

# Error Statistics for the Survey of Professional Forecasters for 3-Month T-Bill Rate [QA,PPs]

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## 1. OVERVIEW.

This document reports error statistics for median projections from the Survey of Professional Forecasters (SPF), conducted since 1990 by the Federal Reserve Bank of Philadelphia. We provide the results in a series of tables and, in the PDF version of this document, a number of charts. The tables show the survey variable forecast and, importantly, the transformation of the data that we used to generate the statistics. (The transformation is usually a quarter-over-quarter growth rate, expressed in annualized percentage points. However, some variables, such as interest rates, the unemployment rate, and housing starts are untransformed and, thus, expressed in their natural units.)

The paragraphs below explain the format of the tables and charts and the methods used to compute the statistics. These paragraphs are general. The same discussion applies to all variables in the survey.

## 2. DESCRIPTION OF TABLES.

Table 1 reports error statistics for various forecast horizons, sample periods, and choices of the real-time historical value that we used to assess accuracy. In each quarterly survey, we ask our panelists for their projections for the current quarter and the next four quarters. The current quarter is defined as the quarter in which we conducted the survey. Our tables provide error statistics separately for each quarter of this five-quarter horizon, beginning with the current quarter (denoted  $H = 1$ ) and ending with the quarter that is four quarters in the future ( $H = 5$ ). For each horizon, we report the mean forecast error [ME(S)], the mean absolute forecast error [MAE(S)], and the root-mean-square error [RMSE(S)]. All are standard measures of accuracy, though the academic literature generally places the most weight on the latter.

We define a forecast error as the difference between the historical value and the forecast. The mean error for each horizon is simply the average of the forecast errors at that horizon, constructed over the sample period shown in Table 1. Other things the same, a forecast with a mean error close to zero is better than one with a mean error far from zero. The mean absolute error is the sample average of the absolute value of the errors. Many analysts prefer this measure to the mean error because it does not allow large positive errors to offset large negative errors. In this sense, the mean absolute error gives a cleaner estimate of the size of the errors. Decision makers, however, may care not only about the average size of the errors but also about their variability, as measured by variance. Our last measure of accuracy is one that reflects the influence of the mean error and the variance of the error. The root-mean-square error for the SPF [RMSE(S)], the measure most often used by analysts and academicians, is the square root of the the average squared error. The lower the root-mean-square error, the more accurate the forecast.

### 2.1. Benchmark Models.

The forecast error statistics from the SPF are of interest in their own right. However, it is often more interesting to compare such statistics with those of alternative, or benchmark, forecasts. Table 1 reports four such comparisons. It shows the ratio of the root-mean-square error of the SPF forecast to that of four benchmark models. The benchmark models are statistical equations that we estimate on the data. We use the equations to generate projections for the same horizons included in the survey. In effect, we imagine standing back in time at each date when a survey was conducted and generating a separate forecast with each benchmark model. We do this in the same way that a survey panelist would have done using his own model.

A RMSE ratio below unity indicates that the SPF consensus (median) forecast has a root-mean-square error lower than that of the benchmark. This means the SPF is more accurate. We now describe the benchmark models. The first is perhaps the simplest of all possible benchmarks: A no-change model. In this model, the forecast for quarter  $T$ , the one-step-ahead or current-quarter forecast, is simply the historical value for the prior quarter ( $T - 1$ ). There is, in other words, no change in the forecast compared with the historical value. Moreover, the forecast for the remaining quarters of the horizon is the same as the forecast for the current quarter. We denote the relative RMSE ratio for this benchmark as  $RMSE(S/NC)$ , using NC to indicate no change. The second and third benchmark models generate projections using one or more historical observations of the the variable forecast, weighted by coefficients estimated from the data. Such autoregressive (AR) models can be formulated in two ways. We can estimate one model to generate the forecasts at all horizons, using an iteration method to generate the projections beyond the current quarter (IAR), or we can directly estimate a new model for each forecast horizon (DAR). The latter formulation has been shown to reduce the bias in a forecast when the underlying model is characterized by certain types of misspecification. The root-mean-square error ratios are denoted  $RMSE(S/IAR)$  and  $RMSE(S/DAR)$ , respectively.

The one- through five-step-ahead projections of the benchmark models use information on the quarterly average of the variable forecast. The latest historical observation is for the quarter that is one quarter before the quarter of the first projection in the horizon. In contrast, the panelists generate their projections with the help of additional information. They submit their projections near the middle of each quarter and hence have access to some monthly indicators for the first month of each quarter, when those data are released before the survey deadline. This puts the projections of panelists for some variables at an advantage relative to the corresponding benchmark projections. Moreover, the panelists may also examine the very recent historical values of such monthly indicators in forming their projections for quarterly averages. Such monthly statistical momentum represents an advantage not shared by the benchmark models, which use only quarterly averages. For survey variables whose observations are reported at a monthly frequency, such as interest rates, industrial production, housing starts, and unemployment, we estimate and forecast a fourth benchmark model, the DARM. This model adds recent monthly historical values to the specification of the DAR model. For the projections for unemployment, nonfarm payroll employment, and interest rates, we add the values of monthly observations, beginning with that for the first month of the first quarter of the forecast horizon. These values should be in the information set of the survey panelists at the time they formed their projections. In contrast, for variables such as housing starts and industrial production, we include only lagged values of monthly observations. For such variables, the panelists would not have known the monthly observation for the first month of the first quarter of the forecast horizon. In general, we find that adding monthly observations to the benchmark DAR models improves accuracy. Indeed, for the projections for interest rates and the unemployment rate, the accuracy of the benchmark DARM projections rivals that of the SPF projections.

## 2.2. Real-Time Data.

All benchmark models are estimated on a rolling, fixed window of 60 real-time quarterly observations. Lag lengths, based on either the Akaike information criterion (AIC) or the Schwarz information criterion (SIC), are re-estimated each period. The tables below indicate whether the lag length was chosen by the AIC or SIC.

We would like to make the comparison between the SPF forecast and the forecasts of each benchmark as fair as possible. Therefore, we must subject the benchmark models to the same data environment the survey panelists faced when they made their projections. This is important because macroeconomic data are revised often, and we do not want the benchmark models to use a data set that differs from the one our panelists would have used. We estimate and forecast the benchmark models with real-time data from the Philadelphia Fed real-time data set, using the vintage of data that the survey panelists would have had at the time they generated their own projections. (For more information on the Philadelphia Fed real-time data set, go to [www.philadelphiafed.org/econ/forecast/real-time-data/](http://www.philadelphiafed.org/econ/forecast/real-time-data/).)

