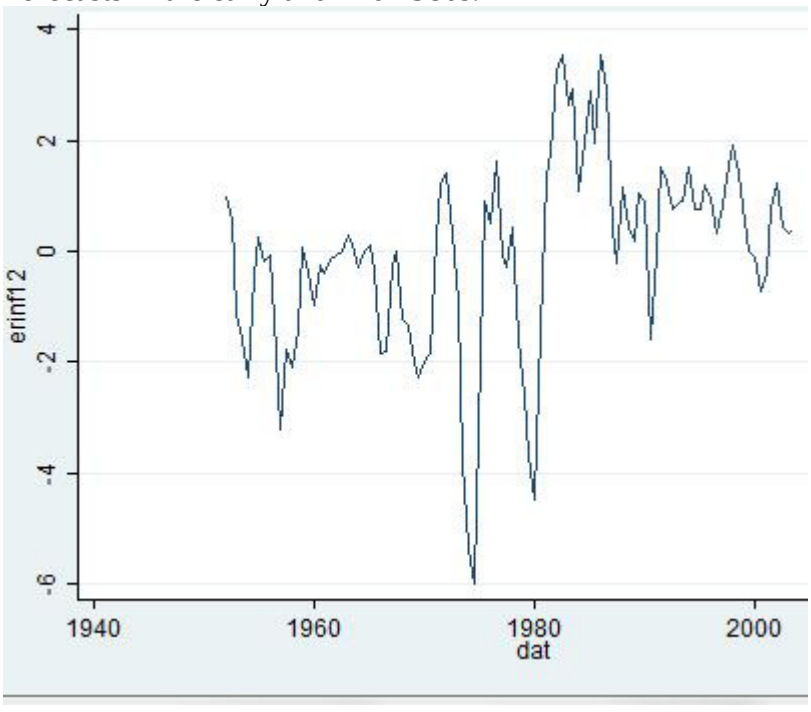
Inflation Expectations in the USA

This note will look at two sources of information on subjective expected inflation in the USA – the Livingston Expectations Survey of experts and the breakeven inflation rate which would cause Treasury Inflation Protected Securities (TIPS) to have the same return as nominal Treasury securites. I use TIPS data from FRED which only lists TIPS returns from 2003 on. In this note, I will use Livingston data only up to 2003 when the survey format was changed. The justification for this choice is that the post 2003 data can then be used to test out of sample forecasts without risk of data snooping (note "justification" is not a synonym for "cause").

The Livingston Survey was conducted in June and December starting June 1946. Respondents were asked, among other things, to forecast the consumer price index 6 months ahead and 12 months ahead. The data set
http://www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/data-files/
Also includes values for the price index for the period when forecasts were made so CPI inflation forecasts can be calculated from the CPI level forecasts. The base year for the price index was adjusted four times so the relevant CPI index dropped (not all the way down to 100). I use the change in the price index when forecasts were made as the realization of CPI inflation except for intervals crossing those four date when I use the percent change in the monthly consumer price index for all urban consumers (`CPIAUCSL`) from FRED (doubled to annualize it if the interval is 6 months).

The Livingston Survey started in 1946 – the year World War II price controls were lifted. In the initial years, both inflation and inflation expectations were all over the map. The overall 1946-2013 mean squared error of the forecasts of inflation over the following 12 months is 8.98%. I will generally use forecasts made only June 1951 and later deliberately dropping the periods with huge forecast errors. Nonetheless the performance of the median forecast is not impressive – the mean squared error of forecasts of inflation over the following year is over 2.97%. The time series of forecast errors (forecast minus outcome) unsurprisingly shows that forecasters didn't anticipate the oil shocks, but also shows persistently too high forecasts in the early and mid 1980s.



A simple regression of the forecast error on the forecast has (as is usual) a positive coefficient. Since the data are overlapping 12 months intervals, I use the Newey West estimate of standard errors with one lag. This is the very minimal concession to time series econometrics. For what it's worth, the null of no bias is rejected at the 5% level

```
Regression with Newey-West standard errors          Number of obs  =       113
maximum lag: 1


             |             Newey-West
erinf12 |      Coef.   Std. Err.  t
-------------+-------------------------
finf12   |   .4349   .1914     2.27
  _cons |  -2.045   .8023   -2.55
```

If the extreme forecasts made before June 1951 are excluded, the coefficient becomes much smaller and not statistically signficantly different from zero

```
. newey erinf12 finf12 if dat>1951.9,lag(1)

Regression with Newey-West standard errors          Number of obs  =       104
maximum lag: 1


             |             Newey-West
erinf12 |      Coef.   Std. Err.      t
-------------+------------------------------------
  finf12 |    .107268   .0973468     1.10
   _cons |  -.4643168   .2969554    -1.56
```

The null that the median forecast is the conditional mean of inflation is also not rejected at the 5% level if lagged annual inflation is included in the regression. In contrast if lagged inflation over the 12 months before the forecast and over the 6 months before the forecast are included, the null is rejected.

