An Empirical Measure of the Real Rate of Interest

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The interest rate adjusted for expected inflation, the real rate of interest, is a key variable in macroeconomics. It is the price one pays for currently available resources expressed in terms of future resources. How does the real rate of interest behave? Despite the importance of this question, there is no generally available measure of the real rate of interest one can use to answer it. Economists who have studied the real rate have had to create their own series. The purpose of this article is to construct and make available a number of alternative empirical measures of the real rate of interest.

As noted above, the real rate of interest is the difference between the observed market rate of interest and the inflation rate expected by the public. Expected inflation, however, is not directly observable.[1] In order to construct a real rate series, one must select a proxy for expected inflation. We examine two possibilities—inflation forecasts made by Data Resources Incorporated (DRI) and by the staff of the Board of Governors of the Federal Reserve System. The DRI forecasts are made monthly. Through 1978, the Board staff produced monthly forecasts. Thereafter, it produced them eight times per year. These forecast series, therefore, allow construction of real rate series that are observed frequently enough to study cyclical timing relationships.

As an illustration of the usefulness of having a real rate series, we first review recent public debate over the typical level of the real rate. The main part of the article provides a defense of the plausibility of the real rate series constructed here and listed in the appendix. We compare forecasts of inflation from four different sources: the staff of the Board of Governors, DRI, the Michigan Survey of Consumers, and the Livingston Survey. We argue that the

The views expressed are those of the authors and do not necessarily represent those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

[1] Hetzel (1992) makes a proposal for indexed bonds that would render expected inflation directly observable. Expected inflation would be the difference in yields between nonindexed and indexed Treasury securities of the same maturity.

broad agreement exhibited among all these series is evidence that the series used here (Board of Governors staff and DRI) have been representative of the expectations of inflation affecting financial markets.

We then discuss other approaches to estimating the real rate. In this context, we examine the predictive ability of the four forecast series. We point out the persistent underprediction of inflation by survey forecasts in the 1970s. We argue that this underprediction does not reflect a basic defect in the survey data, but rather the special difficulty in predicting inflation during the final transition from a commodity to a fiat money standard.

1. CONTROVERSY OVER THE BEHAVIOR OF THE REAL RATE

Recently, the behavior of the real rate of interest has become an issue in debates over monetary policy. For example, during Humphrey-Hawkins testimony in July 1993, the chairman of the Federal Reserve System, Alan Greenspan (1993), drew attention to the unsustainably low value of the then current short-term real rate:

> Currently, short-term real rates, most directly affected by the Federal Reserve, are not far from zero; long-term rates, set primarily by the market, are appreciably higher, judging from the steep slope of the yield curve and reasonable suppositions about inflation expectations. This configuration indicates that market participants anticipate that short-term real rates will have to rise as the head winds diminish, if substantial inflationary imbalances are to be avoided. (P. 853)

In spring 1994, after the Federal Reserve began to raise the funds rate, controversy arose over what constitutes typical behavior of the real rate of interest. This controversy is illustrated by the following excerpts from *The Wall Street Journal*.

> [W]ith the economy now growing at a robust pace . . . the Fed has concluded that it is time to take the foot off the accelerator and put monetary policy into a "neutral" stance. . . . Robert Reischauer, director of the Congressional Budget Office, said neutral probably means inflation-adjusted rates of somewhere between ¾% and 1½%. But chief White House economist Laura Tyson has said that—excluding the anomalous 1980s—inflation-adjusted interest rates "have always been below 1%." (Wessel, 4/19/94, p. A2)

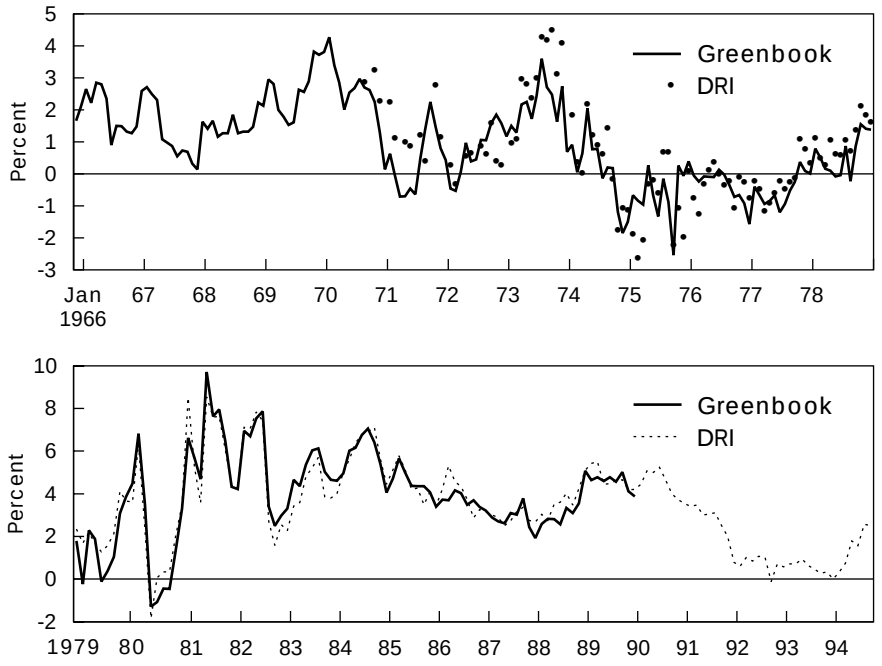
> The federal funds rate . . . now stands at 3.5%. And inflation is running at roughly 3%. That means the "real" interest rate . . . is only .5%. That is well below historical experience, says Barry Bosworth of the Brookings Institution, who adds that the norm is "1.5% to 2% real short-term rates in the middle of an economic expansion." (Murray, 4/11/94, p. A1)

> In 1992 and 1993 real interest rates had been stuck around zero because of a weak world economy. Rates have since increased with global economic prospects, but the recent level of real rates, 1.9% to 2%, is not high by historical standards; it is just about the average since 1961. Real rates remain well below the average of 3% that prevailed during the period of high growth and robust investment from 1984 to 1989. (Barro, 8/19/94, p. A10)

2. REAL RATE SERIES

Figure 1 shows two real rate series for Treasury bills, one using inflation forecasts from the staff of the Board of Governors and one using forecasts from DRI. (The data appendix provides a detailed discussion of data sources and the

Figure 1 Greenbook's and DRI's One- to Two-Quarter Real Treasury Bill Rates



Notes: The Greenbook real rate is calculated for dates on which Greenbooks were published. It is the difference between the yield on those dates on a Treasury bill maturing at the end of the subsequent quarter and a weighted average of Greenbook inflation forecasts for the contemporaneous and subsequent quarter. Inflation is measured by the GNP (GDP from 1992 on) implicit price deflator. The DRI real rate is calculated using the same Treasury bill yield and DRI predictions of inflation from the DRI publication immediately preceding publication of the Greenbook. Observations in the top panel are monthly. Observations in the bottom panel correspond to FOMC meetings, which have been held eight times a year since 1981, and tick marks indicate the first FOMC meeting of the year.

construction of the real rate series.) The Board staff forecasts are contained in a document referred to as the Greenbook, which is prepared prior to Federal Open Market Committee (FOMC) meetings. Because Greenbooks remain confidential for five full calendar years after the year in which they are published, the Greenbook real rate series ends in 1989. The DRI forecasts are from the table "Quarterly Summary for the U.S. Economy—Control" in the DRI/McGraw-Hill monthly publication *Review of the U.S. Economy*. Observations in the top part of Figure 1 are monthly. In the bottom part of the graph, they correspond to FOMC meetings, which have occurred eight times a year since 1981.

We calculate the Greenbook real rate series for dates on which the Board staff issued Greenbooks. The real rate is the difference between the yield (recorded on the Greenbook issue date) on a Treasury bill that matures on the last working day of the subsequent quarter and a weighted average of the Greenbook inflation forecasts for the contemporaneous and subsequent quarter. Inflation is measured by the GNP (GDP from 1992 on) implicit price deflator. We calculate the DRI real rate series using the same Treasury bill yield and DRI predictions of inflation from the most recent monthly DRI *Review of the U.S. Economy* available as of the issue of the Greenbook. The Greenbook and DRI real rate series generally move together. Some discrepancies in the two series arise because the dates on which the Greenbook and DRI inflation forecasts are made can differ by as much as a month.

