-year-ahead forecasts, and for variables other than the National Income and Product Accounts and the monetary aggregates, such as the CPI and the unemployment rate. For example, prices in financial markets (stock prices and interest and exchange rates) are measured precisely and thus are not subject to revision.

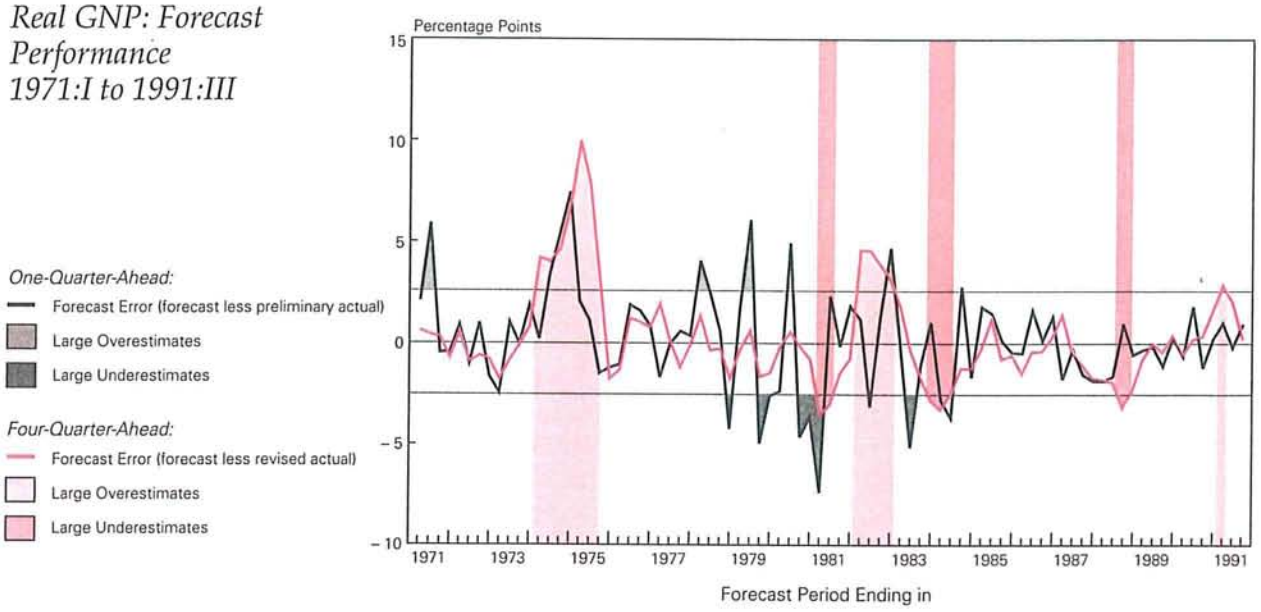
## *Variations in Forecast Accuracy over Time*

A crucial determinant of the size of forecast errors is the forecast period; some periods are very difficult to predict while others are relatively easy. Figure 1 shows the errors of one-quarter-ahead and four-quarter-ahead forecasts, made by one prominent forecaster, of growth in real GNP from 1971:I to 1991:III. The errors for the different time spans follow different patterns: The four-quarter-ahead forecasts are dominated by the overestimates of the two major recessions, 1974–75 and 1981–82, and the underestimates of the early recoveries from the 1980 and 1981–82 recessions. The only other errors in the four-quarter-ahead forecasts that exceeded 2½ percentage points were a 3.2 percentage point underestimate of the rate of real growth in the year after the October 1987 stock market crash and a 2.9 percentage point overestimate for the 1990:I to 1991:I period, which included the 1990–91 recession.

The one-quarter-ahead forecasts are not so clearly linked to business cycle turning points, even though the largest errors were the overestimates in 1974 and the underestimates of the early recovery from the 1980 recession. In addition, large errors occurred in 1978, 1979, 1983, and 1984. But because the one-quarter-ahead errors, although large, were

Figure 1

*Real GNP: Forecast Performance 1971:I to 1991:III*




offsetting, the errors of forecasts covering multi-quarter time spans were not especially great.

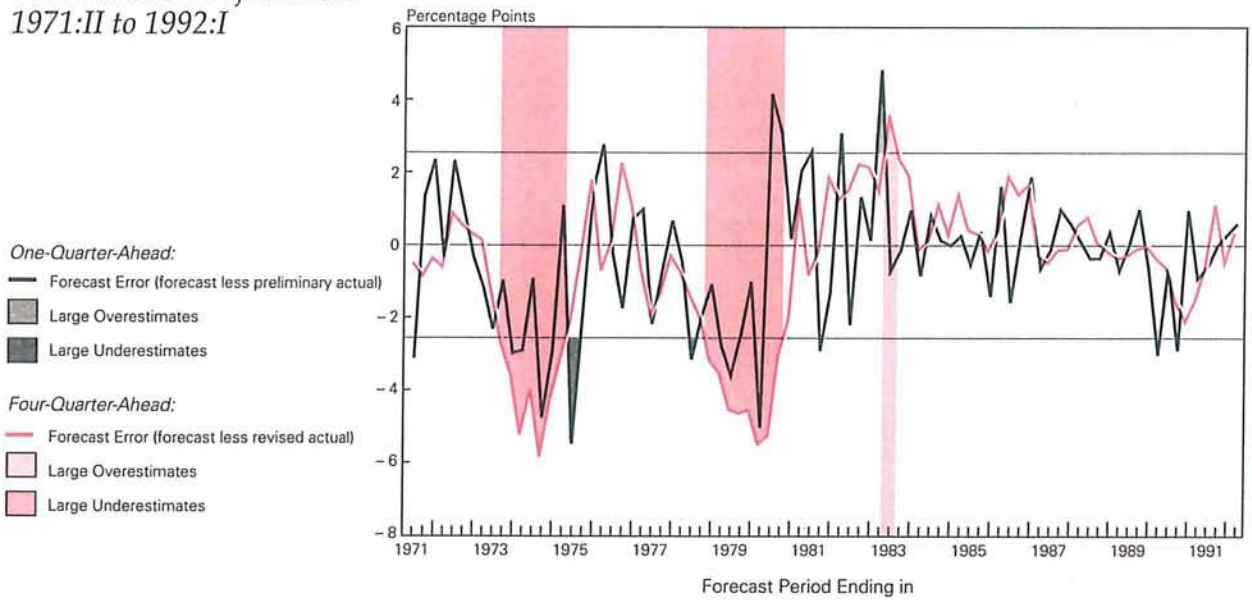
Forecasters' reputations probably reached the nadir in 1979–80, when for six quarters in a row virtually all one-quarter-ahead forecasts were in the wrong direction—when forecasts expected positive real growth, it was negative and vice versa. And in the only quarter (1980:II) when everyone's forecast was of the correct algebraic sign, the size of the decline was vastly underestimated.

Figure 2 shows corresponding information for CPI forecast errors. By far the largest errors were the sustained underestimations of the acceleration of inflation in 1973–75 and again in 1978–80. From these experiences forecasters gained the reputation of systematically underestimating inflation. These shortfalls were followed by large overestimates of the rate of inflation in 1983, which was undoubtedly associated with the underestimation of the severity of the 1981–82 recession. Since 1983, the record of forecasting the CPI has been much improved. The one-quarter-ahead forecast errors have exceeded 2 percentage points only in 1990:I and in 1990:III, when the forecasts were made just prior to the sharp increase in oil prices associated with Iraq's invasion of Kuwait. These errors resulted in the 2.1 percentage point underestimate of the inflation rate for the year 1990, the first error that large since the overestimates in 1983. The fact that CPI forecasting errors have declined in absolute terms does not necessarily indicate that forecasting ability has improved, however. The variability of the inflation rate has also been much smaller in the last 10 years. Relative to the 1970s, the 1980s have been an easy time to forecast inflation.