Regression with Newey-West standard errors Number of obs = 104
maximum lag: 1 F(3, 100) = 4.41
  Prob > F = 0.0059

erinf12	Coef.	Std. Err.	t
finf12	.3265296	.145388	2.25
linf	.1507523	.1489315	1.01
l2inf6	-.3703435	.1492302	-2.48
_cons	-.4341144	.2692709	-1.61

This is **not** a valid test of the null hypothesis that the forecasters have rational expectations and a quadratic loss function. They may not have had access even to flash CPI estimates for June or December when making their forecasts. In any case, they definitely did not have the final CPI estimates. It has been noted that Livinston forecasts are closer to forecasts of the second BLS CPI estimates (the first revision) than of the final estimates (Keane and Runkle AER)

The table shows that high forecasts are, on average, too high. It also shows that forecasters do not fully incorporate information about price increases in the preceding 6 months. Again this is at least partly because much of that information had not been collected and published when they made their forecasts.

The glass is at least half full. The null that Livingston forecasts add no useful information to that in lagged CPI inflation is overwhelmingly rejected (it would correspond to a coefficient of one of forecast error on the forecast, that is of zero of outcome on the forecast – this extreme null is even rejected when the extreme forecasts made before June 1951 are included).

It is widely argued that lagged core inflation is a better predictor of inflation than lagged CPI inflation. For this reason, I explore using the personal consumption expenditure deflator excluding food and energy. This is available from 1957 on so annual core inflation realizations (pcecinf) are available only from June 1958 on. In a way this is an advantage as the extremely inaccurate median forecasts from early Livingston surveys aren't considered in regressions using pcecinf. First the regression (which again is not a valid test of the null of rational expectations and a quadratic loss function) on lagged pcecinf (lpcecinf) and l2pcecinf6 (the annualized rate of core inflation over the 6 months before the forecasts were made).

```
. newey  erinf l2pcecinf6 lpcecinf finf12,lag(1)

Regression with Newey-West standard errors          Number of obs  =        90
maximum lag: 1
                             Newey-West
       erinf |      Coef.   Std. Err.      t
-------------+------------------------------------------------------------------
l2pcecinf6 |  -.8913226   .2538234    -3.51
   lpcecinf |   .8661764    .370575     2.34
     finf12 |   .0839524   .2620271     0.32
      _cons |  -.1636305   .3254642    -0.50
```

Notably the forecasts are too low if the most recent core inflation is high.

An arguable valid test of the hypothesis uses core inflation from 18 to 6 months before the forecasts (legpcecinf for lag extra half personal consumption expenditure core inflation) were made so, for example, from December 1970 through December 1971 in a regression including the forecast made June 1972 of CPI inflation over the following 12 months. The null is rejected

```
. newey  erinf lehpcecinf finf12,lag(1)

Regression with Newey-West standard errors          Number of obs  =        89
maximum lag: 1                                      F(  2,    86) =      3.37
                                                    Prob > F       =    0.0389


                             Newey-West
       erinf |      Coef.   Std. Err.      t
-------------+------------------------------------------------------------------
  lehpcecinf |   .4830308   .2202333     2.19
     finf12 |  -.4145991   .2564272    -1.62
      _cons |  -.1827848   .3522127    -0.52
```

The Livingston Survey participants appear to over react to lagged core inflation.

Interestingly the useful additional information in the Livingston Survey forecasts which is not present in lagged core inflation is quite concentrated in the period of oil shocks. If the entire available period of inflation realizations from June 1959 through December 2004 is used, the coefficient on the Livingston forecast is extremely statistically significant

```
. newey inf finf12 lpcecinf l2pcecinf6,lag(1)
```

Regression with Newey-West standard errors Number of obs = 90
maximum lag: 1

inf	Coef.	Newey-West Std. Err.	t
finf12	.9160477	.2620271	3.50
lpcecinf	-.8661764	.370575	-2.34
l2pcecinf6	.8913226	.2538234	3.51
_cons	.1636305	.3254642	0.50

If realizations from 1973 through 1981 are excluded, the coefficient on the Livingston Forecast drops dramatically. The null of no useful information isn't quite rejected at about the 5% level (even though STATA doesn't allow a Newey West correction given the exclusion)

. reg inf finf12 lpcecinf l2pcecinf6 if dat<1973|dat>1981.6

Number of obs = 72 R-squared = 0.5903

inf	Coef.	Std. Err.	t
finf12	.2517186	.1270064	1.98
lpcecinf	-.2895296	.2474532	-1.17
l2pcecinf6	.6615161	.2251409	2.94
_cons	.894372	.2492705	3.59

I think it almost goes without saying that the excluded periods were carefully chosen to get that t-statistic under 2. Also while I believe the useful contribution of the expert forecasters is based on knowing the price of oil, I haven't managed to render the Livingston forecast irrelevant by including information on the price of oil.