An open question in the literature on forecasting is: What version or vintage of the data should we use to compute the errors? A closely related question is: What version of the data are professional forecasters trying to predict? Our computations take no strong position on these questions. Rather, in Table 1, we evaluate the projections (SPF and benchmark) with five alternative measures of the historical values, all from the Philadelphia Fed real-time data set. These measures range from the initial-release values to the values as we know them today. All together, we compute the forecast error statistics using the following five alternative measures of historical values:

- (1) The initial or first-release value;
- (2) The revised value as it appears one quarter after the initial release;
- (3) The revised value as it appears five quarters after the initial release;
- (4) The revised value as it appears nine quarters after the initial release;
- (5) The revised value as it appears today.

Each measure of the historical value has advantages and disadvantages. The initial-release value is the first measure released by government statistical agencies. A forecaster might be very interested in this measure because it enables him to evaluate his latest forecast soon after he generated it. However, early releases of the data are often subject to large measurement error. Subsequent releases [(2) - (5)] are more accurate, but they are available much later than the initial release. As we go from the first measure to the fifth, we get more reliability, at the cost of higher delays in availability.

The last two columns in Table 1 report the number of observations that we used to compute the error statistics. Some observations are omitted because the data are missing in the real-time data set, such as occurred when federal government statistical agencies closed in late 1995.

### 2.3. Recent Projections and Realizations.

Tables 2 to 7 provide information on recent projections and realizations. They show how we align the data prior to computing the forecast errors that form the backbone of the computations in Table 1. Any forecast error can be written as the equation given by  $\text{error} = \text{realization} - \text{forecast}$ . For our computations, we must be more precise because, for each projection (SPF and benchmarks), we have different periods forecast (T) different forecast horizons (h), and several measures of the realization (m). Thus, we can define the forecast error more precisely as

$$\text{error}(T, h, m) = \text{realization}(T, m) - \text{forecast}(T, h).$$

Tables 2 to 7 are organized along these lines. Table 2 shows recent forecasts from the SPF. Each column gives the projection for a different horizon or forecast step (h), beginning with that for the current quarter, defined as the quarter in which we conducted the survey. The dates (T) given in the rows show the periods forecast. These also correspond to the dates that we conducted the survey. Tables 3 to 6 report the recent projections of the four benchmark models. These are organized in the same way as Table 2. Table 7 reports recent values of the five alternative realizations (m) we use to compute the error statistics.

### 2.4. Qualifications.

We note two minor qualifications to the methods discussed above. The first concerns the vintage of data that we used to estimate and forecast the benchmark models for CPI inflation. The second concerns the five measures of realizations used for the unemployment rate, nonfarm payroll employment, and CPI inflation. To estimate and forecast the benchmark models for CPI inflation, we use the vintage of data that would have been available in the middle of each quarter. This predates by one month the vintage that SPF panelists would have had at their disposal when they formed their projections. The effect is likely small because revisions to the CPI are generally small. To compute the realizations for unemployment, nonfarm payroll employment, and CPI inflation, we use the vintages associated with the middle of each quarter. The measure that we call initial comes from this vintage, even though the initial estimate was available one month earlier. Thus, for these variables, our initial estimate reflects some revision by government statistical agencies. The effect for unemployment and CPI inflation is likely small. The effect could be somewhat larger for nonfarm payroll employment.

## 3. DESCRIPTION OF GRAPHS.

### 3.1. Root-Mean-Square Errors.

For each sample period shown in Table 1, we provide graphs of the root-mean-square error for the SPF forecast. There is one page for each sample period. On each page, we plot (for each forecast horizon) the RMSE on the y-axis. The x-axis shows the measure of the historical value that we used to compute the RMSE. These range from the value on its initial release to the value one quarter later to the value as we know it now (at the time we made the computation).

The graphs provide a tremendous amount of information. If we focus on a particular graph, we can see how a change in the measure of the realization (x-axis) affects the root-mean-square-error measure of accuracy. The effect is pronounced for some variables, such as real GDP and some of its components. For others, there is little or no effect. For example, because the historical data on interest rates are not revised, the estimated RMSE is the same in each case.

If we compare a particular point on one graph with the same point on another, we see how the forecast horizon affects accuracy. In general, the RMSE rises (accuracy falls) as the forecast horizon lengthens. Finally, if we compare a graph on one page with the corresponding graph on another page, we see how our estimates of accuracy in the SPF change with the sample period. Periods characterized by a high degree of economic turbulence will generally produce large RMSEs.

### 3.2. Fan Charts.

The last chart plots recent historical values and the latest SPF forecast. It also shows confidence intervals for the forecast, based on back-of-the-envelope calculations. The historical values and the SPF forecast are those associated with the latest vintage of data and survey, respectively, available at the time we ran our computer programs. The confidence intervals are constructed under the assumption that the historical forecast errors over the sample (shown in the footnote) follow a normal distribution with a mean of zero and a variance given by the root-mean-square error. The latter is estimated over the aforementioned sample, using the measure of history listed in the footnote.

Table 1. Forecast Error Statistics for SPF Variable: TBILL (3-Month T-Bill Rate [QA,PPs])