Large variations in forecast accuracy over time have several important implications. First, in terms of comparing different forecasters, it is critically important to compare identical forecast periods. The best forecaster's errors in the 1970s would be far larger, in absolute terms, than an inferior forecaster's errors in the 1980s. More fundamentally, the fact that accuracy varies over time poses a challenge to the constancy assumption needed to make inferences about future periods. Is it possible to know whether the current "easy" period will last or whether we will revert to the hectic 1970s? In the former case, only recent experience would be relevant for estimating the accuracy of current forecasts. But in the latter case, recent experience would be deceptive; it will be important to look at a longer sweep of history to remind us of how much uncertainty there can be.

Figure 2

*CPI: Forecast Performance 1971:II to 1992:I*




## *Has Forecast Accuracy Improved?*

The figures clearly suggest forecast accuracy has improved over the past 20 years. Since the four-quarter period ending in 1984:I, no four-quarter real GNP forecast error has exceeded 3¼ percentage points and only two have exceeded 2½ percentage points. The record for inflation forecasts has been more impressive: Since the four-quarter period ending in 1983:IV, no four-quarter-ahead CPI forecast error has exceeded 2¼ percentage points and only one (1989:I to 1990:I) has exceeded 2 percentage points.

These facts undoubtedly overstate the degree of improvement that has been achieved. History shows a close association between business cycle turning points and the size of forecast errors. Much of the improvement merely reflects the fact that no turning point occurred for the 92 months between November 1982 and July 1990. Forecast errors did increase during the 1990–91 recession, when real growth was overestimated by nearly 3 percentage points and inflation underestimated by about 2 percentage points. Even errors this large, far larger than average, pale in comparison with those from earlier recessions.

In order to try to distinguish genuine improvement from a string of good luck, it is helpful to examine a longer time period. Table 3 summarizes the longest consistent forecasting record available—the forecasts of real GNP growth in the following year made each November since 1952 by the Research Seminar in Quantitative Economics (RSQE) at the University of Michigan. The distribution of errors has been fairly stable over time: About half of the errors were less than 1 percentage point, ranging only from a low of 40 percent in the 1970s to 60 percent in the 1960s and 1980s; about one-fifth of the errors exceeded 2 percentage points, ranging only from a low of 10 percent in the 1980s to a high of nearly 30 percent in the 1950s. In absolute terms, the largest errors, underestimates of the first years of expansions, occurred in the 1950s. Errors were far smaller in the relatively tranquil 1960s but rose somewhat in the turbulent 1970s; errors in the 1980s were about the same as the 1960s. The 1990s are off to a poor start: The errors for 1990 and 1991 are both larger than the average for the entire period, nearly double the average error in the 1980s.

A long-term trend toward greater accuracy is more apparent when the errors are judged relative to standards, in order to account for varying degrees of

Table 3
*Accuracy of RSQE Forecasts of Real GNP, 1953 to 1991*
Percentage Points unless Otherwise Specified

| Years | MEAN (1) | MAE (2) | MAE/N4 (3) | RMSE (4) | RMSE/SD Actual (5) |
|---|---|---|---|---|---|
| All | −.1 | 1.3 | .51 | 2.0 | .70 |
| 1953–71 | −.8 | 1.4 | .62 | 2.2 | .84 |
| 1972–91 | .5 | 1.2 | .43 | 1.6 | .57 |
| 1950s | −1.5 | 2.1 | .59 | 3.2 | .90 |
| 1960s | −.7 | 1.0 | .71 | 1.4 | .85 |
| 1970s | .6 | 1.4 | .39 | 1.9 | .55 |
| 1980s | .2 | .9 | .44 | 1.3 | .51 |

Note: MEAN = Mean Error, MAE = Mean Absolute Error, RMSE = Root Mean Squared Error, N4 = naïve "same as four-year average" forecast, SD Actual = standard deviation of actual real growth in forecast period.
Source: Forecasts: Research Seminar in Quantitative Economics, University of Michigan, *The Economic Outlook for 1992*, Table 1, p. 4.

difficulty over time. Column (3) in the table compares the MAE of the RSQE forecast with that of a naïve rule of thumb that predicts real growth each year to be equal to its average rate in the four previous years. (This rule is more accurate than the simple rule that predicts next year's growth will be the same as this year's growth.) The RSQE errors were 40 to 30 percent smaller than those of the naïve rule in the 1950s and 1960s, respectively, and improved to a level nearly 60 percent smaller in the 1970s and 1980s. Column (5) shows that the RMSE of the Michigan forecast has declined steadily relative to the standard deviation of real GNP in each forecast period. The standard deviation of real GNP is a direct measure of the difficulty of forecasting in each period. Alternatively, it can be viewed as the RMSE of a forecaster who knew in advance the average actual growth rate in the forecast period but knew nothing about the yearly deviations from that true average. The Michigan forecasts have improved steadily relative to that hypothetical straw man.

Thus, forecast accuracy seems to have improved, whether viewed from the perspective of several decades or by comparing the recent performance with the rather dismal record in the 1970s and early 1980s. Continuing improvement is not inevitable; the performance in the 1990–91 recession was distinctly worse than average. Future improvement (deterioration) depends on whether forecasting techniques improve more rapidly (slowly) than changes occur in the structure of the economy.

## *Variations in Accuracy among Variables*

It is commonly asserted that particular economic variables are "unpredictable." Because it is easy to find someone who will gladly predict anything, such statements are intended to refer to the accuracy of predictions and not the difficulty of making some prediction, no matter how reliable. It is obvious that some variables can be predicted more accurately than others, but not at all obvious how to compare errors in forecasts of different variables. Is a $10 billion error in GNP better or worse than a 50 basis point error in interest rates? Is a 1 percentage point error for the CPI the same as a 1 percentage point error for the unemployment rate? Clearly, forecast errors for different variables cannot simply be added up. Some kind of standardization is required if a comparison of different variables is even to be attempted.