So far the results are standard (and available in the literature). The median Livingston Survey forecast is not the mean of inflation conditional on available information, but it does contain useful information beyond lagged inflation.

The median Livingston Survey CPI inflation forecast is very well fit using only one obersvation of lagged PCE core inflation with an R-squared over 85%

. reg finf12 lpcecinf

Number of obs = 92

R-squared = 0.8556

```
 Root MSE      =  .97094

------------------------------------------------------------------------------
     finf12 |      Coef.   Std. Err.      t
------------+-----------------------------------------------------------------
   lpcecinf |   .8621962   .0373311    23.10
      _cons |   .6334772   .1878934     3.37
```

Interestingly, there is no sign that inflation expectations were more anchored after June 1989 than before. The coefficient on the product of lagged PCE inflation and an indicator that the realization of inflation occurred June 1990 or later is statistically insignificantly different from zero and actually positive.

```
. reg finf12  lpcecinf

      Source |       SS       df       MS              Number of obs =      92
-------------+------------------------------           F(  1,    90) =  533.42
       Model |  502.867348     1  502.867348           Prob > F      =  0.0000
    Residual |  84.8446781    90  .942718646           R-squared     =  0.8556
-------------+------------------------------           Adj R-squared =  0.8540
       Total |  587.712026    91  6.45837391           Root MSE      =  .97094

------------------------------------------------------------------------------
     finf12 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
   lpcecinf |   .8621962   .0373311    23.10   0.000     .7880315    .9363609
      _cons |   .6334772   .1878934     3.37   0.001     .2601941     1.00676
------------------------------------------------------------------------------

. reg finf12 lpcecinf if dat>1990

      Source |       SS       df       MS              Number of obs =      29
-------------+------------------------------           F(  1,    27) =   89.66
       Model |  12.2432864     1  12.2432864           Prob > F      =  0.0000
    Residual |  3.68689894    27  .136551813           R-squared     =  0.7686
-------------+------------------------------           Adj R-squared =  0.7600
       Total |  15.9301853    28  .568935189           Root MSE      =  .36953

------------------------------------------------------------------------------
     finf12 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
   lpcecinf |   .6366098   .0672315     9.47   0.000      .498662    .7745575
      _cons |   1.472466   .2088154     7.05   0.000     1.044013     1.90092
------------------------------------------------------------------------------

. gen lpcecinf90 = lpcecinf*(dat>1989.9)
(26 missing values generated)
```

```
. reg finf12 lpcecinf lpcecinf90

      Source |       SS       df       MS              Number of obs =      92
-------------+------------------------------           F(  2,    89) =  266.81
       Model |  503.702899     2   251.85145           Prob > F      =  0.0000
    Residual |   84.009127    89  .943922776           R-squared     =  0.8571
-------------+------------------------------           Adj R-squared =  0.8538
       Total |  587.712026    91  6.45837391           Root MSE      =  .97156

------------------------------------------------------------------------------
      finf12 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    lpcecinf |   .8697291   .0382033    22.77   0.000     .7938199    .9456383
  lpcecinf90 |   .0640359   .0680621     0.94   0.349     -.071202    .1992738
       _cons |    .53916   .2130694     2.53   0.013     .1157957    .9625243
------------------------------------------------------------------------------
```

This absense of evidence of increased anchoring also holds when PCE core inflation is lagged an extra 6 months so that it should be information available at the time forecasts were made. The coefficient on the interaction term becomes very slightly negative but not at all statistically significant

```
. reg finf12 lehpcecinf lehpcecinf90

    R-squared     =  0.7756
    Root MSE      =  1.2082

         finf12 |      Coef.       Std. Err.      t
----------------+------------------------------------
     lehpcecinf |   .8132067   .0478704    16.99
lehpcecinf90 |  -.0244246    .084654    -0.29
          _cons |   .8795297   .2679225     3.28
```

This is true of survey expectations even though the actual persistence of inflation declined.

```
. newey inf lehpcecinf lehpcecinf90,lag(1)

Regression with Newey-West standard errors          Number of obs  =        89

                    |             Newey-West
                inf |      Coef.   Std. Err.      t
----------------+------------------------------------------------------------
     lehpcecinf |   .6353168   .1385857     4.58
lehpcecinf90 |  -.3125715    .144614    -2.16
          _cons |   1.832259   .6395069     2.87
------------------------------------------------------------------------------
```

So the forecasts show an excessive response to PCE core inflation lagged 18 months which became significantly more excessive after 1990

. newey erinf lehpcecinf lehpcecinf90,lag(1)

Regression with Newey-West standard errors Number of obs = 89
maximum lag: 1 F(2, 86) = 12.73
Prob > F = 0.0000