Computed Over Various Sample Periods Various Measures of Realizations Transformation: Level Lag Length for IAR(p), DAR(p), and DARM(p) Models: AIC Last Updated: 09/01/2009 10:22									
H	ME(S)	MAE(S)	RMSE(S)	RMSE(S/NC)	RMSE(S/IAR)	RMSE(S/DAR)	RMSE(S/DARM)	Nspf	N
History: Initial Release									
1985:01-2007:01									
1	-0.04	0.08	0.10	0.24	0.25	0.25	0.55	89	89
2	-0.15	0.32	0.45	0.54	0.55	0.52	0.79	89	89
3	-0.30	0.65	0.83	0.72	0.77	0.72	0.87	89	89
4	-0.47	0.94	1.20	0.83	0.88	0.81	0.95	89	89
5	-0.60	1.18	1.50	0.89	0.92	0.85	0.99	89	89
1985:01-1996:04									
1	-0.02	0.08	0.10	0.23	0.22	0.22	0.48	48	48
2	-0.15	0.38	0.48	0.55	0.51	0.48	0.82	48	48
3	-0.33	0.76	0.92	0.76	0.76	0.69	0.87	48	48
4	-0.53	1.07	1.31	0.88	0.89	0.82	1.00	48	48
5	-0.67	1.29	1.59	0.93	0.92	0.85	1.04	48	48
1997:01-2007:01									
1	-0.05	0.08	0.10	0.24	0.32	0.32	0.68	41	41
2	-0.16	0.25	0.40	0.52	0.67	0.62	0.74	41	41
3	-0.27	0.52	0.72	0.65	0.80	0.79	0.86	41	41
4	-0.40	0.79	1.05	0.75	0.87	0.81	0.88	41	41
5	-0.52	1.05	1.39	0.84	0.93	0.86	0.92	41	41
H	ME(S)	MAE(S)	RMSE(S)	RMSE(S/NC)	RMSE(S/IAR)	RMSE(S/DAR)	RMSE(S/DARM)	Nspf	N
History: One Qtr After Initial Release									
1985:01-2007:01									
1	-0.04	0.08	0.10	0.24	0.25	0.25	0.55	89	89
2	-0.15	0.32	0.45	0.54	0.55	0.52	0.79	89	89
3	-0.30	0.65	0.83	0.72	0.77	0.72	0.87	89	89
4	-0.47	0.94	1.20	0.83	0.88	0.81	0.95	89	89
5	-0.60	1.18	1.50	0.89	0.92	0.85	0.99	89	89
1985:01-1996:04									
1	-0.02	0.08	0.10	0.23	0.22	0.22	0.48	48	48
2	-0.15	0.38	0.48	0.55	0.51	0.48	0.82	48	48
3	-0.33	0.76	0.92	0.76	0.76	0.69	0.87	48	48
4	-0.53	1.07	1.31	0.88	0.89	0.82	1.00	48	48
5	-0.67	1.29	1.59	0.93	0.92	0.85	1.04	48	48
1997:01-2007:01									
1	-0.05	0.08	0.10	0.24	0.32	0.32	0.68	41	41
2	-0.16	0.25	0.40	0.52	0.67	0.62	0.74	41	41
3	-0.27	0.52	0.72	0.65	0.80	0.79	0.86	41	41
4	-0.40	0.79	1.05	0.75	0.87	0.81	0.88	41	41
5	-0.52	1.05	1.39	0.84	0.93	0.86	0.92	41	41

H ME(S) MAE(S) RMSE(S) RMSE(S/NC) RMSE(S/IAR) RMSE(S/DAR) RMSE(S/DARM) Nspf N

History: Five Qtrs After Initial Release

1985:01-2007:01

1	-0.04	0.08	0.10	0.24	0.25	0.25	0.55	89	89
2	-0.15	0.32	0.45	0.54	0.55	0.52	0.79	89	89
3	-0.30	0.65	0.83	0.72	0.77	0.72	0.87	89	89
4	-0.47	0.94	1.20	0.83	0.88	0.81	0.95	89	89
5	-0.60	1.18	1.50	0.89	0.92	0.85	0.99	89	89

1985:01-1996:04

1	-0.02	0.08	0.10	0.23	0.22	0.22	0.48	48	48
2	-0.15	0.38	0.48	0.55	0.51	0.48	0.82	48	48
3	-0.33	0.76	0.92	0.76	0.76	0.69	0.87	48	48
4	-0.53	1.07	1.31	0.88	0.89	0.82	1.00	48	48
5	-0.67	1.29	1.59	0.93	0.92	0.85	1.04	48	48

1997:01-2007:01

1	-0.05	0.08	0.10	0.24	0.32	0.32	0.68	41	41
2	-0.16	0.25	0.40	0.52	0.67	0.62	0.74	41	41
3	-0.27	0.52	0.72	0.65	0.80	0.79	0.86	41	41
4	-0.40	0.79	1.05	0.75	0.87	0.81	0.88	41	41
5	-0.52	1.05	1.39	0.84	0.93	0.86	0.92	41	41

H ME(S) MAE(S) RMSE(S) RMSE(S/NC) RMSE(S/IAR) RMSE(S/DAR) RMSE(S/DARM) Nspf N

History: Nine Qtrs After Initial Release

1985:01-2007:01

1	-0.04	0.08	0.10	0.24	0.25	0.25	0.55	89	89
2	-0.15	0.32	0.45	0.54	0.55	0.52	0.79	89	89
3	-0.30	0.65	0.83	0.72	0.77	0.72	0.87	89	89
4	-0.47	0.94	1.20	0.83	0.88	0.81	0.95	89	89
5	-0.60	1.18	1.50	0.89	0.92	0.85	0.99	89	89

1985:01-1996:04

1	-0.02	0.08	0.10	0.23	0.22	0.22	0.48	48	48
2	-0.15	0.38	0.48	0.55	0.51	0.48	0.82	48	48
3	-0.33	0.76	0.92	0.76	0.76	0.69	0.87	48	48
4	-0.53	1.07	1.31	0.88	0.89	0.82	1.00	48	48
5	-0.67	1.29	1.59	0.93	0.92	0.85	1.04	48	48

1997:01-2007:01

1	-0.05	0.08	0.10	0.24	0.32	0.32	0.68	41	41
2	-0.16	0.25	0.40	0.52	0.67	0.62	0.74	41	41
3	-0.27	0.52	0.72	0.65	0.80	0.79	0.86	41	41
4	-0.40	0.79	1.05	0.75	0.87	0.81	0.88	41	41
5	-0.52	1.05	1.39	0.84	0.93	0.86	0.92	41	41

H	ME(S)	MAE(S)	RMSE(S)	RMSE(S/NC)	RMSE(S/IAR)	RMSE(S/DAR)	RMSE(S/DARM)	Nspf	N
History: Latest Vintage									
1985:01-2007:01									
1	-0.04	0.08	0.10	0.24	0.25	0.25	0.55	89	89
2	-0.15	0.32	0.45	0.54	0.55	0.52	0.79	89	89
3	-0.30	0.65	0.83	0.72	0.77	0.72	0.87	89	89
4	-0.47	0.94	1.20	0.83	0.88	0.81	0.95	89	89
5	-0.60	1.18	1.50	0.89	0.92	0.85	0.99	89	89
1985:01-1996:04									
1	-0.02	0.08	0.10	0.23	0.22	0.22	0.48	48	48
2	-0.15	0.38	0.48	0.55	0.51	0.48	0.82	48	48
3	-0.33	0.76	0.92	0.76	0.76	0.69	0.87	48	48
4	-0.53	1.07	1.31	0.88	0.89	0.82	1.00	48	48
5	-0.67	1.29	1.59	0.93	0.92	0.85	1.04	48	48
1997:01-2007:01									
1	-0.05	0.08	0.10	0.24	0.32	0.32	0.68	41	41
2	-0.16	0.25	0.40	0.52	0.67	0.62	0.74	41	41
3	-0.27	0.52	0.72	0.65	0.80	0.79	0.86	41	41
4	-0.40	0.79	1.05	0.75	0.87	0.81	0.88	41	41
5	-0.52	1.05	1.39	0.84	0.93	0.86	0.92	41	41

Table 1 notes.