3. HOW SIMILAR ARE THE INFLATION FORECASTS?

We now examine the correspondence among four inflation forecasts: the Greenbook, the DRI *Review,* the Livingston Survey, and the Michigan Survey. Different groups make the four forecasts. The staff of the Board of Governors makes the Greenbook forecasts. The 19 members of the FOMC critically examine the Greenbook forecasts at their meetings. Professional forecasters trained as economists make the DRI forecasts and sell them to a variety of corporations and state governments. Economists working for banks, corporations, and in financial markets make the forecasts in the Livingston Survey. The Survey Research Center of the University of Michigan randomly selects respondents from the public for the inflation forecasts in its Survey of Consumers. A straightforward explanation for the similar behavior among these different measures of expected inflation is that they do in fact capture movements in the public's expectation of inflation. This similarity suggests that the real rate series proposed here capture, at least broadly, the real rate as perceived by the public.

The Livingston Survey is available starting in June 1946. Joseph Livingston was a financial columnist from Philadelphia who surveyed business economists twice yearly on their expectations of CPI inflation. Among others, Carlson (1977), Caskey (1985), Hafer and Resler (1980), Jacobs and Jones (1980), and

Mullineaux (1978) examine the properties of this series. A series for the real rate of interest constructed from Livingston Survey data on expected inflation consists of only two observations per year.

The Survey Research Center of the University of Michigan has collected data on expected inflation quarterly since 1966 and monthly since 1978. (Before 1966, it asked respondents only whether they expected prices to go up or down.) Starting in 1978, the median, as well as the mean, of the individual respondents' forecasts from the Michigan Survey becomes available. The survey median has been lower than the survey mean in 95 percent of the observations. For all observations, the median prediction is lower than the mean prediction by an average of 1.0 percentage points. (This fact indicates that a small number of respondents regularly expected inflation to be unusually high relative to the group forecast.)

Figures 2 and 3, which compare Greenbook forecasts with DRI and Livingston forecasts, respectively, reveal a great deal of similarity between the paired forecasts. The standard deviation of the difference between the Greenbook and DRI forecasts from 1970Q3 to 1989Q4 is about 1 percent. The standard deviation of the difference between the Livingston and matching (May and November) Board staff forecasts from 1968 to 1989 is 0.60 percent.

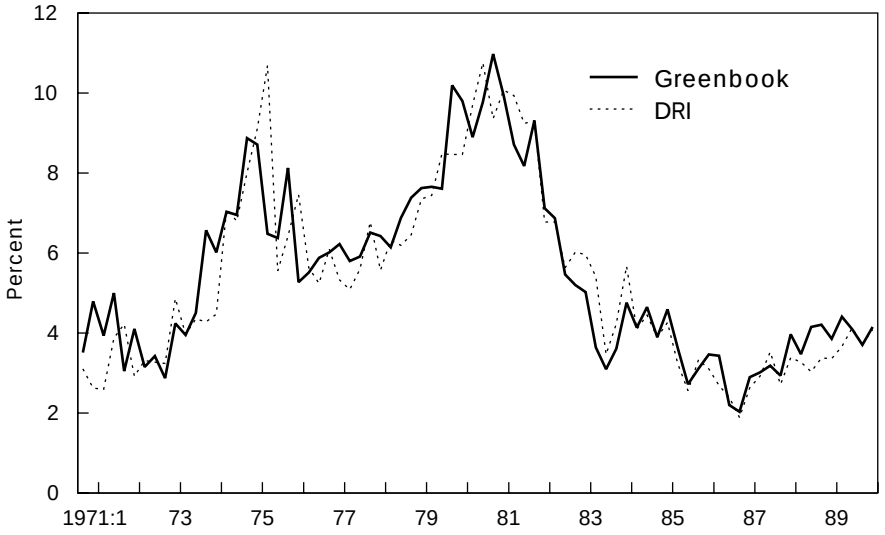
Figure 4 plots Livingston Survey forecasts of four-quarter CPI inflation. It also plots the Michigan four-quarter mean forecasts of CPI inflation made in the same month and, beginning in 1978, the median forecasts as well. Although the Livingston and Michigan series move together, the Livingston series regularly lies below the Michigan series until 1980. From 1982 through the middle of 1988, the Livingston and Michigan mean forecasts are close. Thereafter, the mean of the Michigan forecast lies above the Livingston forecast. Over the period starting with the November survey of 1967 and ending with the May survey of 1994, the standard deviation of the difference in the Michigan (mean value) predictions and the Livingston predictions is 1.1 percent.

We maintain that the broad underlying similarity among the series examined above indicates that they capture movements in the public's expectations of inflation. Of course, as indicated by the discrepancies in inflation forecasts among the series, individual observations from a particular series are only rough estimates of the consensus view of expected inflation that shapes the behavior of market rates. Nevertheless, we believe the real rate series contained in Table 1, which are constructed from Greenbook and DRI inflation forecasts, do capture the general behavior of the short-term real rate of interest.

4. COMPARING PREDICTED AND ACTUAL INFLATION

Two characteristics of the various inflation forecasts examined above warrant close scrutiny. First, through the 1970s, the inflation forecasts generally fall short of subsequently realized inflation. These persistent forecast errors could

Figure 2 Greenbook's and DRI's Inflation Predictions



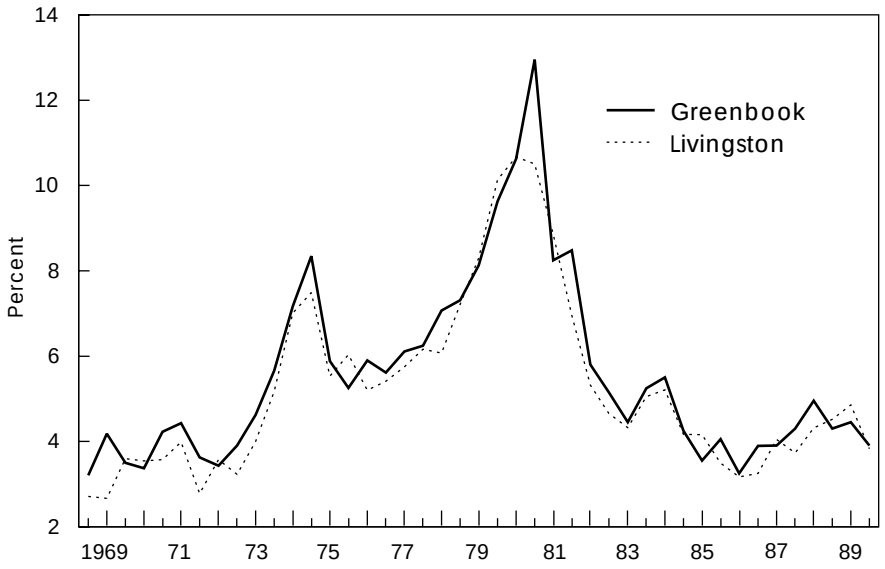
Notes: Observations of predicted inflation are from Greenbooks for February, May, August, and November FOMC meetings and are of the annualized quarterly percentage change in the GNP price deflator for the subsequent quarter. DRI predictions are from DRI publications with the same monthly date as the Greenbook.

indicate a defect in the survey data on expected inflation. Second, the forecasts do have some predictive power. That is, they perform more accurately than naive forecasts that simply employ past observations of inflation to predict future inflation. This latter characteristic, however, is not a necessary property of forecasts. The process generating inflation could be such that predicting inflation is simply very hard.

Figure 5 compares quarterly predictions of CPI inflation over future four-quarter periods from the Michigan Survey with the subsequently realized CPI inflation. It illustrates the persistent underprediction of inflation over much of the period shown. The Michigan Survey respondents underpredict inflation except during the early 1970s, the mid-1970s, the mid-1980s, and the early 1990s. They underpredict inflation whenever inflation rises. From 1973 through 1981, the average underprediction is 1.6 percentage points. (The standard deviation of the prediction errors is 2.3 percent.) This pattern of errors in predicting inflation is similar for the other sources—Greenbook, DRI, and Livingston. From 1966 to 1981, the Livingston Survey underestimates inflation by 1.8 percentage points on average. (The standard error of the forecast errors is 2.1 percent.)