-

Newey-West			
erinf6	Coef.	Std. Err.	t
lehpcecinf	.3113511	.0644115	4.83
lehpcecinf90	.2661206	.1066455	2.50
_cons	-1.060648	.3876576	-2.74

This simple pattern in a well known data set makes the fact that inflation expectations were regularly described as “anchored” a bit puzzling. I think that the expectations augmented Phillips curve was so firmly accepted that economists used “anchored expectations” to imply that unit labor costs were not growing rapidly or perhaps that actual inflation was not accelerating. In the language of contemporary macroeconomics the word “expectations” may refer to what should be expected given the ex post observed behavior of time series or to what expectations must have been for a standard model to fit the data, but in any case not to any forecast made by an actual human being.

The very very crude model of inflation expectations the autoregressive expectations model which consists of a constant times lagged PCE core inflation works rather well. The assumption of rational expectations is not so easily reconciled with the data (of course it is possible if one makes the right assumptions about survey participants' objectives – it is always possible to reconcile any behavior with rationality).

It is clear why the crude autoregressive expectations assumption was abandoned. Inflation expectations do not seem to have been especially anchored from 1990 through 2003, but there were especially anchored back in the 50s and 60s. Estimated coefficients on lagged inflation (which were interpreted as the effect of lagged inflation on expected inflation) shifted up in the 70s. This was the storming of the Bastille of the rational expectations revolution, because of this pattern it was almost universally decided that it would be better to populated models unrealistically sophisticated agents with rational expectations than with unrealistically unsophisticated agents. The interesting point is that newer data which push back the other way have not caused much reconsideration.

One reason why the difference between rational expectations and autoregressive expectations is inportant is that if people have rational expectations a credible change in policy regime will be credited – that is people will believe that the policy has changed. This implied the forecast that a firm commitment to disinflation would cause lower inflation without causing high unemployment (later revised to without causing prolonged high unemployment). This view was not much dented by the

prolonged high unemployment which accompanied the Volcker and Thatcher deflations. The argument became that credibility had to be earned – that it took a while for economic agents to learn that Volcker and Thatcher were determined enemies of inflation. Hindsight suggests that this is consistent only with extremely bounded rationality, but in any case, it implies that Volcker must, on average, have had more inflation fighting credibility than say Arthur Burns or G William Miller. The partial success of autoregressive expectations model suggests a simple way to test this hypothesis against the alternative that Volcker had less inflation fighting credibility than Burns and Miller (averaged over their joint terms). First using all data with indicators for the Fed chairman (the omitted chairmen are Burns and Miller)

. reg finf12 linf eccles mccabe martin volcker greenspan

Number of obs = 114
R-squared = 0.8992

finf12	Coef.	Std. Err.	t
linf	.4922279	.0386679	12.73
eccles	-19.30548	1.16177	-16.62
mccabe	-7.103626	.5229511	-13.58
martin	-2.449952	.3354724	-7.30
volcker	1.335534	.3525847	3.79
greenspan	-.5930826	.3238802	-1.83
_cons	2.718602	.3466771	7.84

After controlling for lagged annual CPI inflation, expected annual CPI inflation was over 2.7 % significantly higher when Volcker was chairman than when Burns or Miller were. This evidence that Volcker had lower inflation fighting credibility is strongly significant.

As always data from the early years (including all of the Eccles and McCabe years) are very strange

The point estimate is markedly lower (due to the different coefficient on lagged inflation) but the null that Volcker was percieved to be at least as much of an inflation hawk as Burns & Miller null is strongly rejected when forecasts of inflation to be realized before June 1952 are excluded

. reg finf12 linf martin volcker greenspan if dat>1951.9

Number of obs = 106
R-squared = 0.8987
Root MSE = .88925

finf12	Coef.	Std. Err.	t
linf	.5345877	.037626	14.21
martin	-2.370629	.3013004	-7.87
volcker	1.304586	.3067739	4.25
greenspan	-.4507592	.2872395	-1.57
_cons	2.4457	.3204548	7.63

That coefficient can be, in effect, forced to be one by regressing forecast annual cpi inflation minus lagged annual cpi inflation (fdinf) on indicators for Fed Chairmen.