- (1) The forecast horizon is given by H, where H = 1 is the SPF forecast for the current quarter.
- (2) The headers ME(S), MAE(S), and RMSE(S) are mean error, mean absolute error, and root-mean-square error for the SPF.
- (3) The header RMSE(S/NC) is the ratio of the SPF RMSE to that of the no-change (NC) model.
- (4) The headers RMSE(S/IAR), RMSE(S/DAR) and RMSE(S/DARM) are the ratios of the SPF RMSE to the RMSE of the iterated and direct autoregressive models and the direct autoregressive model augmented with monthly observations, respectively. All models are estimated on a rolling window of 60 observations from the Phila Fed real-time data set.
- (5) The headers Nspf and N are the number of observations analyzed for the SPF and benchmark models.
- (6) When the variable forecast is a growth rate or an interest rate, it is expressed in annualized percentage points. When the variable forecast is the unemployment rate, it is expressed in percentage points.
- (7) Sample periods refer to the dates forecast, not the dates when the forecasts were made.

Source: Tom Stark, Research Department, FRB Philadelphia.

Table 2. Recent SPF Forecasts - Dated at the Quarter Forecast

Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 By Forecast Step (1 to 5)  
 Transformation: Level  
 Last Updated: 09/01/2009 10:22

Qtr Forecast	Step 1	Step 2	Step 3	Step 4	Step 5
2002:04	1.400	1.700	2.325	2.450	3.105
2003:01	1.200	1.300	1.900	2.730	2.955
2003:02	1.170	1.250	1.410	2.280	3.300
2003:03	0.950	1.200	1.450	1.790	2.700
2003:04	0.960	1.020	1.280	1.800	2.100
2004:01	0.910	1.025	1.120	1.430	2.300
2004:02	1.000	1.000	1.120	1.310	1.770
2004:03	1.445	1.300	1.200	1.250	1.600
2004:04	1.910	1.765	1.574	1.500	1.500
2005:01	2.500	2.260	2.150	2.000	1.830
2005:02	3.000	2.890	2.520	2.500	2.364
2005:03	3.395	3.432	3.200	2.870	2.900
2005:04	3.900	3.852	3.775	3.500	3.253
2006:01	4.364	4.294	4.087	3.950	3.700
2006:02	4.800	4.600	4.500	4.275	4.060
2006:03	5.075	5.000	4.650	4.560	4.305
2006:04	4.962	5.150	4.981	4.650	4.560
2007:01	5.000	4.962	5.160	4.960	4.635
2007:02	4.985	4.995	4.900	5.065	4.850
2007:03	4.830	4.953	4.950	4.830	4.953
2007:04	3.950	4.850	4.920	4.900	4.750
2008:01	2.407	3.945	4.900	4.900	4.900
2008:02	1.510	2.225	3.910	4.840	4.900
2008:03	1.785	1.683	2.200	3.925	4.845
2008:04	0.650	1.850	1.750	2.300	4.100
2009:01	0.200	0.697	2.060	1.920	2.580
2009:02	0.200	0.276	0.800	2.300	2.200
2009:03	0.200	0.250	0.300	1.000	2.640
2009:04	NA	0.236	0.304	0.400	1.180
2010:01	NA	NA	0.280	0.400	0.575
2010:02	NA	NA	NA	0.416	0.500
2010:03	NA	NA	NA	NA	0.710

Table 2 notes.

- (1) Each column gives the sequence of SPF projections for a given forecast step. The forecast steps range from one (the forecast for the quarter in which the survey was conducted) to four quarters in the future (step 5).
- (2) The dates listed in the rows are the dates forecast, not the dates when the forecasts were made, with the exception of the forecast at step one, for which the two dates coincide.

Source: Tom Stark, Research Department, FRB Philadelphia.

Table 3. Recent Benchmark Model 1 IAR Forecasts - Dated at the Quarter Forecast

Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 By Forecast Step (1 to 5)  
 Transformation: Level  
 Lag Length for IAR(p): AIC  
 Last Updated: 09/01/2009 10:22

Qtr Forecast	Step 1	Step 2	Step 3	Step 4	Step 5
2002:04	1.767	2.131	2.438	1.014	3.728
2003:01	1.277	2.015	2.601	2.875	1.367
2003:02	1.186	1.392	2.329	3.021	3.110
2003:03	1.103	1.351	1.615	2.669	3.503
2003:04	0.988	1.283	1.599	1.898	3.007
2004:01	1.035	1.150	1.533	1.890	2.209
2004:02	1.039	1.213	1.373	1.818	2.197
2004:03	1.294	1.240	1.439	1.624	2.114
2004:04	1.823	1.517	1.459	1.692	1.882
2005:01	2.448	2.146	1.770	1.700	1.936
2005:02	3.016	2.850	2.477	2.011	1.936
2005:03	3.179	3.403	3.186	2.737	2.226
2005:04	3.699	3.423	3.685	3.431	2.956
2006:01	4.086	3.893	3.555	3.867	3.613
2006:02	4.736	4.310	4.072	3.658	3.962
2006:03	4.860	4.914	4.429	4.133	3.710
2006:04	4.975	4.904	4.975	4.428	4.123
2007:01	4.847	4.947	4.870	4.956	4.395
2007:02	4.983	4.760	4.855	4.785	4.888
2007:03	4.519	4.930	4.655	4.725	4.671
2007:04	3.990	4.335	4.845	4.546	4.577
2008:01	2.746	3.776	4.183	4.743	4.440
2008:02	1.077	2.337	3.643	4.063	4.635
2008:03	1.458	0.472	2.124	3.572	3.971
2008:04	1.542	1.480	0.188	2.067	3.547
2009:01	-0.077	1.721	1.642	0.175	2.126
2009:02	0.386	-0.058	1.982	1.894	0.377
2009:03	-0.090	0.243	-0.260	2.285	2.195
2009:04	NA	0.261	0.685	0.000	2.600
2010:01	NA	NA	0.611	1.205	0.468
2010:02	NA	NA	NA	0.893	1.564
2010:03	NA	NA	NA	NA	1.414

Table 3 notes.