In evaluating the Greenbook forecasts, we use forecasts of one-quarter-ahead (nominal output deflator) inflation made for FOMC meetings held in

Figure 3 Greenbook's and Livingston's Two-Quarter Inflation Predictions



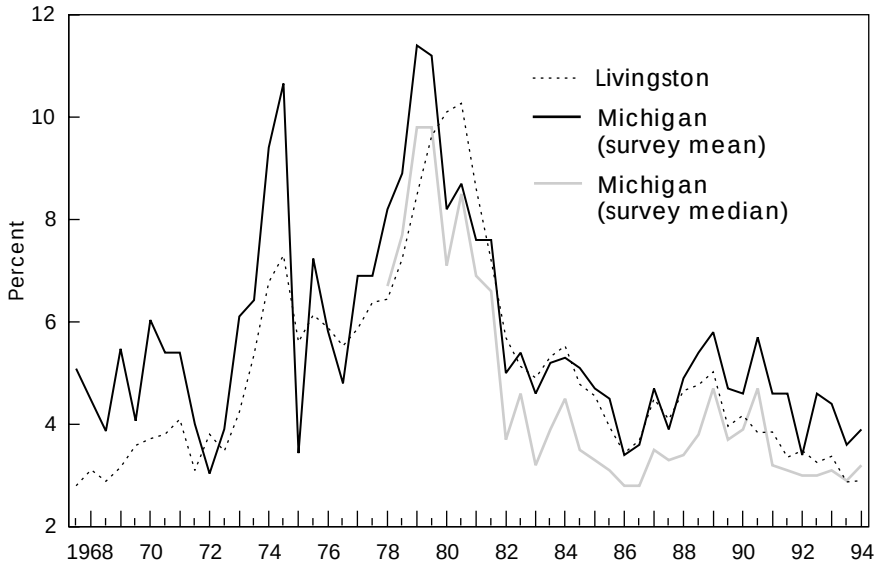
Notes: Greenbook predictions of inflation are for the GNP implicit price deflator before 1980 and for the CPI thereafter. Livingston predictions are for the CPI. The tall tick marks correspond to May Greenbook predictions of the annualized inflation rate for the last two quarters of the year. Tall tick marks also correspond to Livingston predictions of the annualized inflation rate for the eight-month period ending December and are from the June release. The short tick marks correspond to the December Greenbook predictions of the annualized inflation rate for the first two quarters of the following year. Short tick marks also correspond to Livingston predictions of the annualized inflation rate for the eight-month period ending in June and are from the December release.

February, May, August, and November (Figure 2). In general, from 1966 through 1981, subsequently realized inflation exceeds predicted inflation. During this period, the Greenbook underpredicts inflation by 1.1 percentage points on average. (The standard deviation of the one-quarter-ahead prediction errors is 1.6 percent.) In 1982, actual inflation falls below predicted inflation. The predictions are then fairly accurate from 1983 through 1989. For the corresponding DRI forecasts, from 1970Q3 through 1981Q4, the average underprediction is 1.2 percentage points and the standard deviation of the one-quarter-ahead prediction errors is 2.4 percent.[2]

One way to assess whether the forecasts shown in Figure 2 have predictive value is to compare them with naive forecasts made by simply extrapolating

[2] The actual inflation series changes over time as nominal and real output are rebenchmarked and as seasonal factors change. The original forecasts, therefore, were for a somewhat different inflation series than the one to which they are compared here.

Figure 4 Michigan's and Livingston's Inflation Predictions

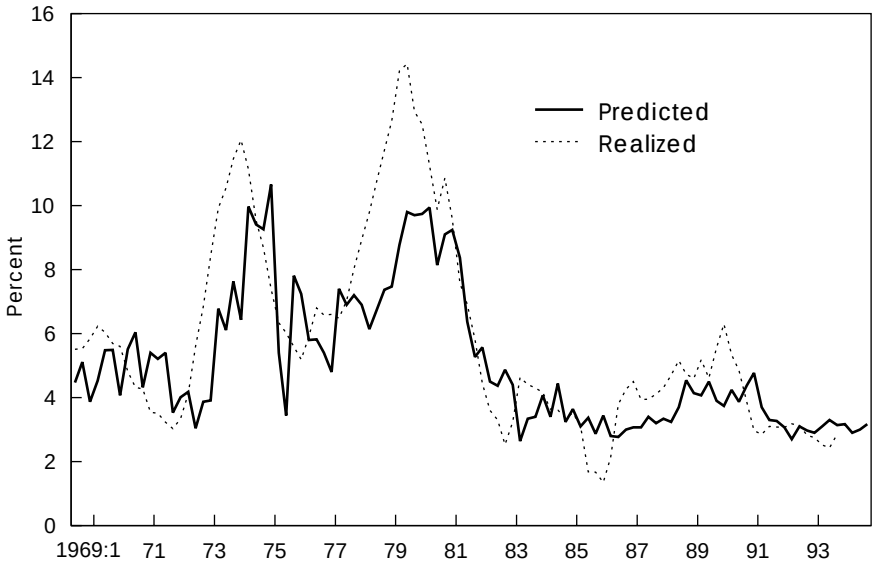


Notes: Observations of predicted CPI inflation are for the subsequent four-quarter period. The Livingston Survey was conducted in May and November. Its forecasts are matched with Michigan Survey of Consumers forecasts also made in the months of May and November. Michigan forecasts are the mean (black line) and the median (grey line) of respondents' forecasts. The median is available only starting in 1978. Tall tick marks indicate first observation of the year.

past inflation. Accordingly, we use the inflation rate from the quarter prior to the quarter in which the inflation forecast was made as a simple benchmark forecast. For the period 1966 through 1981, if the Greenbook's *forecast* of (GNP deflator) inflation for the subsequent quarter is replaced with the past quarter's *actual* inflation rate, the correlation with subsequently realized inflation is 0.63. For this period, the correlation between the Greenbook predictions of inflation and subsequently realized inflation is 0.79. This latter correlation represents an improvement of 25 percent over the naive prediction made using the prior quarter's actual inflation figure. For the period 1982Q1 to 1994Q2, the correlation between the prior quarter's inflation rate and the subsequently realized inflation rate is 0.42, while the correlation between the predicted and subsequently realized inflation rate is 0.62, an improvement of 48 percent.

In evaluating the DRI predictions, as with the Greenbook, we use forecasts of one-quarter-ahead (nominal output deflator) inflation dated as of February, May, August, and November. (The forecasts were made at the end of the preceding month.) For the period 1973Q1 through 1981Q4, the correlation between the naive prediction (using the actual inflation rate two quarters in the past) and

Figure 5 Michigan's Inflation Predictions and Realized Inflation



Notes: Observations of predicted inflation are from the Survey of Consumers conducted by the Survey Research Center of the University of Michigan. Before 1978, predicted inflation consists of quarterly observations of the mean inflation rate predicted by respondents. From 1978 on, observations are quarterly averages of monthly observations of the median inflation rate predicted by respondents. Observations of actual inflation are the subsequently realized annual percentage changes in the CPI (all urban consumers).

subsequently realized inflation is 0.49, while the correlation between predicted and subsequently realized inflation is 0.60, an improvement of 22 percent.[3]

5. IS THERE A BETTER WAY TO ESTIMATE THE REAL RATE?

Empirical work on the real rate of interest divides two groups. In one group, researchers use survey data to measure expected inflation. They regress the observed market rate of interest on a proxy for expected inflation derived from survey data (almost invariably the Livingston Survey) and on a collection of variables believed to be determinants of the real rate (government deficit, price of oil, etc.). Makin (1983) and Mehra (1985) represent examples of this methodology. Researchers in the other group assume that expected inflation

[3] For the same period, the Greenbook's average underprediction is 1.0 percentage points and the standard deviation of the one-quarter-ahead prediction errors is 1.9 percent. The correlation between predicted and subsequently realized inflation is 0.72.

equals subsequently realized inflation plus a white-noise error term. They use subsequently realized inflation over the relevant forecast period as a proxy for expected inflation (see Fama [1975]).

Researchers in the latter group use the ex-post real rate of interest (the market rate minus subsequently realized inflation) as a noisy measure of the ex-ante real rate. Using either a time-series or a structural model of the real rate, they then often fit a regression explaining this ex-post real rate. Then they use the fitted parameters of the model to generate a less noisy, smoother series for the real rate. For example, Antoncic (1986) generates estimates of the real rate by assuming the real rate is a random walk. (See also Garbade and Wachtel [1978] and Fama and Gibbons [1982].) Huizinga and Mishkin (1986) generate estimates of the real rate by assuming it can be represented as a linear combination of variables, that is, as a distributed lag of ex-post real rates, inflation rates, and the price of energy. (See also Bonser-Neal [1990].)