Given the sensitivity of the coefficient of interest to this nuisance parameter and the useful role of lagged PCE core inflation in forcasting the median Livinston forecast, I regress using lpcecinf as a control
. reg finf12 lpcecinf martin volcker greenspan

Number of obs = 92
R-squared = 0.9200

finf12	Coef.	Std. Err.	t
lpcecinf	.6813138	.040201	16.95
martin	-1.601933	.2763324	-5.80
volcker	.8094612	.2580105	3.14
greenspan	-.2764481	.2429186	-1.14
_cons	1.765346	.2987749	5.91

And

. reg finf12 lpcecinf linf martin volcker greenspan

```
  Number of obs =      92
  R-squared     =  0.9298
```

finf12	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lpcecinf	.3630536	.0993603	3.65	0.000	.1655318	.5605753
linf	.3018132	.0871106	3.46	0.001	.1286431	.4749833
martin	-1.493546	.2622295	-5.70	0.000	-2.014841	-.9722507
Volcker	1.002689	.2494095	4.02	0.000	.5068795	1.498499
greenspan	-.1828489	.2304636	-0.79	0.430	-.6409954	.2752977
_cons	1.747552	.2815488	6.21	0.000	1.187852	2.307253

There is strong evidence from the Livingston Survey that Paul Volcker had (on average over his chairmanship) extraordinarily low inflation fighting credibility.

This is not at all because the view of Volcker as a very determined oponent of inflation is inconsistent with the data on inflation. If actual not forecast inflation is used, the standard result that he was a more determined fighter of inflation than Burns and Miller is supported by the data (abeit not as strongly as the conclusion that he was perceived at the time to be a total wimp)

. newey inf linf eccles mccabe martin volcker greenspan if finf12!=.,lag(1)

```
Regression with Newey-West standard errors          Number of obs  =       112
maximum lag: 1
```

inf	Coef.	Newey-West Std. Err.	t
linf	.4432437	.1426186	3.11
eccles	-4.091905	1.987331	-2.06
mccabe	-4.854238	1.89385	-2.56
martin	-2.581114	1.00559	-2.57
volcker	-.8953866	1.198619	-0.75
greenspan	-2.299477	.9156995	-2.51
_cons	4.014983	1.183306	3.39

. newey inf lpcecinf martin volcker greenspan if finf12!=.,lag(1)

Regression with Newey-West standard errors Number of obs = 90
maximum lag: 1

| Newey-West
inf	Coef. Std. Err. t P>|t
lpcecinf	.7130411 .1567622 4.55
martin	-1.810828 1.210923 -1.50
volcker	-1.498491 1.23335 -1.21
greenspan	-1.782179 1.104759 -1.61
_cons	2.554083 1.426065 1.79

This means that forecast errors were significantly higher when Volcker was chairman than when Burns or Miller was

. newey erinf linf eccles mccabe martin volcker greenspan if finf12!=.,lag(1)

Regression with Newey-West standard errors Number of obs = 112
maximum lag: 1

Newey-West
erinf6	Coef. Std. Err. t
linf	.1241476 .0788516 1.57
eccles	-3.138085 1.080949 -2.90
mccabe	-2.766702 .9135608 -3.03
martin	-.2346639 .7440878 -0.32
volcker	2.07204 .826205 2.51
greenspan	1.378613 .7165661 1.92
_cons	-.8862287 .8472964 -1.05

. newey erinf lpcecinf martin volcker greenspan if finf12!=.,lag(1)

Regression with Newey-West standard errors Number of obs = 90
maximum lag: 1

Newey-West
erinf6	Coef. Std. Err. t
lpcecinf	.1840498 .1080232 1.70
martin	.242059 .8669294 0.28
volcker	1.923481 .7575317 2.54
greenspan	1.47998 .7507768 1.97
_cons	-1.20058 1.016317 -1.18

The fact that the median Livingston survey inflation forecast adds useful information not present in lagged CPI and PCE core inflation does not mean that it is a good forecast. The full sample mean squared forecast error is amazingly high over 3.15 % . This is the error of forecasts of CPI inflation over the next twelve months. This is partly due to the extreme forecasts of inflation in the early years of the survey. If forecasts of annual inflation realized before June 1952 are excluded, then the mean squared forecast error declines but is still greater than 1.93 %. Even forecasts of realizations June 1990 have a high mean squared error over 1.326%. These forecasts were mostly made during the great moderation which was a period of steady low inflation.

The median Livinston survey forecast is not noticeably better than a forecast based on a simple regression on lagged annual PCE core inflation estimated using data before the oil shocks (so inflation realized before December 1973) . The forecast is 0.772% + 0.757*lpcecinf%. For the full sample, this actually has a lower mean squared forecast error. Even if forecasts of inflation realized before June 1952 are excluded, the simple regression performs almost exactly as well as the median expert forecaster with a mean squared forecast error less than 2.023%. Notably, the median forecast is generally used and also used in this note because it performs better than the average forecast. The mean squared error of the average forecast is much lower than the average mean squared error of individual forecasts. This means that the average expert who participated in the Livingston survey would have done better using a constant plus a constant times lagged annual PCE core inflation.