Although perfection is the goal of forecasting, we know that the future is unknown and we do not expect forecasts to eliminate all uncertainty. A forecast is useful if it can reduce uncertainty. But to measure a reduction presumes some estimate of the level of uncertainty that prevailed initially. Forecast evaluation cannot be done in absolute terms but only relative to some standard, because no unique esti-

*A forecast is useful if it can reduce uncertainty, but to measure a reduction presumes some estimate of the initial level of uncertainty.*

mate of the level of uncertainty exists, no totally obvious standard of comparison. The only sensible standard of comparison is some alternative forecasting technique. Traditionally, forecasts have been evaluated relative to simple rule-of-thumb forecasts, such as no change or same change (as in some past period). A no-change standard of comparison is a sensible, even a surprisingly stringent, standard of

Table 4
*Mean Absolute Errors of Forecasts Relative to Naïve Straw Man*

| Variable (Straw Man) Forecast | High (1) | Low (Ratio) (2) | Median (3) | >1.2 (4) | >1.1 (5) | >1 (Percent) (6) | >.9 (7) | >.8 (8) |
|---|---|---|---|---|---|---|---|---|
| Short-term interest rate | | | | | | | | |
| Next half-year | 1.48 | .97 | 1.28 | 67 | 92 | 92 | 100 | 100 |
| Next year | 1.67 | .95 | 1.20 | 50 | 67 | 92 | 100 | 100 |
| Long-term interest rate | | | | | | | | |
| Next half-year | 1.59 | 1.04 | 1.28 | 83 | 83 | 100 | 100 | 100 |
| Next year | 1.57 | .89 | 1.20 | 50 | 75 | 83 | 92 | 100 |
| Unemployment rate | | | | | | | | |
| Next half-year | 2.26 | .57 | .84 | 3 | 14 | 28 | 31 | 55 |
| Next year | 2.71 | .63 | .97 | 14 | 24 | 31 | 62 | 76 |
| CPI growth rate | | | | | | | | |
| Next half-year | .98 | .59 | .72 | 0 | 0 | 0 | 7 | 21 |
| Following half-year | 1.02 | .56 | .68 | 0 | 0 | 7 | 10 | 14 |
| Next year | 1.11 | .38 | .54 | 0 | 3 | 3 | 10 | 14 |
| GNP (Lag*) | | | | | | | | |
| Next half-year | 2.05 | .63 | .86 | 21 | 31 | 34 | 48 | 72 |
| Following half-year | 1.21 | .56 | .75 | 3 | 3 | 7 | 17 | 34 |
| Next year | 1.54 | .56 | .69 | 3 | 3 | 7 | 14 | 31 |
| GNP (Lead**) | | | | | | | | |
| Next half-year | 3.25 | 1.00 | 1.30 | 69 | 86 | 93 | 100 | 100 |
| Following half-year | 1.49 | .74 | .96 | 17 | 28 | 38 | 66 | 76 |
| Next year | 2.09 | .78 | .99 | 28 | 38 | 48 | 69 | 97 |

Note: Short-term interest, long-term interest, and unemployment rates are relative to a no-change straw man. CPI and GNP growth rates are relative to a same-change straw man.

*Lag: Last observed half-year growth rate prior to forecast.

**Lead: Next half-year growth rate after forecast.

Source: Twelve individual forecasters' interest rate forecasts, 1982–91; other variables, 29 individual forecasts, 1986–91, as published in *The Wall Street Journal*.

comparison for several variables—primarily ratios of two variables, such as unemployment rates, profit rates, foreign exchange rates, and interest rates. Most economic variables, however, grow exponentially over time. For these variables, a same-change standard is a more stringent and sensible basis of comparison.

Variations in the difficulty of predicting different variables can be illustrated by examining the forecasts published twice a year in *The Wall Street Journal* from a survey conducted by Tom Herman. Interest rate forecasts for the next six months have been collected since 1982, and for the next year since 1984; forecasts of real GNP, the CPI, and the unemployment rate have been collected since 1986. Although 68 different individuals have submitted at least one forecast, more than half (36) of these have participated in fewer than 10 of the surveys, and only three have participated in all surveys. We have already seen that forecast accuracy varies over time, so that the infrequent forecasters would benefit from skipping difficult periods and suffer if they missed the easy periods. In order to try to control for these missing forecasts, each forecaster's performance is compared, not to those of the other forecasters but to a straw man—a no-change forecast for interest rates and the unemployment rate, and a same-change forecast for the CPI and the real GNP growth rate. Difficult (easy) periods presumably would also be more (less) difficult for the straw man, so that individuals' performance relative to the straw man would be affected less by missing forecasts or gaps.

The results, summarized in Table 4, show drastic differences among variables in the forecasters' ability to outperform the straw man. At one extreme, none of the forecasters could predict the long-term interest

rate a half-year into the future as well as the simple assumption that the rate would not change; 83 percent (10 of the 12 forecasters) were more than 20 percent *less* accurate than the naïve straw man. Only one forecaster, a different individual for the half-year and the full-year horizons, could predict short-term interest rates more accurately than the straw man, and neither forecaster was more than 5 percent more accurate.

At the other extreme, everyone could predict the CPI better than the simple straw man forecast, which predicted that future changes will be the same as the most recent change. Only 14 percent (four of 29 forecasters) were unable to beat the straw man by more than 20 percent in forecasting CPI growth over the next year.

The real GNP growth and unemployment rates are more difficult to estimate than the CPI but not as difficult as interest rates. Only about one-third of the forecasters were unable to outperform the no-change straw man for the unemployment rate. Nearly half of the forecasters could beat the straw man by more than 20 percent for the half-year horizon, and almost 25 percent of the forecasters were over 20 percent more accurate in the year-ahead forecast.

Real GNP forecasts are compared to two straw men. The first, GNP lag, is the simple idea that real GNP will continue to grow at the same rate as it grew in the last observed half-year. One-third of the forecasters could not improve upon this forecast of the next half-year, while all but one could improve upon this forecast of the following half-year and of the entire year after the forecast is made.

The forecasts were made during the first few days of January and July, a few weeks before the initial estimate of actual growth in the prior quarter was released. Although they did not yet know the preliminary official estimate of the previous quarter, the forecasters had a considerable amount of information on that quarter. A second straw man—GNP lead—compares the forecasts with the preliminary estimate of real GNP growth in the half-year before the forecasts, which is released a few weeks after the forecasts were made. Only a few forecasters slightly outperformed this straw man for the first half-year period, but a majority were more accurate in forecasting real growth in the subsequent half-year and in the full year after the forecast.

This contrast reinforces the earlier observation concerning the importance of forecast release dates. It also illustrates the importance of the choice of a straw man as a standard of comparison. Although the no-change and same-change standards applied here seem reasonable, other standards could alter the results. These results are not sensitive, however, to the summary error measure or the actual data employed. Similar results hold for the RMSE instead of the MAE, or for revised actual data in place of the preliminary actual data used in the table.

## *Variations in Forecast Accuracy among Forecasters*

Much of the interest in forecast accuracy stems from the wish to know "Who is the best forecaster?" Appendix A presents the mean absolute errors of nine different forecasters for 24 different variables over the period from 1986:I through 1991:III, corresponding to the period when the National Income and Product Accounts were based to 1982, and prior to the December 1991 benchmark revision to a 1987 base year.[1]

Even a cursory examination of the information in Appendix A shows that no single forecaster dominates all outliers for all, or even most, of the variables.[2] In light of the importance of the time within the quarter when the forecast was made, consider only the early-quarter forecasts, those made in the first month. For most variables, the most accurate forecaster varies depending on the horizon of the forecast. Even for the few exceptions (gross domestic final sales, housing starts, state and local government purchases, and the unemployment rate), three different forecasters were "the best." One of the two remaining forecasters was best in predicting the GNP deflator up through seven quarters ahead. However, different forecasters have different interests; to deem one of these forecasters the best, based on a few variables, runs the risk of misleading those forecast users whose primary interest is in some other variable.

Suppose attention is confined to the concept of the inflation rate; Appendix A shows one forecaster who excels for the CPI measure while a different forecaster excels for the GNP deflator. Assume a forecast user cares only about one specific variable and one specific horizon. Appendix A can be used to determine which forecaster has been the most accurate for that particular variable and horizon, but this

[1] Additional summary error measures (RMSEs, Theil coefficients, and mean errors) are available on request from the author.