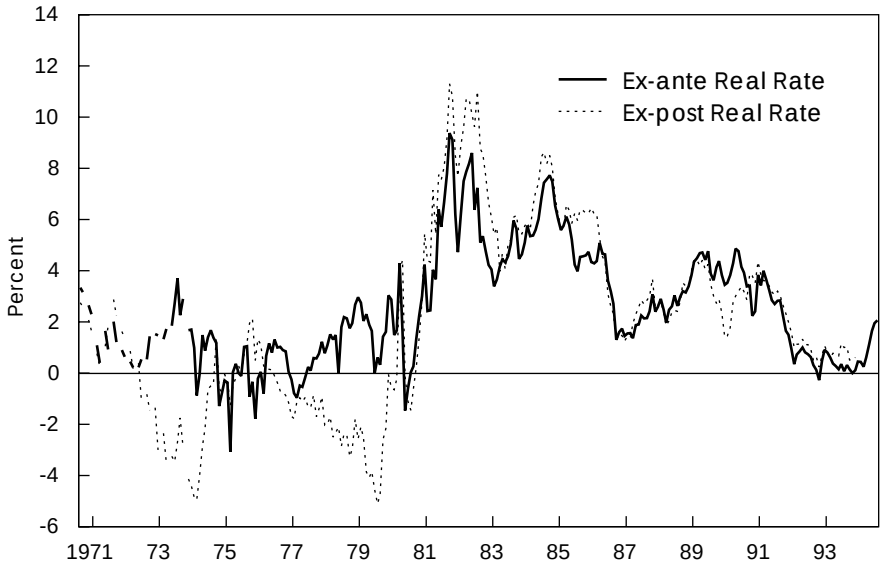
The approaches used by each group yield quite different measures of real rates over the earlier and latter parts of the 1970s.[4] Figure 6 plots a one-year real rate calculated as the difference between the one-year Treasury bill rate and predictions of four-quarter CPI inflation from DRI. It also plots the realized real rate for the corresponding four-quarter period, that is, the one-year bill rate minus the subsequently realized inflation rate. The increases in the rate of inflation that began in 1973, 1977, and, to a lesser extent, 1989 are associated with a realized real rate significantly less than the real rate calculated using inflation forecasts. Conversely, when inflation falls starting in 1981, the realized real rate lies well above the predicted real rate.

Researchers in the second group discussed above justify their use of realized inflation as an unbiased measure of expected inflation through the assumption of rational expectations. Specifically, they assume that participants in financial markets understand the nature of the monetary regime that generates inflation. The assumption of rational expectations, together with the assumption that individuals make efficient use of information, implies that forecast errors, apart from special cases, will not exhibit persistent bias. Because measures of expected inflation derived from survey data persistently underpredict inflation through the end of the 1970s, they fail to meet the requirements set by this second group.

A variant of the rational expectations approach is to assume that the public understands the time-series behavior of inflation. One can then use past observations of inflation to recreate the public's predictions of inflation. (For an interesting application, see Choi [1994].) Under the assumption that inflation is an autoregressive process, we regress inflation on its lagged values to generate

[4] The issue of which approach generates better measures of the real rate will be settled only when a consensus develops over the validity of a structural model of the real rate. The predictions of that model can then be compared with the alternative empirical measures of the real rate.

Figure 6 DRI's Ex-ante Real Rate and the Ex-post Real Rate



Notes: The one-year real ex-ante rate is the Salomon Brothers one-year government bond yield read from a yield curve minus four-quarter predicted CPI inflation from DRI publications. The bond yield is for the last working day of the month. Observations are dated as of the subsequent month. If that month is the first or second month of a quarter, the quarter in which that month falls is the first quarter used in the four-quarter inflation forecast. If that month is the third month of a quarter, the subsequent quarter is the first quarter used in the four-quarter inflation forecast. No observation is plotted in cases in which the DRI forecast was unavailable. The ex-post one-year real rate is the bond yield minus the subsequent four-quarter CPI inflation rate. Tick marks indicate first observation of the year.

predictions of inflation. Equation (1) is a regression of contemporaneous (implicit GNP deflator) inflation on its three lagged values for the period 1966Q1 to 1979Q4.

$$\pi_t = 0.45\pi_{t-1} + 0.31\pi_{t-2} + 0.24\pi_{t-3} + \hat{u} \qquad (1)$$

$\overline{R}^2 = 0.32$ SEE $= 1.96$ DW $= 2.0$ Degrees of Freedom $= 50$

We employ regressions like (1) to generate inflation forecasts whose predictive accuracy can be compared to the Greenbook and DRI predictions displayed in Figure 2.

The forecasts of Figure 2 were made close to the middle of a quarter (February, May, August, and November) and were for the succeeding quarter. For example, the prediction of 1970Q4 inflation shown in Figure 2 was made by the Board staff in the August 12, 1970, Greenbook and by DRI at the end of July. At the time these predictions were made, the forecasters would have just received GNP data for the preceding quarter, 1970Q2. We therefore conduct the comparison as follows.

To begin, we regress inflation on its three lagged values over the period 1966Q1 to 1970Q2.[5] We then use this regression to forecast inflation for 1970Q3. Next, we substitute the resulting prediction for 1970Q3 and the realized inflation rates for 1970Q2 and 1970Q1 into the regression equation to obtain a prediction of inflation for 1970Q4. This predicted value is comparable to the Greenbook and DRI predictions of one-quarter-ahead inflation made in 1970Q3 for 1970Q4 and shown in Figure 2: all three predictions use data for the period predating 1970Q3. We repeat this procedure for each quarter through 1980Q4. That is, we run a series of rolling regressions, each of which starts in 1966Q1, with each successive regression containing one additional quarter.

The resulting comparison of forecast errors highlights the Board staff's and DRI's persistent underprediction of inflation through the 1970s (see Cullison [1988]). From 1970Q3 through 1980Q4, Greenbook and DRI forecasts underestimate inflation by 1.3 percent and 1.6 percent on average, respectively, while the time-series forecasts slightly overestimate inflation by -0.2 percent. The time-series predictions, however, are not superior on all dimensions. The sum of the squared errors of the predictions from 1970Q3 to 1980Q4 is lower for the Greenbook than for the autoregressive predictions, 171 compared to 204 (267 for DRI). Also, the autocorrelation in the Greenbook and DRI forecast errors is negligible, while the autocorrelation in the autoregressive predictions is 0.4.

We conduct one final test in the spirit of the rational expectations literature to see whether Greenbook forecasts made efficient use of information. We calculate the correlation between the forecast errors of one-quarter-ahead inflation (derived again from the series shown in Figure 2) and the figure for the most recently available rate of growth of GNP as of the date of the forecast. (The latter figure is taken from the Greenbook.) It seems likely that when the rate of growth of GNP was high, the Board staff would underestimate inflation, and vice versa. In this event, the correlation between forecast errors and GNP growth would be positive. However, the correlation is in fact negligible (-0.03). In this case, the Board staff was making efficient use of available information.

6. WHY THE PERSISTENT FORECAST ERRORS?

We maintain that the underprediction of inflation exhibited by survey data reflected the long period of time required for the public to realize that the process generating inflation under the prior commodity and Bretton Woods monetary standards had disappeared irrevocably. (See Caskey [1985] for a thorough

[5] We choose 1966 as a starting date under the assumption that as of this date the FOMC no longer conducted monetary policy subject to constraints imposed by the Bretton Woods system. We choose the end date on the basis of when DRI predictions become available.

exposition of this view.) Before World War II, the quantity of money had been determined through fixing its value in terms of gold or silver. After World War II, the United States was part of the Bretton Woods system, which mimicked the international gold standard. Under the Bretton Woods system, the Federal Reserve maintained a dollar price of gold. In order to maintain the reserves necessary to peg the price of gold, the Fed had to respond to reserve outflows by raising rates, just as central banks had responded to gold outflows under the gold standard.

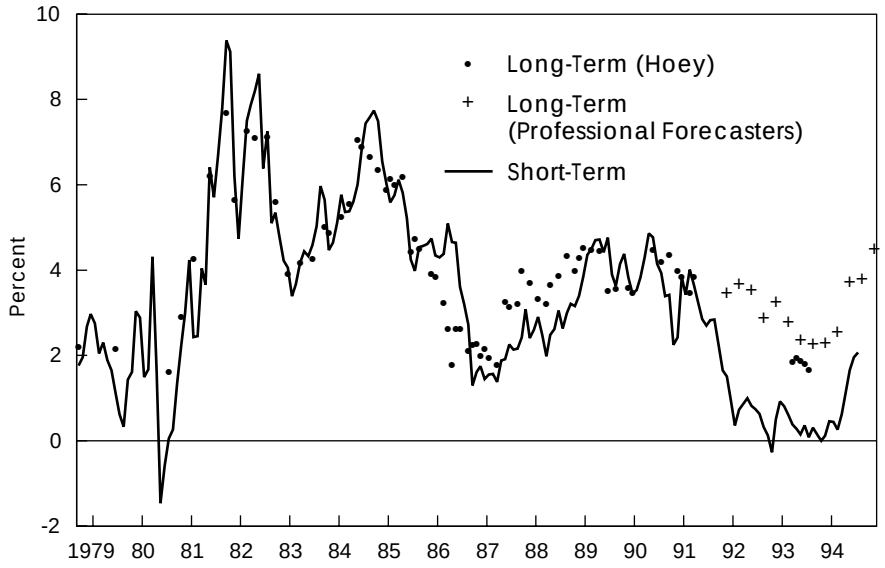
After the mid-1960s, the monetary regime changed to a pure fiat money regime. In 1968, Congress eliminated the gold cover on Federal Reserve notes. With the closing of the gold window in August 1971, the last vestigial, institutional relationship tying the value of the dollar to the value of a commodity disappeared. Under the new fiat money regime, there were no institutional arrangements to tie down the inflation rate. Moreover, monetary policy from the mid-1960s until the end of the 1970s was unique in the history of the United States through the emphasis placed on controlling growth of real output and unemployment. As a consequence, the character of the process generating inflation changed. The level of the inflation rate began to move randomly instead of reverting to a low average value.