Of course before June 1973 participants did not have the data used to estimate the two constants, nor did they have the data which has convinced people that lagged PCE core inflation is a better predictor of CPI inflation than lagged CPI inflation is. The interesting question is how the two forecasts compare out of sample. The mean squared forecast error based on realizations post oil shock (December 1973 through December 2004) is similar for the median Livingston forecast (2.18%) and the fitted values of the simple regression (2.27%). Most remarkably, the mse of the median Livingston forecast of annual inflation realized June 1990 through December 2004 is over 1.326% while the MSE of forecasts based on the simple regression is less than 0.868%. Since 1990, the median expert forecaster performed notably worse than a simple regression estimated using data which were at least 17 years old.

Now, of course, it is possible to reconcile this result with the rational expectations hypothesis (it is always possible to reconcile any data with the rational expectations hypothesis). However, this result (among many many others) makes it hard to understand why anyone sincerely considers the assumption of rational expectations a good approximation to reality.

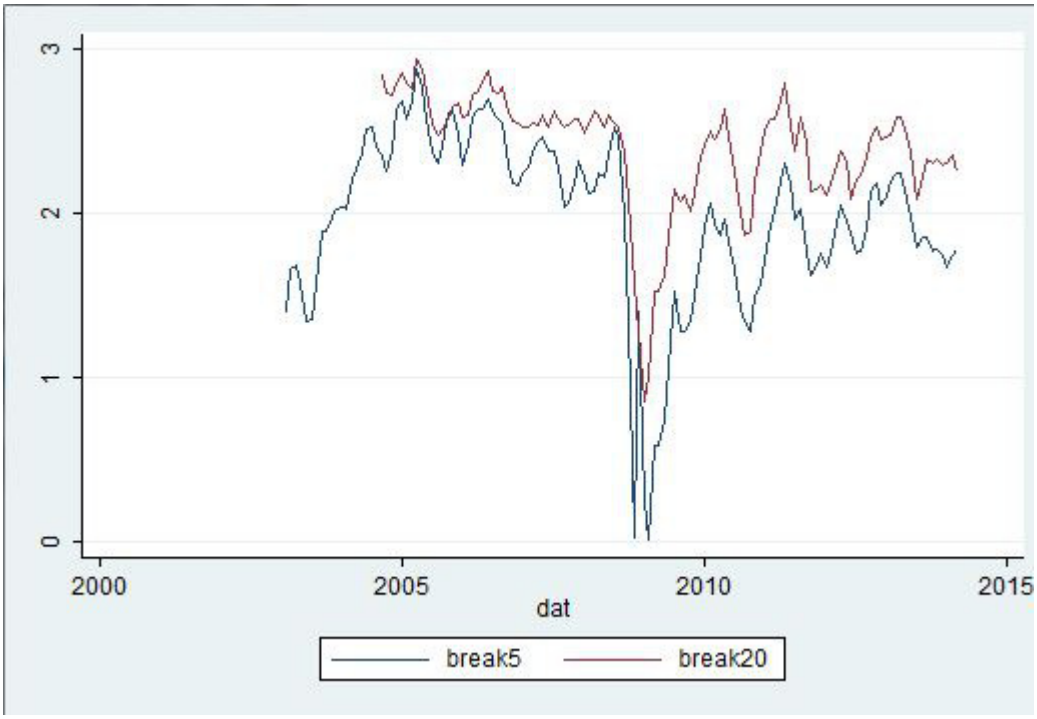
The contrast between conventional views about inflation expectations and the data in the Livingston Survey could hardly be more dramatic. There is almost no evidence that inflation expectations became anchored after 1990 and less than no evidence that Paul Volcker had unusual inflation fighting credibility. A simple regression model of expectations does not fit the data perfectly, but it fits much better than the assumption that survey participants had rational expectations and a quadratic loss function.

TIPS Breakevens

Another source of information on inflation expectations is based on Treasury Inflation Protected Securities (TIPS) whose coupons and principle are multiples of the CPI. A TIPS breakeven is the rate of CPI inflation necessary for the return on a TIPS to be equal to the return on a regular nominal

Treasury security of the same maturity. This is definitely not equal to the CPI inflation rate expected by bond traders. The key reason appears to be that returns on regular Treasuries are low partly because they are extremely liquid – in fact they are used almost as currency by financial firms. This means that the TIPS breakevens are presumably lower than expected CPI inflation. The problem is that the liquidity premium need not be constant. In particular, it is clear that liquidity premia were huge during the financial crisis, that is roughly from October 2008 through May 2009. More subtle changes in liquidity premia might make it unwise to attempt to infer changes in expected inflation from changes in TIPS breakevens.

TIPS breakevens are clearly highly variable. It is not clear if this shows unanchored inflation expectations or variable liquidity premia.