- (1) Each column gives the sequence of benchmark IAR projections for a given forecast step. The forecast steps range from one to five. The first step corresponds to the forecast that SPF panelists make for the quarter in which the survey is conducted.
- (2) The dates listed in the rows are the dates forecast, not the dates when the forecasts were made, with the exception of the forecast at step one, for which the two dates coincide.
- (3) The IAR benchmark model is estimated on a fixed 60-quarter rolling window. Its forecasts are computed with the indirect method. Estimation uses data from the Philadelphia Fed real-time data set.

Source: Tom Stark, Research Department, FRB Philadelphia.

Table 4. Recent Benchmark Model 2 No-Change Forecasts - Dated at the Quarter Forecast

Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 By Forecast Step (1 to 5)  
 Transformation: Level  
 Last Updated: 09/01/2009 10:22

Qtr Forecast	Step 1	Step 2	Step 3	Step 4	Step 5
2002:04	1.643	1.717	1.723	1.907	3.170
2003:01	1.333	1.643	1.717	1.723	1.907
2003:02	1.157	1.333	1.643	1.717	1.723
2003:03	1.040	1.157	1.333	1.643	1.717
2003:04	0.930	1.040	1.157	1.333	1.643
2004:01	0.917	0.930	1.040	1.157	1.333
2004:02	0.917	0.917	0.930	1.040	1.157
2004:03	1.077	0.917	0.917	0.930	1.040
2004:04	1.487	1.077	0.917	0.917	0.930
2005:01	2.007	1.487	1.077	0.917	0.917
2005:02	2.537	2.007	1.487	1.077	0.917
2005:03	2.863	2.537	2.007	1.487	1.077
2005:04	3.360	2.863	2.537	2.007	1.487
2006:01	3.827	3.360	2.863	2.537	2.007
2006:02	4.393	3.827	3.360	2.863	2.537
2006:03	4.703	4.393	3.827	3.360	2.863
2006:04	4.907	4.703	4.393	3.827	3.360
2007:01	4.903	4.907	4.703	4.393	3.827
2007:02	4.983	4.903	4.907	4.703	4.393
2007:03	4.737	4.983	4.903	4.907	4.703
2007:04	4.303	4.737	4.983	4.903	4.907
2008:01	3.390	4.303	4.737	4.983	4.903
2008:02	2.043	3.390	4.303	4.737	4.983
2008:03	1.627	2.043	3.390	4.303	4.737
2008:04	1.493	1.627	2.043	3.390	4.303
2009:01	0.297	1.493	1.627	2.043	3.390
2009:02	0.213	0.297	1.493	1.627	2.043
2009:03	0.173	0.213	0.297	1.493	1.627
2009:04	NA	0.173	0.213	0.297	1.493
2010:01	NA	NA	0.173	0.213	0.297
2010:02	NA	NA	NA	0.173	0.213
2010:03	NA	NA	NA	NA	0.173

Table 4 notes.

- (1) Each column gives the sequence of benchmark no-change projections for a given forecast step. The forecast steps range from one to five. The first step corresponds to the forecast that SPF panelists make for the quarter in which the survey is conducted.
- (2) The dates listed in the rows are the dates forecast, not the dates when the forecasts were made, with the exception of the forecast at step one, for which the two dates coincide.
- (3) The projections use data from the Philadelphia Fed real-time data set.

Source: Tom Stark, Research Department, FRB Philadelphia.

Table 5. Recent Benchmark Model 3 DAR Forecasts - Dated at the Quarter Forecast

Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 By Forecast Step (1 to 5)  
 Transformation: Level  
 Lag Length for DAR(p): AIC  
 Last Updated: 09/01/2009 10:22

Qtr Forecast	Step 1	Step 2	Step 3	Step 4	Step 5
2002:04	1.767	2.281	2.466	1.922	3.733
2003:01	1.277	2.188	2.628	2.961	2.409
2003:02	1.186	1.584	2.531	3.169	3.464
2003:03	1.103	1.373	1.843	2.913	3.623
2003:04	0.988	1.309	1.759	2.366	3.474
2004:01	1.035	1.230	1.630	2.289	2.794
2004:02	1.039	1.295	1.503	2.101	2.896
2004:03	1.294	1.313	1.577	1.869	2.685
2004:04	1.823	1.570	1.534	1.933	2.372
2005:01	2.448	2.187	1.838	1.878	2.306
2005:02	3.016	2.833	2.473	2.141	2.241
2005:03	3.179	3.396	3.075	2.738	2.493
2005:04	3.699	3.424	3.561	3.250	3.018
2006:01	4.086	3.889	3.597	3.674	3.445
2006:02	4.736	4.312	4.219	3.662	3.764
2006:03	4.860	4.955	4.506	4.298	3.702
2006:04	4.975	4.942	5.097	4.537	4.243
2007:01	4.847	4.978	4.955	5.043	4.504
2007:02	4.983	4.730	4.947	4.850	4.930
2007:03	4.519	4.927	4.599	4.809	4.694
2007:04	3.990	4.323	4.802	4.483	4.637
2008:01	2.746	3.723	4.143	4.653	4.328
2008:02	1.077	2.359	3.534	3.980	4.525
2008:03	1.458	0.536	2.105	3.460	3.865
2008:04	1.542	1.394	0.407	2.117	3.403
2009:01	-0.077	1.717	1.532	0.622	2.277
2009:02	0.386	-0.351	1.928	1.893	0.981
2009:03	-0.090	0.155	-0.754	2.258	2.250
2009:04	NA	0.694	1.056	-0.496	2.638
2010:01	NA	NA	0.957	1.639	0.221
2010:02	NA	NA	NA	1.572	2.157
2010:03	NA	NA	NA	NA	2.184

Table 5 notes.

- (1) Each column gives the sequence of benchmark DAR projections for a given forecast step. The forecast steps range from one to five. The first step corresponds to the forecast that SPF panelists make for the quarter in which the survey is conducted.
- (2) The dates listed in the rows are the dates forecast, not the dates when the forecasts were made, with the exception of the forecast at step one, for which the two dates coincide.
- (3) The DAR benchmark model is estimated on a fixed 60-quarter rolling window. Its forecasts are computed with the direct method. Estimation uses data from the Philadelphia Fed real-time data set.