Given that prior to World War II the United States had been on a commodity standard for all of its history apart from wars and that the Bretton Woods system replaced the gold standard after the War, it is no surprise that the public required some time in order to understand that “high and rising” inflation would not necessarily entail subsequent reductions in inflation. Furthermore, because of the particular historical circumstances surrounding the appearance of inflation, the public was slow to develop an understanding of the new, nonstationary character of inflation. Inflation surged first in conjunction with the Vietnam War. Inflation in wartime had been the historical norm, however. Inflation then surged after two oil-price shocks, one in 1973 and one in 1978. Given the association of inflation with these real shocks, the public required considerable time to realize that changes in the inflation rate were likely to be persistent rather than transitory.

7. WHAT IS THE NORMAL LEVEL OF THE REAL RATE?

What is the average level of the real rate of interest? Before examining this question, we would like to know to what extent generalizations about the short-term rate of interest carry over to the long-term rate of interest. Figure 7 displays a ten-year real rate constructed using forecasts from two surveys of ten-year expected inflation. The initial forecasts are from a survey conducted by Richard Hoey. The first observation in this series is for September 1978. Hoey conducted

Figure 7 Long-Term and Short-Term Real Rates



Notes: The long-term real rate is the ten-year bond yield minus the predicted ten-year inflation rate from the "Decision Makers Poll" conducted in the 1980s by Richard B. Hoey (for Warburg, Paribus, Becker; Drexel, Burnham, Lambert; and Barclay's de Zoete Wedd). The Hoey Survey was discontinued in March 1991, but was reinstated by Cowens Investment Strategy for five months beginning in March 1993. Starting in October 1991, the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia (formerly conducted by the American Statistical Association and the National Bureau of Economic Research) began to collect data in its quarterly survey on expected CPI inflation for a ten-year horizon. The long-term real rate is calculated using both series whenever possible. Observations of the long-term real rate are matched with monthly observations on the short-term real rate calculated as the difference between Salomon Brothers one-year government bond yields and DRI predictions of four-quarter CPI inflation. Tick marks indicate first observation of the year.

his survey only intermittently before 1981. He conducted it more frequently starting in 1983 and discontinued it in March 1991. Cowens Investment Strategy conducted the survey again for five months in 1993. Toward the end of 1991, in its quarterly Survey of Professional Forecasters, the Federal Reserve Bank of Philadelphia began to collect predictions of CPI inflation over future ten-year intervals. This latter series fills in most of the missing observations from the Hoey Survey, although the observations are less frequent.

Figure 7 also plots the DRI one-year real rate from Figure 6. For the period 1978 to 1991, short- and long-term rates are quite close.[6] From July 1980 through March 1991, the long-term real rate averages 4.25 percent, while

[6] For the period shown in Figure 7, the standard deviation of the one-year real rate (2.2) is slightly higher than that for the Hoey long-term real rate series (1.5).

the short-term real rate averages 4.3 percent. With the sharp fall in short-term market rates in 1991, however, long-term and short-term real rates diverge. From November 1991 through August 1994, the long-term real rate averages 3.0 percent, while the short-term real rate averages only 0.63 percent. This divergence suggests that statements about the behavior of the short-term real rate of interest do not necessarily carry over to the behavior of the long-term rate of interest.

From November 1965 through the end of 1993, the mean of the Treasury bill real rate calculated using Greenbook inflation forecasts (the series shown in Figure 1) is 2.3 percent.[7] As a check on this figure, we calculate a semiannual, one-year Treasury bill real rate using inflation forecasts from the Livingston Survey for the period June 1951 through June 1965. The mean of this series is 2.1 percent, which lies close to the first estimate.[8] Trehan (1995) calculates the realized real rate on one-year Treasury bonds as 1.8 percent over the period 1954 to 1993.

The real rate, however, is variable over time. From November 1965 to June 1974, the Greenbook Treasury bill real rate is 1.6 percent. It falls to −0.38 from July 1974 to September 1978. It then begins to rise and is 1.1 percent from October 1978 to October 1979. From November 1979 to October 1990, the real rate averages 4.3 percent. It reaches its maximum value of 9.7 percent in May 1981. The DRI one-year Treasury bill real rate, whose monthly observations are shown in Figure 6, falls in the 1990s, to 2.1 percent over the interval November 1990 to June 1992 and then to 0.5 percent over the interval July 1992 to the end of 1993.

8. CONCLUDING COMMENTS

We have examined four sources of short-term inflation forecasts: the Greenbook issued by the staff of the Board of Governors before FOMC meetings, the DRI monthly publication *Review of the U.S. Economy,* the semiannual Livingston Survey, and the Survey of Consumers conducted by the Survey Research Center of the University of Michigan. The inflation forecasts in these series can diverge significantly for individual observations and moderately over extended periods.

[7] The standard deviation of the real rate is somewhat lower than for the nominal rate. From November 1965 to July 1979, the standard deviation of the one- to two-quarter Greenbook real Treasury bill rate shown in Figure 1 is 1.3, while the standard deviation of the nominal bill rate is 1.6. The corresponding figures for the period August 1979 through July 1994 are 2.1 and 3.4.

[8] We use the one-year Treasury bill rate from Salomon Brothers' "Analytical Record of Yields and Yield Spreads." From 1951 through 1958, the bill rate is for mid-month. For this period, in matching the Livingston inflation forecasts, we use the Treasury bill rate from May and November. From 1959 through June 1965, the bill rate is for the first of the month. For this period, we use an average for May and June and also for November and December.

Nevertheless, they display the same broad patterns. We conclude that these series can be used to construct measures of the real rate of interest. The average short-term real rate on Treasury bills is about 2 percent. The real rate exhibits considerable variation, however, and at times has remained considerably above or below the 2 percent norm.

DATA APPENDIX

Sources of Inflation Forecasts

1. The Greenbook, formally titled "Current Economic and Financial Conditions," is prepared by the staff of the Board of Governors of the Federal Reserve System and is circulated prior to FOMC meetings. Part 1 of the Greenbook, "Summary and Outlook," has made forecasts for nominal and real output and the implicit output deflator since November 1965. Since 1980, the Greenbook has also made predictions for CPI inflation. Greenbooks remain confidential for five full calendar years after the year in which they were published.

Initially, Greenbook forecasts were entirely judgmental. The Board staff first made a forecast using a large-scale econometric model in May 1969, although model forecasts did not influence the Greenbook forecasts until the early 1970s. Since the early 1970s, Greenbook forecasts have made use of a judgmental forecast and a model forecast. Senior staff decide how to weight these two kinds of forecasts in the combined forecast that appears in the Greenbook. Once a combined forecast for nominal and real GNP is arrived at, the equations in the staff's econometric model are adjusted to produce the combined forecast. This adjusted model is then estimated to provide consistent forecasts of the various components of the National Income and Product Accounts.

2. The DRI/McGraw-Hill monthly publication *Review of the U.S. Economy* publishes quarterly forecasts of CPI and implicit GNP deflator inflation. Forecasts are taken from the table "Quarterly Summary for the U.S. Economy—Control." We have issues of the DRI *Review* starting in March 1973. (We are indebted to John Caskey for these issues. We are indebted to Steve McNees and Delia Sawhney of the Boston Fed for the earlier observations.)

3. Begun in 1947 by Joseph Livingston, the Livingston Survey is currently conducted by the Federal Reserve Bank of Philadelphia. Twice annually (in June and December) the Philadelphia Fed asks about 50 business economists for their forecasts of the level of the CPI at six- and twelve-month horizons. The forecasts of inflation in the article follow Carlson (1977). Carlson notes that the December survey is mailed early in November when respondents have available the October CPI. The respondents forecast the level of the CPI for the following June. The forecast of inflation, therefore, is assumed to be the

annualized rate of growth of the CPI over the eight-month period from October to June. Similarly, the inflation forecast based on the forecasted December level of the CPI for the following year is assumed to be the annualized rate of growth of the CPI over the 14-month period ending in December of the following year.