[2] Further information on the participating forecasting organizations is provided in Appendix B.

does not imply that this particular forecaster will continue to be the most accurate in the future. The reason is that the *differences* in accuracy are typically fairly small; the "best" forecaster's errors were, on average, less than 10 percent smaller than those of the second best forecaster. These differences are of doubtful economic or statistical significance.

The fact that the accuracy of the most prominent group of forecasters is similar does not imply that *all* forecasters are equally accurate. A few of the individuals whose performance was summarized in Table 4 commonly made errors that were large multiples of the simple straw man used as a standard of comparison. It is as easy to make poor forecasts as it is difficult to consistently make the best forecasts.

## *Conclusion*

With so much variability in forecasting accuracy, it is easier to disprove any generalization than to offer a valid one. Nevertheless, it seems clear that a major factor in forecast accuracy is the time period to be forecast. Errors were enormous in the severe 1973–75 and 1981–82 recessions, much smaller in the 1980 and 1990–91 recessions, and generally quite minimal apart from business cycle turning points. Because turning points also tend to be periods when simple rule-of-thumb forecasts fare poorly, the moral for the forecast user seems to be not to ignore the forecasts but rather to think carefully about plausible outcomes far from the consensus view.

Clearly, accuracy also varies among variables. For good theoretical reasons, it is difficult to forecast a financial variable where genuinely unique knowledge presents an opportunity to profit. These reasons do not hold as forcefully for standard nonfinancial variables—real GNP, inflation, and unemployment rates—where the opportunities for profit are less apparent. Nevertheless, some nonfinancial variables are also extremely difficult to predict. A prominent example is the change in business inventories, where forecasts are often inferior to a no-change rule of thumb.

The interplay between forecast accuracy and the length or span of the forecast is also important. Forecast accuracy obviously tends to improve as the horizon of the forecast declines. But, at least for real GNP, the improvement is relatively slow over time until the forecast period actually starts, when some actual high-frequency data can be incorporated into the forecast. At the same time, longer time spans are often easier to forecast, as aberrations in the economy and/or noise in the measurement procedures "average out." The variability of four-quarter or eight-quarter cumulative changes is generally smaller than that of quarterly changes.

Finally, the importance of the forecaster, as a determinant of accuracy, is often exaggerated, perhaps by the forecasters themselves. Some forecasters have much to fear from a clear statement of the accuracy of their forecasts. But the vast majority of prominent forecasters, including those who have invited public scrutiny of their performance, have much to gain from disclosure of how accurate their forecasts have been. First, although it may be disappointing to learn that others' performances have been similar, it must be comforting to learn that others cannot document a clearly superior performance. Second, and more importantly, there has been much disillusionment with macroeconomic forecasting. Some of this is justified, but some of it may reflect forecasters' failure to educate forecast users in how much (little) confidence to place in their forecasts. In forecasting, an explanation of how much (little) the forecaster knows can be more useful to the user than a single best guess of what the future will be. Only with some understanding of how large forecast errors are likely to be does the forecaster's message become valuable.

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Change in Business Inventories (Billions of Current Dollars) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 19.7 | 26.0 | 31.2 | 28.5 | 29.8 | 31.2 | 27.7 | 25.4 |
| GSU | 15.8 | 22.3 | 28.0 | 27.5 | 30.2 | 37.5 | 32.9 | 26.7 |
| LHMA | 17.3 | 21.3 | 28.3 | 27.5 | 29.2 | 32.8 | 29.3 | 28.5 |
| RSQE | 17.9 | 19.7 | 25.4 | 26.5 | 28.3 | 31.4 | 30.1 | — |
| WEFA | 21.2 | 20.9 | 26.3 | 30.5 | 34.9 | 34.8 | 31.3 | 31.9 |
| Mid Quarter | | | | | | | | |
| DRI | 16.3 | 23.7 | 31.2 | 29.8 | 31.6 | 32.6 | 32.8 | 27.8 |
| LHMA | 15.9 | 23.2 | 27.8 | 29.3 | 30.9 | 33.1 | 31.9 | 27.5 |
| WEFA | 19.4 | 21.9 | 23.9 | 28.7 | 33.3 | 34.6 | 33.4 | 30.6 |
| Late Quarter | | | | | | | | |
| DRI | 15.5 | 24.6 | 31.6 | 29.7 | 32.6 | 35.2 | 36.0 | 29.0 |
| LHMA | 13.2 | 21.5 | 24.5 | 28.2 | 31.8 | 33.3 | 32.9 | 26.0 |
| | Real Change in Business Inventories (Billions of 1982 Dollars) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 16.8 | 19.3 | 22.9 | 22.0 | 21.5 | 23.5 | 17.9 | 17.9 |
| GSU | 13.2 | 17.3 | 20.8 | 20.2 | 22.1 | 27.7 | 23.6 | 18.7 |
| LHMA | 13.4 | 16.6 | 20.6 | 20.4 | 22.2 | 26.4 | 21.0 | 23.0 |
| RSQE | 14.1 | 14.3 | 18.9 | 20.4 | 20.4 | 23.8 | 20.0 | — |
| WEFA | 17.8 | 17.2 | 20.8 | 23.1 | 24.0 | 26.9 | 21.0 | 23.0 |
| Mid Quarter | | | | | | | | |
| DRI | 12.2 | 17.8 | 21.4 | 21.7 | 22.0 | 24.0 | 19.6 | 19.3 |
| LHMA | 13.7 | 17.3 | 20.4 | 21.8 | 22.2 | 26.4 | 22.0 | 19.9 |
| UCLA | 13.1 | 22.4 | 28.3 | 29.2 | 27.9 | 24.6 | — | — |
| WEFA | 14.9 | 16.4 | 18.9 | 21.2 | 22.5 | 26.2 | 21.7 | 22.4 |
| Late Quarter | | | | | | | | |
| DRI | 12.2 | 20.0 | 22.5 | 22.3 | 22.7 | 26.1 | 21.5 | 20.7 |
| LHMA | 11.9 | 16.2 | 19.6 | 20.6 | 21.5 | 26.1 | 23.5 | 19.9 |
| SPF | 13.3 | 17.0 | 20.7 | 21.2 | 21.7 | — | — | — |
| | Total Civilian Employment—Household Survey (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | .6 | .5 | .5 | .6 | .6 | .6 | .5 | .4 |
| GSU | .4 | .6 | .7 | .8 | .8 | .9 | .8 | .8 |
| LHMA | 1.0 | .8 | .9 | .9 | .9 | 1.0 | .9 | .9 |
| WEFA | .9 | .7 | .8 | .7 | .7 | .7 | .7 | .7 |
| Mid Quarter | | | | | | | | |
| KEDI | 2.2 | 1.8 | 1.6 | 1.4 | 1.4 | 1.4 | 1.3 | — |
| LHMA | .6 | .7 | .7 | .7 | .8 | .9 | .8 | .8 |
| UCLA | .5 | .6 | .6 | .7 | .8 | .7 | — | — |
| WEFA | .6 | .6 | .6 | .7 | .7 | .7 | .7 | .6 |
| Late Quarter | | | | | | | | |
| DRI | .4 | .5 | .5 | .5 | .6 | .6 | .5 | .4 |
| LHMA | .5 | .7 | .7 | .8 | .8 | .9 | .9 | .8 |

Note: — = more than two forecasts not available.