Source: Tom Stark, Research Department, FRB Philadelphia.

Table 6. Recent Benchmark Model 4 DARM Forecasts - Dated at the Quarter Forecast

Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 By Forecast Step (1 to 5)  
 Transformation: Level  
 Lag Length for DARM(p): AIC  
 Last Updated: 09/01/2009 10:22

Qtr Forecast	Step 1	Step 2	Step 3	Step 4	Step 5
2002:04	1.699	2.115	2.444	2.579	2.454
2003:01	1.227	2.042	2.483	3.009	2.849
2003:02	1.192	1.475	2.348	2.867	3.447
2003:03	0.939	1.394	1.677	2.759	3.367
2003:04	0.997	1.112	1.726	2.177	3.214
2004:01	0.946	1.203	1.341	2.227	2.667
2004:02	1.028	1.171	1.455	1.752	2.841
2004:03	1.451	1.231	1.405	1.799	2.342
2004:04	1.896	1.715	1.479	1.718	2.289
2005:01	2.506	2.236	2.021	1.784	2.086
2005:02	2.958	2.900	2.539	2.347	2.145
2005:03	3.392	3.298	3.164	2.791	2.538
2005:04	3.833	3.700	3.542	3.352	2.813
2006:01	4.399	4.076	3.855	3.408	3.261
2006:02	4.700	4.713	4.397	3.987	3.470
2006:03	5.068	4.915	4.831	4.519	3.940
2006:04	4.948	5.243	5.068	4.806	4.317
2007:01	5.013	4.907	5.195	5.019	4.734
2007:02	4.872	4.944	4.897	5.134	4.596
2007:03	4.832	4.808	4.823	4.783	4.884
2007:04	3.813	4.776	4.665	4.727	4.478
2008:01	2.552	3.426	4.588	4.493	4.654
2008:02	0.975	2.109	3.286	4.513	4.246
2008:03	1.648	0.381	1.833	3.213	4.596
2008:04	0.603	1.624	0.214	1.789	3.253
2009:01	0.136	0.569	1.774	0.431	2.224
2009:02	0.198	0.046	0.637	2.149	1.223
2009:03	0.227	0.152	-0.175	0.778	2.745
2009:04	NA	0.572	0.863	0.165	1.358
2010:01	NA	NA	0.900	1.416	0.783
2010:02	NA	NA	NA	1.408	1.944
2010:03	NA	NA	NA	NA	2.036

Table 6 notes.

- (1) Each column gives the sequence of benchmark DARM projections for a given forecast step. The forecast steps range from one to five. The first step corresponds to the forecast that SPF panelists make for the quarter in which the survey is conducted.
- (2) The dates listed in the rows are the dates forecast, not the dates when the forecasts were made, with the exception of the forecast at step one, for which the two dates coincide.
- (3) The DARM benchmark model is estimated on a fixed 60-quarter rolling window. Its forecasts are computed with the direct method and incorporate recent monthly values of the dependent variable. Estimation uses data from the Philadelphia Fed real-time data set.

Source: Tom Stark, Research Department, FRB Philadelphia.

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 Table 7. Recent Realizations (Various Measures)  
 Source: Philadelphia Fed Real-Time Data Set  
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Variable: TBILL (3-Month T-Bill Rate [QA,PPs])  
 Transformation: Level  
 Last Updated: 09/01/2009 10:22

- 1- Initial Release  
 2- One Qtr After Initial Release  
 3- Five Qtrs After Initial Release  
 4- Nine Qtrs After Initial Release  
 5- Latest Vintage  
 -----

Obs. Date	(1)	(2)	(3)	(4)	(5)
2002:04	1.333	1.333	1.333	1.333	1.333
2003:01	1.157	1.157	1.157	1.157	1.157
2003:02	1.040	1.040	1.040	1.040	1.040
2003:03	0.930	0.930	0.930	0.930	0.930
2003:04	0.917	0.917	0.917	0.917	0.917
2004:01	0.917	0.917	0.917	0.917	0.917
2004:02	1.077	1.077	1.077	1.077	1.077
2004:03	1.487	1.487	1.487	1.487	1.487
2004:04	2.007	2.007	2.007	2.007	2.007
2005:01	2.537	2.537	2.537	2.537	2.537
2005:02	2.863	2.863	2.863	2.863	2.863
2005:03	3.360	3.360	3.360	3.360	3.360
2005:04	3.827	3.827	3.827	3.827	3.827
2006:01	4.393	4.393	4.393	4.393	4.393
2006:02	4.703	4.703	4.703	4.703	4.703
2006:03	4.907	4.907	4.907	4.907	4.907
2006:04	4.903	4.903	4.903	4.903	4.903
2007:01	4.983	4.983	4.983	4.983	4.983
2007:02	4.737	4.737	4.737	NA	4.737
2007:03	4.303	4.303	4.303	NA	4.303
2007:04	3.390	3.390	3.390	NA	3.390
2008:01	2.043	2.043	2.043	NA	2.043
2008:02	1.627	1.627	NA	NA	1.627
2008:03	1.493	1.493	NA	NA	1.493
2008:04	0.297	0.297	NA	NA	0.297
2009:01	0.213	0.213	NA	NA	0.213
2009:02	0.173	NA	NA	NA	0.173
2009:03	NA	NA	NA	NA	NA
2009:04	NA	NA	NA	NA	NA
2010:01	NA	NA	NA	NA	NA
2010:02	NA	NA	NA	NA	NA
2010:03	NA	NA	NA	NA	NA