4. The Survey of Consumers conducted by the Survey Research Center of the University of Michigan includes questions on expected price changes in the following 12 months. The survey consists of a random telephone sample of 500 or more individuals and asks the questions "During the next twelve months, do you think prices in general will go up, or go down, or stay where they are now?" and "By about what percent do you expect prices to go up, on the average, during the next twelve months?" The survey begins in 1946, but quantitative estimates of the predicted inflation rate are continuously available only since May 1968. Before 1978 the survey is quarterly; thereafter, it is monthly. The mean of the individual survey responses is available from 1966 to the present. The mean and median are available from 1978 to the present.

5. Richard B. Hoey in "Decision Makers Poll" conducted irregularly timed surveys of inflation expectations when he worked for Bache, Halsey, Stuart & Shields; Warburg, Paribus, & Becker; Drexel, Burnham, Lambert; and Barclays de Zoete Wedd Research, respectively. The first ten-year inflation forecast is from September 1978. The survey begins collecting shorter-term (approximately one-year) forecasts in October 1980. The number of respondents varies between 175 and 500 and includes chief investment officers, corporate financial officers, bond and stock portfolio managers, industry analysts, and economists. The survey dates are the dates on which the polls were mailed to Hoey. The survey was discontinued in March 1991, resumed in March 1993, and ended again definitively in August 1993.

6. The Survey of Professional Forecasters was first conducted by the American Statistical Association and National Bureau of Economic Research in 1968Q4. It is currently conducted quarterly by the Federal Reserve Bank of Philadelphia. In 1981Q3, the survey begins collecting forecasts of four-quarter rates of CPI inflation. In 1991Q4, it begins to collect forecasts of CPI inflation over the next ten years.

Constructing the Real Rate Series

Greenbook Real Rate Series

a) Real rate series of one- to two-quarter maturity calculated as the difference between the Treasury bill rate and expected inflation measured by the implicit output deflator—Table 1, column (4)

This series is shown in Figure 1. It is calculated as the difference between the Treasury bill yield and predicted inflation from the Greenbook. Inflation is

for changes in the implicit GNP (GDP from 1992 on) deflator. A weighted-average inflation rate for the period from the Greenbook date to the end of the succeeding quarter is calculated from the Greenbook's inflation forecasts for the current and succeeding quarters. The weight given to the current quarter's inflation rate is the ratio of the number of days left in the current quarter to the number of days from the Greenbook date until the end of the succeeding quarter. The weight given to the succeeding quarter's inflation rate is the ratio of the number of days in that quarter to the number of days from the Greenbook date until the end of the succeeding quarter. This weighted-average expected inflation rate is subtracted from the Treasury bill yield. The Treasury bill yield is for the date the Greenbook appeared and is for the bill maturing on the last working day of the succeeding quarter. It is copied from the Federal Reserve Bank of New York's daily release "Composite Quotations for U.S. Government Securities." (For August 1972, the Treasury bill yield is for January 4, 1973, instead of December 31, 1972.)

In the 1960s, the FOMC usually met more than 12 times per year. For example, it met 15 times in 1965. In order to make the real rate series monthly through 1978, we record an observation for only the first FOMC meeting of the month for those months in which there was more than one meeting. The FOMC met only nine times in 1979. (Because the October 6, 1979, meeting was unscheduled, there was no Greenbook and no real rate is calculated for this date.) It met 11 times in 1980. Starting in 1981, it has met eight times a year. For this reason, starting in 1979, the observations of the Greenbook real rate series are less frequent than monthly.

The real rate series begins in November 1965 because the Greenbook first began to report predictions of inflation for the November 1965 meeting. Until November 1968, for FOMC meetings in the first two months of a quarter, the Greenbook often reported a forecast of inflation for only the contemporaneous quarter. For this reason, for the following FOMC meeting dates, the real rate calculated is for the period only to the end of the contemporaneous quarter, not to the end of the succeeding quarter: 11/23/65, 1/11/66, 2/8/66, 4/12/66, 5/10/66, 6/7/66, 7/26/66, 11/1/66, 12/13/66, 1/10/67, 7/18/67, 10/24/67, 11/14/67, 1/9/68, 2/6/68, 4/30/68, 5/28/68, 7/16/68, 10/8/68, 10/17/72, and 11/21/72. For these dates, the maturity of the Treasury bill used to calculate the real rate varies between one and three months. For other dates, the maturity varies between three and six months. For this reason, some of the variation in real rates reflects term-structure considerations. This variation is a consequence of the fact that the FOMC meets at different times within a quarter and the Greenbook inflation forecasts are for the quarters of the year.

b) Real rate series of one- to two-quarter maturity calculated as the difference between the commercial paper rate and expected inflation measured by the implicit output deflator—Table 1, column (5)

This series is calculated like the one above except that the interest rate is the commercial paper rate for prime paper placed through dealers. Observations are matched with the publication dates of the Greenbook. From 1965 through 1969, rate data are from the New York Fed release "Commercial Paper." Subsequently, they are from the Board's FAME database. From 1965 through April 1971, the paper rate is for four- to six-month paper. Thereafter, if there are fewer than 135 days from the Greenbook date to the end of the subsequent quarter, the three-month paper rate is used; otherwise, the six-month paper rate is used.

DRI Real Rate Series

a) Real rate series of one- to two-quarter maturity calculated as the difference between the Treasury bill rate and expected inflation measured by the implicit output deflator

This series is shown in Figure 1. It is calculated like the Greenbook series discussed above except for the substitution of predictions of (implicit GDP deflator, GNP before 1992) inflation from the most recent DRI *Review of the U.S. Economy* available as of the publication of the Greenbook. In order to keep the Greenbook and DRI real rate forecasts as closely comparable as possible, we keep the interest rate the same. Consequently, unlike the Greenbook forecasts, the matching between the date on which the interest rate is recorded and the date of the inflation forecast is not exact.

b) Real rate series of one-year maturity calculated as the difference between the Treasury bill rate and expected inflation measured by the consumer price index—Table 1, column (3)

This series is the difference between the one-year Treasury bill rate and the four-quarter inflation rate predicted by DRI. The one-year Treasury bill rate is from Salomon Brothers "Analytical Record of Yields and Yield Spreads" and is read from a yield curve. The yield for each month is for the last business day for the preceding month. Because the DRI forecasts for a particular "control" month are made at the end of the preceding month, the date of the interest rate and forecast are fairly closely matched.

Four-quarter predicted inflation is a geometric average of the quarterly DRI predictions of CPI inflation. When the control date on the DRI forecasts is the first or second month of the quarter, the initial quarterly inflation forecast is the one reported for the contemporaneous quarter. For example, if the control date is January or February, then the initial quarter used in constructing the inflation forecast is the first quarter of the year. If the control date is the third month of the quarter, the initial quarter used in constructing the four-quarter forecast is the inflation forecast for the subsequent quarter. For example, if the control date is March, then the initial quarter of the four-quarter forecast is the second quarter.

c) Real rate series of two-quarter maturity calculated as the difference between the Treasury bill rate and expected inflation measured by the consumer price index—Table 1, column (1)

The calculations for this series are like those for the preceding series with two changes. First, the interest rate is the six-month Treasury bill yield from Salomon Brothers. Second, the geometric average of the quarterly predictions of inflation is for two quarters.

d) Real rate series of two-quarter maturity calculated as the difference between the commercial paper rate and expected inflation measured by the consumer price index—Table 1, column (2)

The calculations for this series are like those for the preceding series with two changes. First, the interest rate is the 180-day commercial paper rate for the last working day of the month preceding the control date on the DRI forecast of inflation. Second, the geometric average of the quarterly DRI predictions of CPI inflation is for two quarters.

Hoey and Survey of Professional Forecasters Ten-Year Real Rate Series

These series are shown in Figure 7. The ten-year market rate is the ten-year Treasury constant maturity yield taken from the Federal Reserve's Statistical Release G.13, "Selected Interest Rates."

Real Rate Series

Table 1 presents five series for the real rate of interest. The first three are constructed using CPI inflation predictions from DRI. The first two are for interest rates of two-quarter maturity and the third is for one-year maturity. The first and third use the Treasury bill real rate, while the second uses the six-month commercial paper rate.[9] The last two real rate series use inflation forecasts from the Greenbook. Depending upon when the Greenbook was published within the quarter, the maturity of the real rate varies from slightly more than three months to almost six months. One series uses the Treasury bill rate and the other the commercial paper rate.

[9] In periods such as 1969–1970 and 1973–1974, when market rates were high relative to Regulation Q ceilings, disintermediation out of bank deposits apparently drove down the bill rate relative to the paper rate. Consequently, in these periods the two real rate series differ.