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Civilian Unemployment Rate | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | .1 | .2 | .3 | .5 | .6 | .7 | .7 | .7 |
| GSU | .1 | .3 | .4 | .5 | .6 | .7 | .8 | .9 |
| LHMA | .2 | .3 | .4 | .6 | .7 | .9 | 1.0 | 1.1 |
| RSQE | .1 | .3 | .4 | .6 | .6 | .7 | .7 | — |
| WEFA | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 |
| Mid Quarter | | | | | | | | |
| DRI | .1 | .2 | .3 | .5 | .6 | .7 | .7 | .6 |
| KEDI | .1 | .3 | .4 | .5 | .6 | .7 | .8 | — |
| LHMA | .1 | .2 | .3 | .5 | .6 | .7 | .8 | .9 |
| UCLA | .1 | .3 | .4 | .6 | .7 | .7 | — | — |
| WEFA | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 |
| Late Quarter | | | | | | | | |
| DRI | .1 | .2 | .3 | .4 | .5 | .7 | .7 | .7 |
| LHMA | .1 | .2 | .3 | .5 | .6 | .8 | .9 | .9 |
| SPF | .1 | .3 | .4 | .5 | .6 | — | — | — |
| | Consumer Price Index (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | .9 | .9 | .8 | .7 | .6 | .5 | .4 | .3 |
| GSU | 1.0 | .9 | .8 | .6 | .5 | .4 | .2 | .2 |
| LHMA | .8 | .9 | .8 | .7 | .5 | .5 | .4 | .4 |
| RSQE | 1.2 | 1.1 | 1.0 | .8 | .8 | .7 | .6 | 1.3 |
| WEFA | 1.0 | 1.0 | .9 | .8 | .6 | .5 | .4 | .3 |
| Mid Quarter | | | | | | | | |
| DRI | .4 | .7 | .7 | .6 | .5 | .5 | .4 | .3 |
| KEDI | 1.9 | 1.1 | .9 | .7 | .7 | .7 | .7 | — |
| LHMA | .5 | .7 | .7 | .6 | .6 | .5 | .4 | .4 |
| UCLA | .7 | .7 | .7 | .6 | .5 | .5 | — | — |
| WEFA | .6 | .8 | .8 | .8 | .6 | .5 | .4 | .3 |
| Late Quarter | | | | | | | | |
| DRI | .2 | .6 | .6 | .6 | .5 | .5 | .4 | .3 |
| LHMA | .3 | .6 | .7 | .6 | .5 | .4 | .4 | .4 |
| | Federal Government Purchases, Nominal (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 7.4 | 5.4 | 4.9 | 4.1 | 3.5 | 3.2 | 2.6 | 1.9 |
| GSU | 7.5 | 6.3 | 5.1 | 3.3 | 3.5 | 3.0 | 2.8 | 2.8 |
| LHMA | 8.3 | 6.5 | 4.5 | 3.8 | 3.5 | 3.2 | 2.8 | 2.3 |
| RSQE | 6.9 | 5.4 | 4.6 | 4.5 | 4.0 | 3.7 | 3.2 | — |
| WEFA | 8.1 | 5.6 | 4.6 | 3.5 | 3.2 | 2.6 | 2.2 | 1.9 |
| Mid Quarter | | | | | | | | |
| DRI | 7.6 | 5.1 | 4.2 | 3.8 | 3.3 | 3.2 | 2.6 | 2.0 |
| LHMA | 7.6 | 6.2 | 4.5 | 3.9 | 3.6 | 3.3 | 2.9 | 2.4 |
| WEFA | 7.1 | 4.7 | 3.3 | 2.8 | 2.8 | 2.5 | 1.7 | 1.5 |
| Late Quarter | | | | | | | | |
| DRI | 6.7 | 4.9 | 3.9 | 3.8 | 3.5 | 3.3 | 2.8 | 2.1 |
| LHMA | 7.2 | 5.7 | 4.2 | 3.8 | 3.6 | 3.2 | 2.9 | 2.5 |

Appendix A

*Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Federal Government Purchases, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 9.0 | 4.7 | 5.4 | 4.6 | 3.7 | 2.9 | 2.1 | 1.8 |
| GSU | 1.4 | 5.5 | 4.4 | 3.2 | 2.5 | 2.1 | 2.1 | 1.9 |
| LHMA | 10.1 | 5.3 | 4.7 | 3.7 | 3.3 | 2.9 | 2.6 | 1.8 |
| WEFA | 9.0 | 4.5 | 4.7 | 3.4 | 2.8 | 2.2 | 1.8 | 1.5 |
| Mid Quarter | | | | | | | | |
| DRI | 8.6 | 4.8 | 4.7 | 4.3 | 3.5 | 3.0 | 2.2 | 2.0 |
| LHMA | 8.8 | 5.3 | 4.3 | 3.7 | 3.3 | 2.8 | 2.5 | 1.9 |
| WEFA | 8.9 | 4.1 | 3.6 | 3.1 | 2.4 | 1.9 | 1.5 | 1.4 |
| Late Quarter | | | | | | | | |
| DRI | 8.5 | 4.5 | 4.4 | 4.1 | 3.5 | 2.9 | 2.2 | 1.9 |
| LHMA | 9.2 | 5.3 | 4.5 | 3.7 | 3.2 | 2.6 | 2.5 | 2.1 |
| | Federal Surplus (Billions of Current Dollars) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 20.1 | 29.1 | 33.0 | 34.3 | 32.8 | 30.9 | 30.9 | 34.8 |
| GSU | 22.3 | 27.5 | 28.1 | 31.5 | 31.8 | 39.2 | 39.1 | 44.4 |
| LHMA | 28.0 | 29.8 | 31.0 | 37.9 | 39.8 | 42.5 | 43.8 | 41.8 |
| WEFA | 22.4 | 27.6 | 25.9 | 34.7 | 35.4 | 39.6 | 40.2 | 42.8 |
| Mid Quarter | | | | | | | | |
| DRI | 14.8 | 26.2 | 34.2 | 33.2 | 33.0 | 31.0 | 33.2 | 35.0 |
| KEDI | 31.9 | 28.1 | 27.2 | 29.1 | 35.8 | 41.6 | 40.9 | — |
| LHMA | 21.7 | 34.8 | 32.8 | 34.9 | 40.7 | 42.5 | 41.7 | 37.9 |
| WEFA | 17.8 | 28.7 | 28.5 | 31.1 | 33.3 | 35.4 | 39.0 | 43.2 |
| Late Quarter | | | | | | | | |
| DRI | 13.8 | 24.4 | 30.2 | 33.0 | 31.4 | 29.6 | 32.2 | 31.9 |
| LHMA | 21.0 | 30.2 | 30.9 | 35.0 | 40.0 | 40.9 | 42.3 | 39.7 |
| | Final Sales, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 1.6 | 1.2 | .9 | .9 | .9 | .9 | .9 | .8 |
| GSU | 1.8 | 1.3 | 1.0 | 1.1 | 1.1 | 1.3 | 1.3 | 1.2 |
| LHMA | 1.5 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| RSQE | 1.6 | 1.1 | 1.1 | 1.1 | 1.0 | .9 | .9 | — |
| WEFA | 1.3 | 1.1 | 1.0 | .9 | .9 | 1.0 | .9 | .8 |
| Mid Quarter | | | | | | | | |
| DRI | 1.5 | 1.2 | .9 | .9 | .9 | .9 | .8 | .8 |
| LHMA | 1.5 | 1.2 | .9 | .9 | .9 | 1.0 | 1.0 | .9 |
| WEFA | 1.4 | 1.1 | 1.0 | .9 | .9 | .9 | .9 | .8 |
| Late Quarter | | | | | | | | |
| DRI | 1.5 | 1.2 | .8 | .8 | .8 | .8 | .8 | .8 |
| LHMA | 1.4 | 1.2 | .8 | .9 | .9 | 1.0 | 1.0 | 1.0 |
| SPF | 1.1 | .9 | .8 | .9 | 1.0 | — | — | — |

Note: — = more than two forecasts not available.