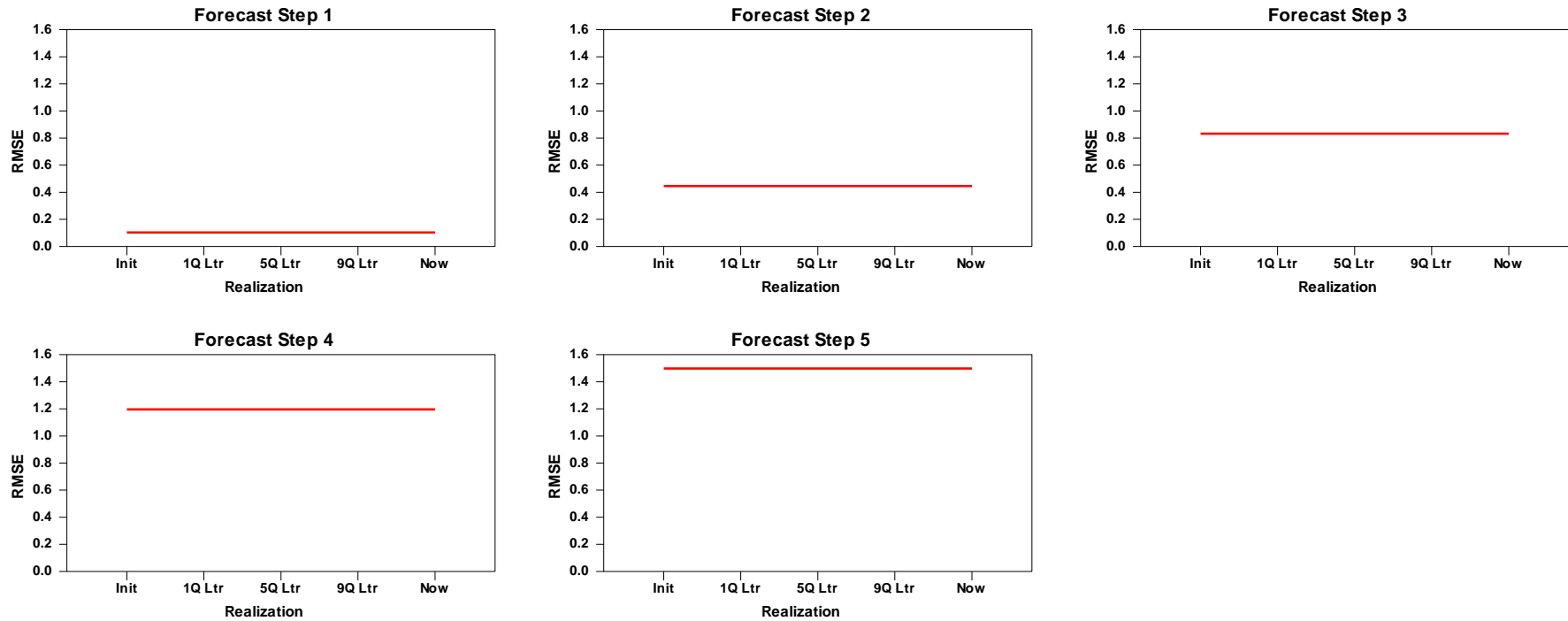
Table 7 notes.

- (1) Each column reports a sequence of realizations from the Philadelphia Fed real-time data set.  
 (2) The date listed in each row is the observation date.  
 (3) Moving across a particular row shows how the observation is revised in subsequent releases.

Source: Tom Stark, Research Department, FRB Philadelphia.

# Root-Mean-Square Errors: 1985:01-2007:01

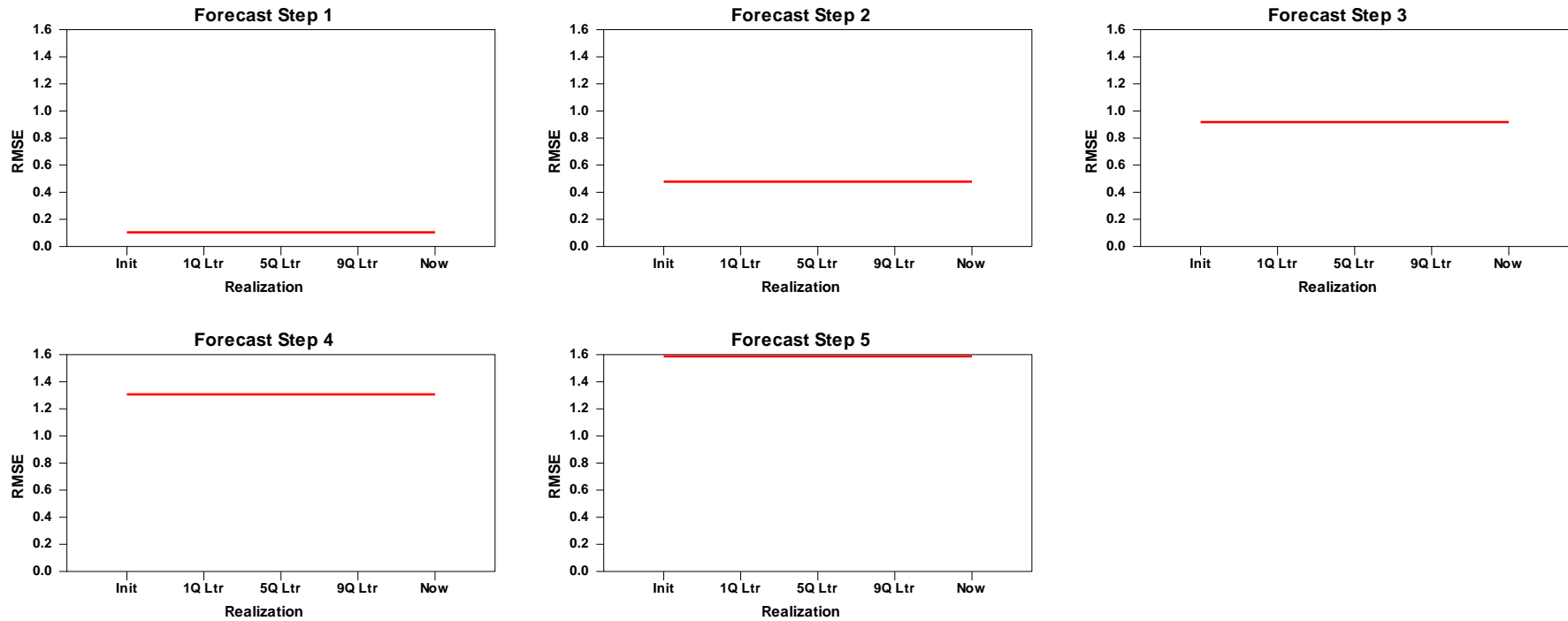
*SPF Projections for 3-Month T-Bill Rate [QA,PPs], Transformation: Level*



The RMSE is plotted against the realization used to compute it, from the value on initial release to the value as we now know it. Source: Tom Stark, FRB Philadelphia.