Table 1 Real Rate of Interest

		(1)	(2)	(3)	(4)	(5)
		DRI			Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1965	11				1.66	2.27
	12				2.1	2.34
1966	1				2.65	2.82
	2				2.22	2.32
	3				2.85	3.38
	4				2.8	3.59
	5				2.35	3.07
	6				0.9	2.16
	7				1.5	2.36
	8				1.49	2.38
	9				1.32	2.1
	10				1.27	2.67
	11				1.48	3.1
	12				2.59	3.23
1967	1	(DRI data are not available			2.71	3.84
	2	until August 1970.)			2.49	3.24
	3				2.31	3.25
	4				1.08	1.95
	5				0.98	1.9
	6				0.87	1.89
	7				0.55	1.48
	8				0.73	1.5
	9				0.69	1.45
	10				0.32	1.19
	11				0.14	1.18
	12				1.63	2.24
1968	1				1.41	2.08
	2				1.66	2.04
	3				1.16	1.73
	4				1.27	1.81
	5				1.27	2.1
	6				1.85	2.29
	7				1.27	2.28
	8				1.32	2.14
	9				1.32	1.98
	10				1.47	2.09
	11				2.23	2.49
	12				2.13	2.25
1969	1				2.95	3.1
	2				2.81	3.27
	3				2	2.96

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
		DRI			Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1969	4				1.79	2.71
	5				1.53	2.85
	6				1.61	3.43
	7				2.63	4.41
	8				2.56	4.12
	9				2.89	4.19
	10				3.82	5.23
	11				3.72	4.96
	12				3.81	4.79
1970	1				4.27	5.34
	2				3.39	4.47
	3				2.86	4.45
	4				2.01	3.66
	5				2.54	3.83
	6				2.68	4.19
	7				2.97	4.53
	8	3.75	5	3.34	2.7	4.37
	9	3.7	4.5	3.17	2.62	3.7
	10				2.25	2.83
	11	3.24	3.625	2.66	1.3	2.18
	12	2.3	2.715	2.3	0.14	0.96
1971	1				0.63	1.41
	2	1.15	1.525	1.09	−0.04	0.52
	3	−1.5	−0.84	0.41	−0.71	0.26
	4				−0.7	0.22
	5	1.1	1.8	1.65	−0.46	0.08
	6	−0.39	0.21	0.93	−0.64	0.26
	7				0.5	0.81
	8	1.25	1.11	2.02	1.4	2.62
	9	1.58	2.325	1.22	2.25	3.32
	10				1.49	2.59
	11	0.58	1.3	0.91	0.8	1.42
	12	−0.42	−0.065	0.64	0.43	1.05
1972	1				−0.46	0.03
	2	0	0.125	0.45	−0.53	0.14
	3	−1.14	−1.065	0.23	0.06	0.49
	4				0.97	1.31
	5	−0.45	−0.05	0.23	0.39	0.92
	6	−0.69	−0.39	0.54	0.45	1.05
	7				1.06	1.66
	8	−0.17	0.2	0.54	1.05	1.63

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
			DRI		Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1972	9	0.04	0.16	1.44	1.58	2.09
	10				1.85	2.57
	11	1.04	1.05	1.53	1.58	2.1
	12	0.5	0.46	1.48	1.17	1.44
1973	1				1.5	1.75
	2	0.61	0.825	1.33	1.29	1.84
	3	1	1.2	1.73	2.17	2.73
	4				2.25	2.79
	5	1.33	1.68	1.86	1.72	2.46
	6	2.42	2.7	2.73	2.44	3.16
	7	3.34	3.9	3.71	3.6	4.46
	8	1.1	2.18	2.27	2.71	4.01
	9	2.53	3.93	2.9	2.48	3.94
	10				1.63	3.33
	11	1.31	1.91	1.69	2.74	3.37
	12	0.91	1.93	1.71	0.69	2.43
1974	1	0.46	1.75	0.99	0.91	1.51
	2	−1.7	−0.95	−0.87	0.05	0.55
	3	−0.82	−0.56	−0.04	0.64	1.08
	4	0.57	1.21	1.49	2.05	2.87
	5	−0.08	1.46	0.88	0.77	3.32
	6	−0.06	1.63	1.4	0.78	3.36
	7	0.08	3.53	1.68	−0.14	4.05
	8	0.9	3.15	1.39	0.2	2.78
	9	0.17	2.13	1.17	0.18	2.92
	10	−2.82	−0.02	−1.28	−1.19	0.65
	11	−1.13	−0.37	−0.76	−1.85	−0.71
	12	0.24	1.5	−0.28	−1.5	0.13
1975	1	−1.16	0.7	−0.38	−0.67	0.2
	2	−4.17	−3.66	−3.08	−0.84	−0.2
	3	−1.4	−0.9	0.04	−0.96	−0.33
	4	−0.3	−0.07	0.36	0.27	0.39
	5	0.41	0.475	1.02	−0.66	−0.17
	6	−0.85	−0.95	−0.11	−1.33	−0.87
	7	0.67	0.73	1.03	−0.15	−0.18
	8	0.72	0.38	1.05	−0.88	−0.91
	9	−2.21	−2.65	−0.92	−2.54	−2.32
	10	−1.45	−1.82	−0.33	0.26	0.41
	11	−2.51	−2.35	−1.78	−0.06	0.24
	12	−0.63	−0.97	−0.2	0.39	0.65
1976	1	−0.5	−0.4	0.06	−0.05	0.05

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
		DRI			Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1976	2	−1.31	−1.27	−0.79	−0.24	−0.06
	3	0.45	0.05	0.62	−0.08	0.01
	4	0.95	0.65	1.16	−0.09	−0.09
	5	0.39	0.15	0.81	−0.01	−0.2
	6	0.58	0.33	1.32	0.13	0.42
	7	0.7	0.5	1.01	−0.02	0.06
	8	0.55	0.35	1.04	−0.34	−0.21
	9	0.64	0.48	0.9	−0.72	−0.55
	10	0.91	0.83	0.85	−0.66	−0.67
	11	−0.17	−0.27	0.06	−0.92	−0.91
	12	−0.19	−0.02	−0.24	−1.57	−1.26
1977	1	−0.85	−0.87	−0.78	−0.4	−0.54
	2	−2.39	−2.71	−0.96	−0.67	−0.73
	3	−1.15	−1.5	−0.47	−0.94	−0.96
	4	−1.22	−1.27	−0.52	−0.85	−0.85
	5	−0.85	−1.07	−0.16	−0.67	−0.74
	6	0.17	0.38	0.24	−1.2	−0.97
	7	−0.04	0.05	0.1	−0.94	−1.03
	8	0.57	0.15	0.6	−0.52	−0.55
	9	0.65	0.55	0.58	−0.25	−0.13
	10	0.96	0.8	0.77	0.37	0.09
	11	1.27	1.05	1.23	0.09	0.21
	12	0.25	0.18	0.78	0.01	0.36
1978	1	0.5	0.49	1.08	0.79	0.47
	2	1.1	0.92	1.52	0.5	0.53
	3	0.87	0.64	1.32	0.16	0.41
	4	0.99	0.75	1.5	0.1	0.03
	5	0.56	0.34	1.35	−0.08	0.07
	6	1.5	1.28	1.8	−0.04	0.67
	7	1.33	1.36	2.2	0.87	1.11
	8	1.47	1.63	2.14	−0.23	0.62
	9	1.63	1.61	1.76	0.86	1.37
	10	2.02	1.94	1.96	1.55	1.73
	11	2.39	2.05	2.68	1.41	3
	12	2.42	2.92	2.97	1.38	2.45
1979	1	1.73	2.26	2.75	1.79	2.17
	2	1.38	1.55	2.05		
	3	1.69	1.64	2.3	−0.23	0.05
	4	1.35	1.06	1.89	2.28	2.2
	5	0.59	0.48	1.65	1.88	2.01
	6	0.33	0.25	1.15		