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Gross Domestic Purchases, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 2.1 | 1.6 | 1.5 | 1.6 | 1.5 | 1.4 | 1.2 | 1.1 |
| GSU | 1.8 | 1.8 | 1.6 | 1.5 | 1.5 | 1.6 | 1.5 | 1.5 |
| LHMA | 1.9 | 1.6 | 1.4 | 1.4 | 1.4 | 1.5 | 1.4 | 1.3 |
| RSQE | 2.0 | 1.9 | 1.7 | 1.6 | 1.5 | 1.3 | 1.1 | — |
| WEFA | 2.1 | 1.5 | 1.4 | 1.3 | 1.3 | 1.2 | 1.1 | 1.0 |
| Mid Quarter | | | | | | | | |
| DRI | 1.7 | 1.6 | 1.4 | 1.5 | 1.5 | 1.5 | 1.3 | 1.2 |
| LHMA | 1.6 | 1.6 | 1.4 | 1.4 | 1.3 | 1.4 | 1.3 | 1.2 |
| WEFA | 1.9 | 1.6 | 1.5 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 |
| Late Quarter | | | | | | | | |
| DRI | 1.7 | 1.6 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 | 1.2 |
| LHMA | 1.4 | 1.3 | 1.2 | 1.3 | 1.4 | 1.4 | 1.4 | 1.3 |
| | Gross Domestic Final Sales, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 1.8 | 1.3 | 1.3 | 1.3 | 1.2 | 1.2 | 1.0 | 1.0 |
| GSU | 1.8 | 1.2 | 1.1 | 1.2 | 1.2 | 1.4 | 1.3 | 1.3 |
| LHMA | 1.6 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.1 | 1.1 |
| RSQE | 2.0 | 1.4 | 1.2 | 1.2 | 1.1 | 1.0 | .9 | — |
| WEFA | 1.6 | 1.0 | .9 | .9 | .9 | .9 | .9 | .8 |
| Mid Quarter | | | | | | | | |
| DRI | 1.6 | 1.3 | 1.3 | 1.3 | 1.2 | 1.2 | 1.1 | 1.0 |
| LHMA | 1.6 | 1.1 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 |
| WEFA | 1.6 | 1.1 | 1.0 | 1.0 | 1.0 | .9 | .9 | .8 |
| Late Quarter | | | | | | | | |
| DRI | 1.4 | 1.1 | 1.2 | 1.2 | 1.1 | 1.2 | 1.1 | 1.0 |
| LHMA | 1.1 | 1.0 | .9 | 1.1 | 1.1 | 1.2 | 1.1 | 1.0 |
| | Gross Domestic Final Private Sales, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 1.8 | 1.7 | 1.5 | 1.6 | 1.4 | 1.3 | 1.2 | 1.0 |
| GSU | 2.1 | 1.7 | 1.6 | 1.7 | 1.6 | 1.7 | 1.7 | 1.6 |
| LHMA | 2.1 | 1.6 | 1.5 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 |
| WEFA | 1.8 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.2 | 1.1 |
| Mid Quarter | | | | | | | | |
| DRI | 1.6 | 1.7 | 1.5 | 1.5 | 1.4 | 1.4 | 1.2 | 1.1 |
| LHMA | 2.0 | 1.6 | 1.4 | 1.5 | 1.5 | 1.5 | 1.4 | 1.3 |
| WEFA | 1.7 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.1 | 1.1 |
| Late Quarter | | | | | | | | |
| DRI | 1.5 | 1.5 | 1.4 | 1.5 | 1.4 | 1.4 | 1.2 | 1.1 |
| LHMA | 1.6 | 1.4 | 1.4 | 1.5 | 1.6 | 1.6 | 1.5 | 1.4 |

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Gross National Product, Nominal (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| BMARK | 1.8 | 1.8 | 1.7 | 1.8 | — | — | — | — |
| DRI | 1.7 | 1.3 | 1.3 | 1.2 | 1.2 | 1.1 | 1.1 | 1.1 |
| GSU | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.5 | 1.4 | 1.3 |
| LHMA | 1.8 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| RSQE | 2.1 | 1.6 | 1.5 | 1.4 | 1.3 | 1.1 | 1.0 | — |
| WEFA | 2.1 | 1.5 | 1.5 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 |
| Mid Quarter | | | | | | | | |
| DRI | 1.4 | 1.3 | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 |
| KEDI | 2.5 | 2.3 | 2.4 | 2.3 | 2.1 | 1.8 | 1.6 | — |
| LHMA | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 |
| UCLA | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.2 | — | — |
| WEFA | 1.6 | 1.5 | 1.5 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 |
| Late Quarter | | | | | | | | |
| DRI | 1.3 | 1.2 | 1.2 | 1.1 | 1.2 | 1.2 | 1.1 | 1.1 |
| LHMA | 1.2 | 1.3 | 1.3 | 1.3 | 1.4 | 1.5 | 1.4 | 1.4 |
| SPF | 1.5 | 1.3 | 1.4 | 1.4 | 1.3 | — | — | — |
| | Gross National Product, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| BMARK | 1.9 | 1.7 | 1.7 | 1.6 | — | — | — | — |
| DRI | 1.7 | 1.2 | 1.2 | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| GSU | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| LHMA | 1.9 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.3 | 1.3 |
| RSQE | 1.6 | 1.6 | 1.6 | 1.5 | 1.4 | 1.3 | 1.1 | — |
| WEFA | 2.1 | 1.5 | 1.5 | 1.4 | 1.3 | 1.2 | 1.2 | 1.0 |
| Mid Quarter | | | | | | | | |
| DRI | 1.5 | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| KEDI | 1.8 | 1.7 | 1.6 | 1.6 | 1.6 | 1.4 | 1.2 | — |
| LHMA | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.2 | 1.1 |
| UCLA | 1.6 | 1.6 | 1.6 | 1.5 | 1.4 | 1.1 | — | — |
| WEFA | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 | 1.2 | 1.2 | 1.0 |
| Late Quarter | | | | | | | | |
| DRI | 1.5 | 1.3 | 1.2 | 1.1 | 1.2 | 1.1 | 1.0 | 1.0 |
| LHMA | 1.4 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.2 | 1.2 |
| SPF | 1.4 | 1.2 | 1.2 | 1.3 | 1.2 | — | — | — |
| | Housing Starts (Millions of Units) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | .1 | .1 | .2 | .2 | .2 | .3 | .3 | .3 |
| GSU | .1 | .1 | .1 | .2 | .2 | .2 | .2 | .2 |
| LHMA | .1 | .1 | .1 | .2 | .2 | .2 | .3 | .3 |
| Mid Quarter | | | | | | | | |
| DRI | .0 | .1 | .1 | .2 | .2 | .3 | .3 | .3 |
| KEDI | .1 | .2 | .2 | .3 | .4 | .4 | .5 | — |
| LHMA | .0 | .1 | .1 | .2 | .2 | .2 | .3 | .3 |
| UCLA | .1 | .1 | .1 | .2 | .2 | .3 | — | — |
| Late Quarter | | | | | | | | |
| DRI | .0 | .1 | .1 | .2 | .2 | .2 | .3 | .3 |
| LHMA | .0 | .1 | .1 | .2 | .2 | .2 | .2 | .3 |
| SPF | .1 | .1 | .1 | .2 | .2 | — | — | — |

Note: — = more than two forecasts not available.