FRED reports constant maturity series for TIPS. Another problem is that, since there are few different TIPS on the market at any given time, the interpolation required to calculate a constant maturity series is more heroic for the TIPS rate than for the nominal Treasury rate. In any case, I use monthly avreages of the five year constant maturity breakeven (break5) and the twenty year constant maturity breakeven (break20). These are very different from the 12 month Livingston forecasts of CPI inflation. Obviously the forecasting horizons are much greater. Also the FRED time series start only in 2003. TIPS were introduced somewhat earlier – it seems concerns about prices of new assets traded in extremely thin markets convinced the St Louis Fed not to publish earlier data. I also use monthly data on the consumer price index (CPI) the personal consumption deflator (PCE) and the Personal consumption deflator excluding food and energy (PCEC).

The 5 year breakeven does not demonstrate ability to forecast CPI inflation. In fact the outcome, annualized CPI inflation over 5 years, and the 5 year breakeven (break5) are slightly negatively correlated. This negative correlation isn't at all nearly statistically significant.

. newey break5 yr5inf, lag(59)

Regression with Newey-West standard errors Number of obs = 74
maximum lag: 59

break5	Coef.	Newey-West Std. Err.	t
yr5inf	-.1014448	.2574171	-0.39
_cons	2.373246	.6778621	3.50

In contrast lagged annual CPI inflation (cpiinf) lagged annualized 6 month CPI inflation (cpiinf6) lagged PCE inflation (pceinf), lagged annualized 6 month PCE inflation (pceinf6), lagged core PCE inflation (pcecinf) and lagged are positively correlated with break5 with correlation coefficients of 0.6000 for cpiinf, 0.6447 for cpiinf6, 0.6277 for cpeinf, 0.6269 for cpeinf6, 0.6153 for pcecinf and 0.6982 for pcecinf6. There is no sign that inflation expectations are anchored.

The R-squared of this regression of break5 on lagged inflation is quite high over 57%. It suggests that inflation in the immediately preceding 6 months has a markedly larger effect on inflation expectations than inflation over the 6 months preceding them

. reg break5 cpiinf cpiinf6 pcecinf pcecinf6

Number of obs = 134
R-squared = 0.5772
Root MSE = .34673

break5	Coef.	Std. Err.	t
cpiinf	.0176023	.0378698	0.46
cpiinf6	.0874388	.0221276	3.95
pcecinf	.2156547	.1533343	1.41
pcecinf6	.3097176	.1235736	2.51
_cons	.8335999	.1328122	6.28

Using only data on inflation in the immediately preceding 6 months the R-squared remains high 56%

. reg break5 cpiinf6 pcecinf6

Number of obs = 134
R-squared = 0.5632
Root MSE = .34969

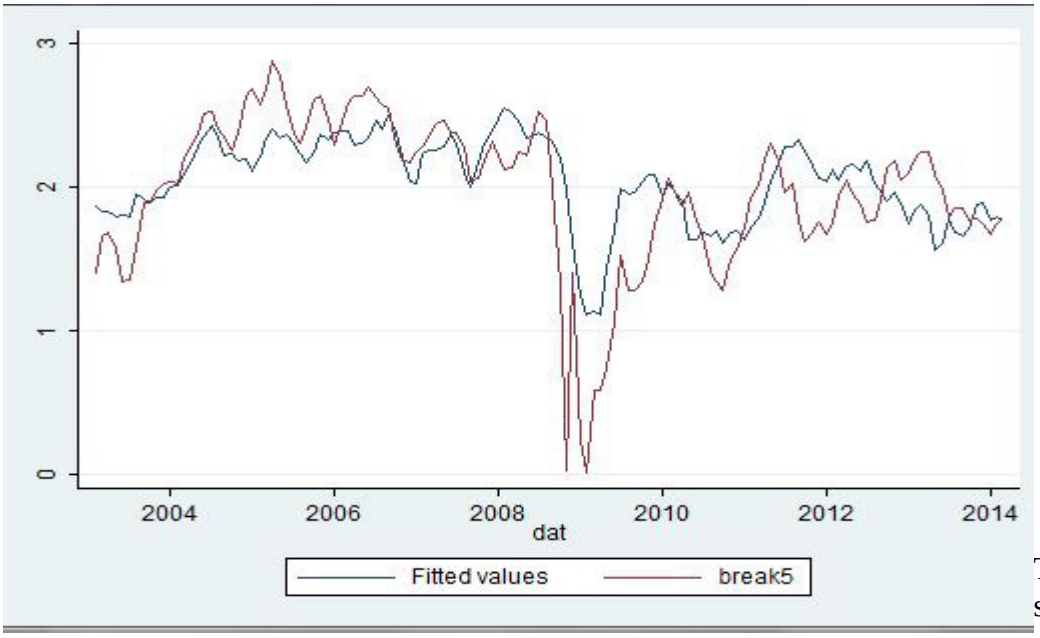
break5	Coef.	Std. Err.	t
cpiinf6	.0865448	.0181592	4.77

```
    pcecinf6 |   .4916303   .0739052     6.65
       _cons |   .9398147   .1090709     8.62
```