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
			DRI		Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1979	7	−0.23	−0.08	0.62	−0.12	0.12
	8	−0.38	−0.24	0.33	0.36	0.7
	9	0.92	1.46	1.43	1.04	2.11
	10	0.5	1.34	1.61		
	11	1.76	2.98	3.04	3.08	3.98
	12	2.42	2.54	2.89		
1980	1	1.58	1.5	1.49	3.86	3.67
	2	1.39	1.36	1.67	4.48	4.53
	3	2.77	2.44	4.31	6.81	7.21
	4	−1.21	−0.24	1.63	3.51	5.05
	5	−4.7	−3.91	−1.46	−1.29	−0.5
	6	−0.67	−0.51	−0.59		
	7	0.3	0.2	0.05	−1.08	−0.96
	8	0.11	−0.52	0.26	−0.45	0.69
	9	1.06	1.02	1.34	−0.46	0
	10	1.76	2.23	2.24	1.33	1.78
	11	2.13	1.89	3	3.3	3.6
	12	4.51	4.36	4.24	6.62	9.04
1981	1	2.37	2.47	2.43		
	2	2.35	2.74	2.45	5.67	5.36
	3	4.14	3.68	4.04	4.68	4.67
	4	3.78	3.73	3.66		
	5	6.6	6.06	6.41	9.71	9.39
	6	6.34	6.86	5.71		
	7	6.96	7.13	6.69	7.62	7.48
	8	7.47	7.55	7.8	7.95	7.97
	9	9.75	8.74	9.38		
	10	8.85	8.5	9.12	6.49	7.13
	11	5.58	5.84	6.21	4.33	4.51
	12	4.79	4.07	4.73	4.22	5.2
1982	1	6.28	6.13	6.16		
	2	7.53	7.29	7.52	6.95	6.97
	3	8.52	7.82	7.87	6.7	7.23
	4	9.07	8.85	8.2		
	5	9.8	9.67	8.6	7.54	7.49
	6	6.57	6.87	6.38		
	7	7.17	7.33	7.25	7.86	8.82
	8	4.02	4.75	5.1	3.4	3.95
	9	4.6	5.36	5.35		
	10	3.92	5.06	4.77	2.5	4.67
	11	4.7	4.72	4.22	2.97	3.45

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
			DRI		Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1982	12	3.65	3.34	4.06	3.31	3.9
1983	1	3.25	3.33	3.39		
	2	3.58	3.3	3.67	4.66	4.62
	3	4.53	4.15	4.16	4.36	4.33
	4	4.6	4.32	4.44		
	5	4.52	4.28	4.33	5.36	5.25
	6	4.43	3.94	4.59		
	7	4.68	4.39	5.03	6.04	6.07
	8	5.62	5.06	5.97	6.12	5.98
	9	5.15	4.7	5.65		
	10	3.91	3.63	4.47	5.03	4.84
	11	4.08	3.77	4.64	4.65	4.5
	12	4.51	4.02	5.11	4.61	4.91
1984	1	5.62	5.34	5.77		
	2	5.25	4.87	5.36	4.95	4.66
	3	4.94	4.5	5.38	6.02	5.98
	4	5.32	5.04	5.61		
	5	5.8	5.54	6.01	6.15	6.61
	6	5.9	5.88	6.84		
	7	6.3	6.5	7.44	6.75	7.17
	8	7.32	7.16	7.58	7.05	7.5
	9	7.39	7.14	7.74		
	10	7.14	6.76	7.49	6.41	6.54
	11	5.98	5.8	6.55	5.39	5.39
	12	5.59	5.24	6.03	4.06	4.3
1985	1	5.04	4.72	5.59		
	2	5.28	4.83	5.75	4.71	4.6
	3	5.86	5.71	6.12	5.66	5.89
	4	5.43	5.26	5.81		
	5	4.95	4.78	5.22	5	5.17
	6	4.15	4.12	4.25		
	7	3.81	4.04	3.98	4.37	4.48
	8	4.53	4.63	4.54	4.36	4.77
	9	4.28	4.24	4.57		
	10	4.37	4.6	4.61	4.36	5.02
	11	4.61	4.65	4.74	4.07	4.28
	12	3.98	4.09	4.34	3.4	3.92
1986	1	4.21	4.41	4.3		
	2	4.53	4.71	4.38	3.72	3.97
	3	5.8	5.88	5.09		
	4	5.24	5.69	4.66	3.7	4.26

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
			DRI		Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1986	5	5.66	5.72	4.64	4.16	4.4
	6	2.75	2.73	3.61		
	7	2.29	2.55	3.2	4.02	4.31
	8	2.8	2.95	2.72	3.49	3.71
	9	0.55	0.61	1.3	3.7	4.17
	10	1.04	1.18	1.61		
	11	1.24	1.31	1.75	3.38	3.63
	12	1.42	1.51	1.45	3.21	3.49
1987	1	1.34	1.51	1.55		
	2	1.24	1.2	1.57	2.89	3
	3	0.96	1.32	1.38	2.71	3.24
	4	1.74	1.83	1.88		
	5	1.38	2.17	1.91	2.62	3.6
	6	1.86	2.54	2.26		
	7	1.52	2.34	2.14	3.09	3.95
	8	1.72	2.12	2.16	3.02	3.55
	9	2	2.41	2.42	3.78	4.81
	10	2.39	3.15	3.08		
	11	1.86	3.04	2.41	2.43	3.94
	12	2.05	3.11	2.6	1.93	4.05
1988	1	2.87	3.16	2.9		
	2	2.52	2.87	2.48	2.59	3.14
	3	1.55	2.13	1.98	2.83	3.52
	4	2.26	2.66	2.48		
	5	2.34	2.78	2.62	2.81	3.51
	6	2.86	3.28	3.05	2.57	3.35
	7	2.37	2.96	2.63		
	8	2.83	3.47	2.99	3.33	4.22
	9	2.79	3.35	3.21	3.09	3.82
	10	2.9	3.32	3.16		
	11	3.13	3.52	3.4	3.55	4.02
	12	3.55	4.08	3.84	5.08	5.82
1989	1	4.08	4.24	4.36		
	2	4.41	4.53	4.5	4.64	4.98
	3	4.55	5.14	4.7	4.77	5.57
	4	4.57	5.08	4.72		
	5	4	4.52	4.42	4.6	5.21
	6	5.06	5.27	4.76		
	7	3.96	4.63	3.89	4.77	5.56
	8	3.94	4.23	3.63	4.56	4.81
	9	4.17	4.45	4.14		

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
		DRI			Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1989	10	4.31	4.65	4.38	5.02	5.71
	11	4.11	4.21	3.83	4.11	4.3
	12	3.59	3.72	3.45	3.87	4.48
1990	1	3.63	3.66	3.53		
	2	3.63	3.55	3.83		
	3	4.8	4.71	4.3		
	4	5.49	5.53	4.86		
	5	5.31	5.35	4.77		
	6	4.42	4.41	4.15		
	7	4.27	4.32	3.93		
	8	3.36	3.33	3.39		
	9	2.49	2.54	3.42		
	10	0.33	0.82	2.25		
	11	1.04	1.27	2.42		
	12	3.36	3.89	3.84		
1991	1	3.48	4.07	3.43		
	2	4.33	4.73	4.01		
	3	4.21	4.37	3.65		
	4	3.75	3.96	3.25		
	5	3.37	3.48	2.85		
	6	2.92	2.98	2.7		
	7	2.88	3.16	2.83		
	8	2.96	3.11	2.84		
	9	2.25	2.41	2.25		
	10	1.54	1.71	1.65		
	11	1.43	1.54	1.51		
	12	0.74	1.04	0.97		
1992	1	0.29	0.5	0.36		
	2	0.79	0.86	0.73		
	3	0.72	0.84	0.86		
	4	0.86	0.92	1		
	5	0.51	0.59	0.82		
	6	0.51	0.57	0.74		
	7	0.32	0.5	0.63		
	8	0.08	0.19	0.32		
	9	−0.01	0.11	0.13		
	10	−0.57	−0.26	−0.27		
	11	0.15	0.3	0.5		
	12	0.88	1.17	0.92		
1993	1	0.89	1.01	0.81		

Table 1 Real Rate of Interest (Continued)

		(1)	(2)	(3)	(4)	(5)
			DRI		Greenbook	
Year	Month	Two-Quarter T-bill	Two-Quarter Commercial Paper	One-Year T-bill	One- to Two-Quarter T-bill	One- to Two-Quarter Commercial Paper
1993	2	0.51	0.63	0.61		
	3	0.4	0.49	0.38		
	4	0.34	0.49	0.28		
	5	0.27	0.35	0.15		
	6	0.17	0.18	0.36		
	7	−0.24	−0.05	0.08		
	8	0.13	0.23	0.31		
	9	−0.35	−0.26	0.15		
	10	−0.68	−0.52	0		
	11	−0.36	−0.33	0.12		
	12	0.14	0.21	0.46		
1994	1	0.14	0.18	0.44		
	2	−0.06	−0.03	0.26		
	3	0.2	0.39	0.62		
	4	0.61	0.84	1.12		
	5	0.99	1.15	1.66		
	6	1.35	1.45	1.96		
	7	1.12	1.32	2.07		
	8		1.84			
	9		1.96			
	10		2.48			
	11		2.63			
	12		3.07			

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