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Implicit GNP Price Deflator (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| BMARK | 1.1 | .9 | .7 | .6 | — | — | — | — |
| DRI | 1.2 | .9 | .7 | .6 | .4 | .3 | .3 | .2 |
| GSU | 1.1 | .8 | .6 | .5 | .4 | .4 | .4 | .5 |
| LHMA | .8 | .7 | .5 | .4 | .4 | .3 | .3 | .3 |
| RSQE | 1.4 | 1.1 | 1.0 | .8 | .7 | .7 | .6 | — |
| WEFA | 1.1 | .8 | .6 | .5 | .5 | .4 | .3 | .4 |
| Mid Quarter | | | | | | | | |
| DRI | .8 | .7 | .6 | .4 | .4 | .3 | .2 | .1 |
| KEDI | 2.1 | 1.4 | 1.4 | 1.1 | .8 | .7 | .7 | — |
| LHMA | .8 | .7 | .5 | .4 | .3 | .2 | .2 | .3 |
| UCLA | .9 | .6 | .5 | .4 | .3 | .2 | — | — |
| WEFA | 1.1 | .8 | .5 | .5 | .5 | .5 | .4 | .5 |
| Late Quarter | | | | | | | | |
| DRI | .8 | .7 | .7 | .5 | .4 | .3 | .3 | .2 |
| LHMA | .9 | .7 | .5 | .5 | .4 | .3 | .3 | .2 |
| SPF | 1.0 | .7 | .5 | .5 | .5 | — | — | — |
| | Investment in Residential Structures, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 7.5 | 6.4 | 6.2 | 6.0 | 5.7 | 5.3 | 5.1 | 4.6 |
| GSU | 5.0 | 6.0 | 5.7 | 6.5 | 5.9 | 5.5 | 5.3 | 5.0 |
| LHMA | 6.7 | 5.9 | 5.4 | 5.5 | 5.5 | 5.5 | 5.5 | 5.7 |
| RSQE | 7.3 | 6.7 | 7.0 | 8.1 | 8.1 | 7.9 | 7.9 | — |
| WEFA | 7.0 | 6.4 | 6.1 | 6.2 | 6.1 | 5.9 | 5.6 | 5.2 |
| Mid Quarter | | | | | | | | |
| DRI | 5.9 | 5.5 | 5.7 | 5.4 | 5.6 | 5.5 | 5.5 | 5.0 |
| LHMA | 6.3 | 5.5 | 5.2 | 5.0 | 5.1 | 5.0 | 5.1 | 5.2 |
| WEFA | 5.8 | 5.2 | 4.8 | 5.3 | 5.7 | 5.7 | 5.4 | 5.3 |
| Late Quarter | | | | | | | | |
| DRI | 5.5 | 5.2 | 5.5 | 5.8 | 6.2 | 5.9 | 5.4 | 4.8 |
| LHMA | 6.5 | 5.5 | 5.5 | 5.8 | 5.9 | 5.6 | 5.4 | 5.3 |
| | Net Exports of Goods and Services (Billions of Current Dollars) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 10.7 | 14.8 | 23.6 | 26.6 | 28.3 | 29.3 | 25.5 | 25.1 |
| GSU | 11.7 | 15.6 | 20.0 | 23.2 | 23.7 | 26.7 | 27.4 | 27.5 |
| LHMA | 10.8 | 14.5 | 16.3 | 22.4 | 28.6 | 34.3 | 38.8 | 41.1 |
| RSQE | 14.0 | 21.1 | 25.6 | 30.0 | 36.5 | 44.3 | 48.6 | — |
| WEFA | 10.0 | 14.0 | 19.3 | 25.1 | 31.5 | 38.3 | 40.4 | 40.8 |
| Mid Quarter | | | | | | | | |
| DRI | 9.8 | 17.8 | 24.3 | 29.6 | 31.3 | 31.4 | 29.7 | 27.5 |
| LHMA | 9.8 | 13.7 | 28.2 | 24.1 | 30.4 | 36.5 | 42.8 | 45.3 |
| WEFA | 10.1 | 16.8 | 21.4 | 28.5 | 35.0 | 40.7 | 43.7 | 45.0 |
| Late Quarter | | | | | | | | |
| DRI | 11.1 | 17.9 | 22.6 | 28.9 | 31.9 | 31.1 | 29.8 | 27.1 |
| LHMA | 10.1 | 16.3 | 18.4 | 20.8 | 27.0 | 32.9 | 39.8 | 42.2 |

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Real Net Exports of Goods and Services (Billions of 1982 Dollars) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 12.6 | 17.1 | 21.9 | 24.0 | 27.8 | 28.0 | 30.0 | 29.7 |
| GSU | 13.2 | 17.3 | 16.7 | 15.3 | 17.5 | 19.5 | 20.1 | 19.0 |
| LHMA | 12.4 | 16.7 | 14.1 | 15.5 | 21.6 | 22.1 | 24.5 | 25.9 |
| RSQE | 14.2 | 15.7 | 14.3 | 14.9 | 21.4 | 22.0 | 20.3 | — |
| WEFA | 11.0 | 12.4 | 15.6 | 14.7 | 18.8 | 22.9 | 20.6 | 19.0 |
| Mid Quarter | | | | | | | | |
| DRI | 11.5 | 16.5 | 19.1 | 22.4 | 24.6 | 27.6 | 28.4 | 27.4 |
| LHMA | 11.5 | 15.2 | 13.8 | 16.5 | 22.0 | 22.5 | 25.7 | 25.7 |
| WEFA | 11.6 | 14.5 | 16.6 | 19.2 | 22.1 | 27.4 | 27.7 | 24.8 |
| Late Quarter | | | | | | | | |
| DRI | 12.1 | 16.6 | 18.0 | 22.9 | 25.6 | 28.9 | 30.0 | 28.9 |
| LHMA | 11.1 | 16.0 | 14.0 | 14.7 | 21.8 | 24.6 | 24.4 | 25.4 |
| | Nonresidential Fixed Investment, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 6.1 | 4.8 | 4.1 | 3.7 | 3.6 | 3.3 | 3.0 | 2.4 |
| GSU | 7.5 | 5.8 | 4.6 | 4.3 | 4.3 | 4.2 | 3.6 | 3.7 |
| LHMA | 8.0 | 5.1 | 4.4 | 3.6 | 3.5 | 3.3 | 2.9 | 2.6 |
| RSQE | 7.7 | 5.9 | 4.7 | 4.3 | 4.2 | 3.7 | 3.5 | — |
| WEFA | 7.3 | 4.8 | 3.8 | 3.2 | 2.9 | 2.7 | 2.6 | 2.3 |
| Mid Quarter | | | | | | | | |
| DRI | 5.8 | 4.8 | 3.9 | 3.6 | 3.5 | 3.4 | 3.0 | 2.6 |
| LHMA | 7.7 | 5.1 | 4.0 | 3.4 | 3.5 | 3.1 | 2.9 | 2.7 |
| WEFA | 6.3 | 4.7 | 3.6 | 3.2 | 2.9 | 2.6 | 2.2 | 2.0 |
| Late Quarter | | | | | | | | |
| DRI | 6.2 | 4.2 | 3.5 | 3.5 | 3.4 | 3.4 | 3.1 | 2.6 |
| LHMA | 7.4 | 4.7 | 3.9 | 3.3 | 3.5 | 3.1 | 2.8 | 2.8 |
| | Personal Consumption Expenditures, Durable Goods, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 7.4 | 5.2 | 4.6 | 4.4 | 3.7 | 3.7 | 3.5 | 3.3 |
| GSU | 8.8 | 5.4 | 4.5 | 4.3 | 3.9 | 4.4 | 4.1 | 3.7 |
| LHMA | 7.1 | 4.6 | 3.8 | 3.6 | 3.2 | 3.6 | 3.3 | 3.3 |
| RSQE | 8.1 | 5.8 | 4.7 | 4.2 | 3.5 | 3.1 | 2.8 | — |
| WEFA | 7.3 | 4.9 | 3.7 | 3.5 | 2.7 | 2.8 | 3.0 | 2.7 |
| Mid Quarter | | | | | | | | |
| DRI | 7.0 | 4.5 | 3.9 | 4.1 | 3.5 | 3.7 | 3.5 | 3.3 |
| LHMA | 7.7 | 5.5 | 4.1 | 3.7 | 3.0 | 3.5 | 3.2 | 3.0 |
| WEFA | 7.1 | 4.9 | 4.0 | 3.5 | 2.8 | 2.9 | 2.9 | 2.6 |
| Late Quarter | | | | | | | | |
| DRI | 4.3 | 4.1 | 3.9 | 4.1 | 3.6 | 3.6 | 3.4 | 3.2 |
| LHMA | 4.9 | 4.2 | 3.6 | 3.5 | 3.1 | 3.5 | 3.3 | 3.0 |