# Root-Mean-Square Errors: 1985:01-1996:04

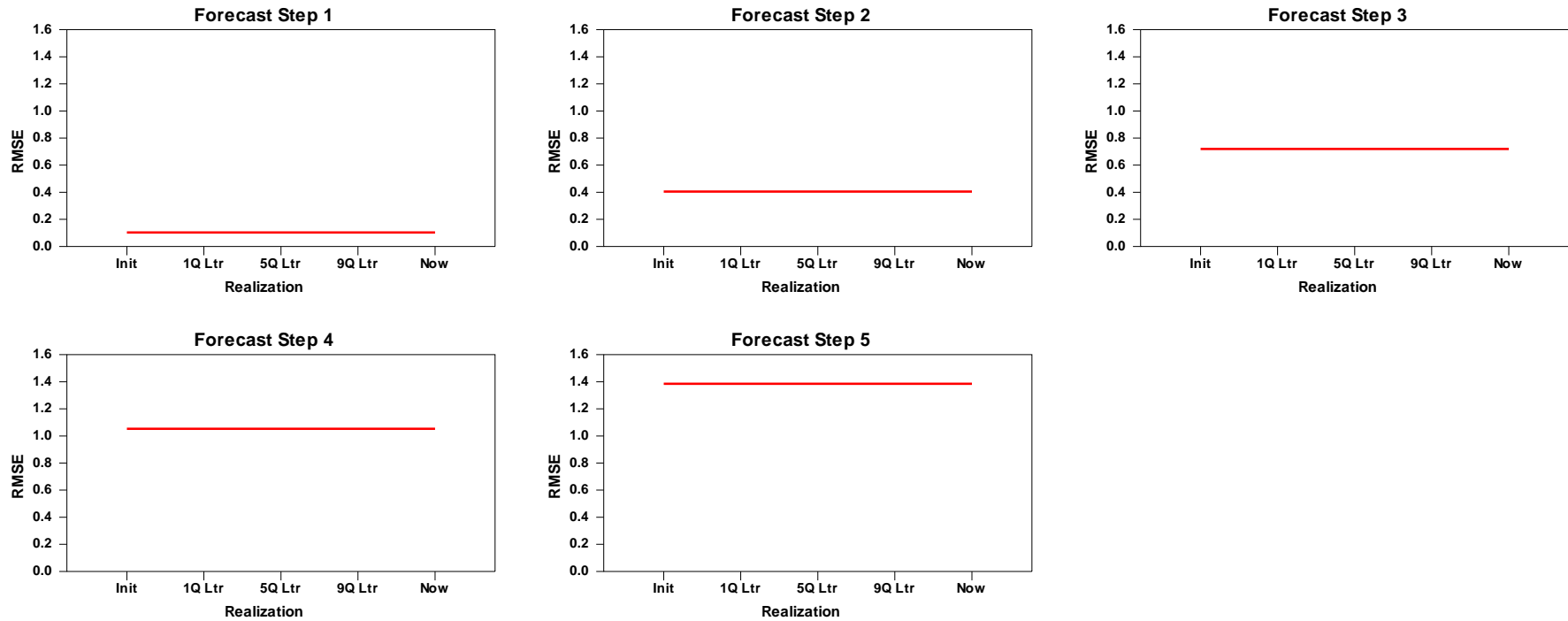
*SPF Projections for 3-Month T-Bill Rate [QA,PPs], Transformation: Level*



The RMSE is plotted against the realization used to compute it, from the value on initial release to the value as we now know it. Source: Tom Stark, FRB Philadelphia.

# Root-Mean-Square Errors: 1997:01-2007:01

*SPF Projections for 3-Month T-Bill Rate [QA,PPs], Transformation: Level*



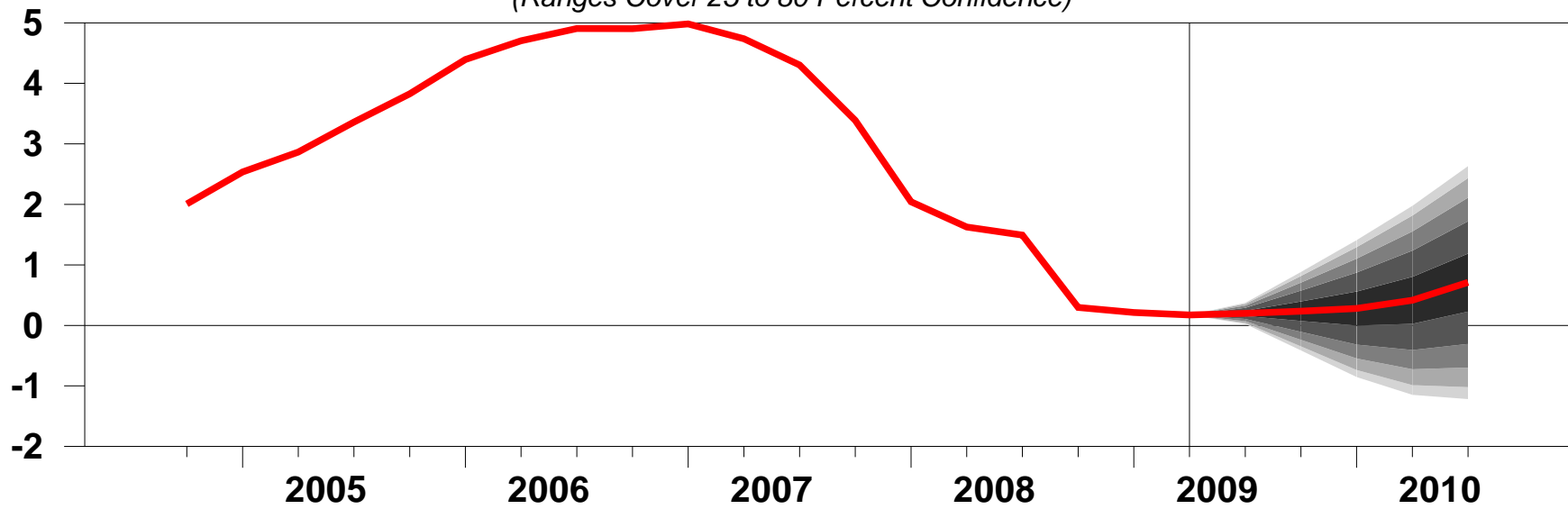
The RMSE is plotted against the realization used to compute it, from the value on initial release to the value as we now know it. Source: Tom Stark, FRB Philadelphia.

# 3-Month T-Bill Rate [QA,PPs]

*History, Forecasts, and Ranges for the SPF of 2009:03*

## Level

*(Ranges Cover 25 to 80 Percent Confidence)*



Ranges at each horizon use the  $N(0, \text{MSE})$  density. The MSEs are based on the sample 85:01-08:01 and use the realization: Five Qtrs After Initial Release. Source: T.Stark, FRB Phila.