Note: — = more than two forecasts not available.

Appendix A

## *Mean Absolute Errors 1986:I to 1991:III, continued*

| Forecaster | Forecast Horizon (Quarters) Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| | Personal Consumption Expenditures, Nondurable Goods and Services, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 1.3 | 1.0 | .9 | .7 | .6 | .5 | .5 | .5 |
| GSU | 1.2 | 1.0 | .9 | .8 | .8 | .8 | .7 | .7 |
| LHMA | 1.4 | 1.2 | 1.0 | .9 | .9 | .9 | .8 | .7 |
| RSQE | 1.5 | 1.3 | .9 | .7 | .7 | .7 | .6 | — |
| WEFA | 1.1 | .9 | .7 | .7 | .7 | .6 | .6 | .6 |
| Mid Quarter | | | | | | | | |
| DRI | 1.2 | 1.1 | 1.0 | .7 | .6 | .7 | .5 | .5 |
| LHMA | 1.2 | 1.0 | .9 | .9 | .8 | .8 | .7 | .7 |
| WEFA | 1.2 | 1.0 | .8 | .7 | .6 | .7 | .6 | .6 |
| Late Quarter | | | | | | | | |
| DRI | 1.2 | 1.2 | .9 | .7 | .6 | .6 | .5 | .5 |
| LHMA | 1.2 | 1.2 | .9 | .9 | .8 | .8 | .8 | .7 |
| | State and Local Government Purchases, Real (Percentage Points, Annual Rates of Growth) | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | 2.5 | 2.2 | 1.9 | 1.8 | 1.9 | 1.9 | 1.9 | 1.8 |
| GSU | 2.2 | 1.7 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 |
| LHMA | 1.8 | 1.5 | 1.2 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| WEFA | 1.6 | 1.2 | .9 | .9 | .9 | .9 | .8 | .8 |
| Mid Quarter | | | | | | | | |
| DRI | 2.0 | 1.8 | 1.7 | 1.6 | 1.7 | 1.6 | 1.7 | 1.6 |
| LHMA | 1.8 | 1.4 | 1.3 | 1.0 | .9 | .9 | .9 | .9 |
| WEFA | 1.7 | 1.2 | 1.0 | .9 | .9 | .8 | .8 | .8 |
| Late Quarter | | | | | | | | |
| DRI | 2.0 | 1.8 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 |
| LHMA | 1.8 | 1.4 | 1.2 | 1.0 | .9 | .9 | .8 | .9 |
| | 90-Day Treasury Bill Rate | | | | | | | |
| Early Quarter | | | | | | | | |
| DRI | .1 | .4 | .8 | 1.0 | 1.1 | 1.2 | 1.3 | 1.5 |
| LHMA | .2 | .5 | .8 | 1.0 | 1.1 | 1.3 | 1.4 | 1.6 |
| RSQE | .1 | .4 | .8 | 1.1 | 1.3 | 1.4 | 1.5 | — |
| WEFA | .2 | .5 | .7 | .8 | .9 | .9 | .9 | .9 |
| Mid Quarter | | | | | | | | |
| DRI | .1 | .3 | .7 | .9 | 1.0 | 1.1 | 1.3 | 1.5 |
| KEDI | .3 | .6 | .8 | .9 | 1.1 | 1.3 | 1.4 | 1.4 |
| LHMA | .1 | .4 | .7 | .8 | 1.0 | 1.1 | 1.2 | 1.4 |
| WEFA | .1 | .4 | .7 | .8 | .8 | .8 | .8 | .9 |
| Late Quarter | | | | | | | | |
| DRI | .0 | .3 | .6 | .8 | 1.0 | 1.2 | 1.4 | 1.5 |
| LHMA | .0 | .3 | .6 | .8 | .9 | 1.1 | 1.2 | 1.3 |

Appendix B

## *Summary Information on Forecasting Organizations Studied*

| Forecasting Organization (Abbreviated Title), Contact for Further Information | Approximate Number of Macroeconomic Variables Forecast | Typical Forecast Horizon, Quarters | Frequency of Release, per Year | Date Forecast First Issued Regularly |
|---|---|---|---|---|
| 1) Benchmark Forecast (BMARK), George Washington University, Frederick Joutz (202) 994–4899 | 30 | 8 | 4 | 1976 |
| 2) Data Resources, Inc. (DRI), Roger Brinner (617) 863–5100 | 1,200 | 10 to 12 | 12 | 1969 |
| 3) Georgia State University (GSU), Economic Forecasting Project, Donald Ratajczak (404) 651–3282 | 540 | 8 | 4 | 1973 |
| 4) Kent Economic and Development Institute, Inc. (KEDI), Vladimir Simunek (216) 678–8215 | 1,700 | 10 | 12 | 1974 |
| 5) Laurence H. Meyer & Associates, Ltd. (LHMA), Larry Meyer (314) 721–4747 | 450 | 7 to 11 | 12 | 1983 |
| 6) Research Seminar in Quantitative Economics (RSQE), University of Michigan, Saul Hymans (313) 764–3299 | 200 | 8 | 8 | 1969 |
| 7) Survey of Professional Forecasters (SPF), Federal Reserve Bank of Philadelphia, formerly ASA/NBER, Dean Croushore (215) 574–3809 | 20 | 5 | 4 | 1968 |
| 8) University of California at Los Angeles (UCLA), School of Business, David Hensley (310) 825–1623 | 1,000 | 8 to 12 | 4 | 1968 |
| 9) Wharton Econometric Forecasting Associates, Inc. (WEFA), Kurt Karl (215) 660–6357 | 1,000 | 12 | 12 | 1963 |