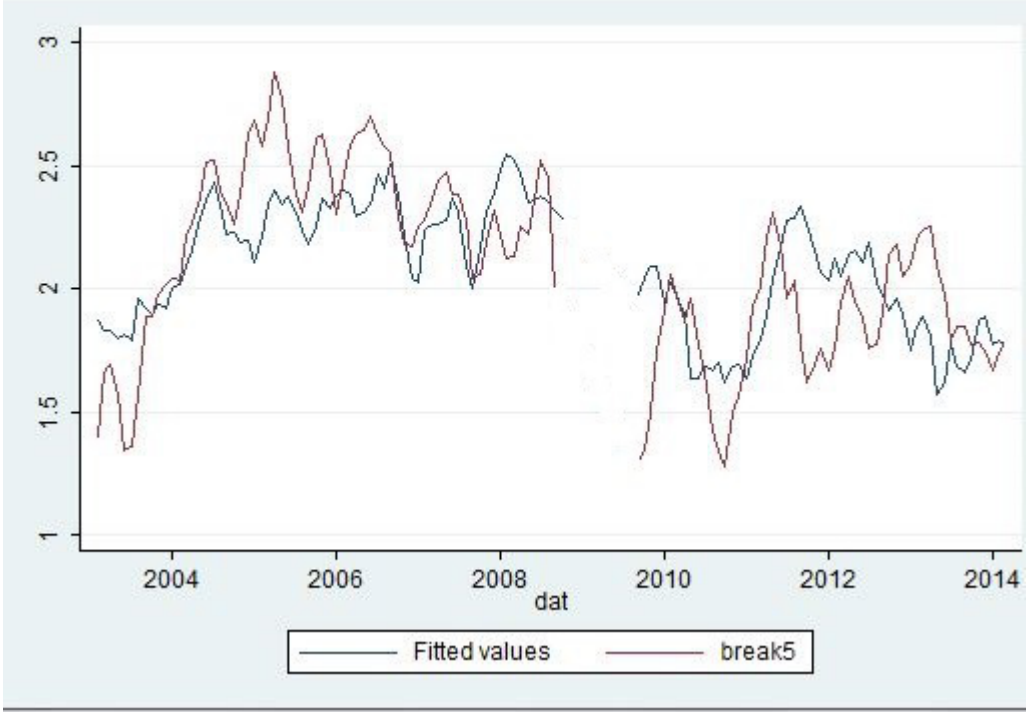
The R-squared drops to 47% if the crisis months September 2008 through July 2009 are excluded

```
. reg break5  cpiinf6   pcecinf6 if dat<2008.7|dat>2009.6

  Number of obs =     123
  R-squared     =  0.4676
  Root MSE      =  .27444

------------------------------------------------------------------------------
      break5 |      Coef.   Std. Err.      t
-------------+----------------------------------------------------------------
     cpiinf6 |   .0428933   .0203086     2.11
   pcecinf6 |   .4569223   .0587317     7.78
       _cons |   1.165426    .093581    12.45
```

As suggested by the R-squared, the fitted values from this regression strikingly track break5 except during the crisis period



This is easier to see if the months September 2008 through July 2009 are excluded



Finally a desperate attempt to test the anchored inflation hypothesis. Since the break5 is a forecast for the following 60 months, the minimal Newey West correction has a maximum lag of 59. Amazingly, the null of no relationship between lagged inflation and break5 is rejected

. newey break5 cpiinf6 pcecinf6,lag(59)

Regression with Newey-West standard errors Number of obs = 134
maximum lag: 59 F(2, 131) = 151.21
Prob > F = 0.0000

break5	Coef.	Newey-West Std. Err.	t
cpiinf6	.0865448	.0212869	4.07
pcecinf6	.4916303	.190832	2.58
_cons	.9398147	.2763341	3.40

For what it's worth, the null is rejected using OLS standard errors, a maximum lag almost half the sample length and a intermediate maximum lag of 24 months

. newey break5 cpiinf6 pcecinf6,lag(24)

Regression with Newey-West standard errors Number of obs = 134
maximum lag: 24 F(2, 131) = 55.62
  Prob > F = 0.0000

break5	Coef.	Newey-West Std. Err.	t
cpiinf6	.0865448	.0194769	4.44
pcecinf6	.4916303	.1593772	3.08
_cons	.9398147	.2512441	3.74

One alarming feature of the data is that the twenty year breakeven (break20) is highly correlated with the five year breakeven (break5). The correlation is over 90% even if the crisis months September 2008 through July 2009 are excluded, the correlation coefficient is 0.8961 . It seems very hard to reconcile this with the efficient markets hypothesis.

Break20 is also well fit with data on inflation in the preceding six months. The regression has an R-squared of 54%

. reg break20 cpiinf6 pcecinf6

Number of obs = 115
R-squared = 0.5384
Root MSE = .24764

break20	Coef.	Std. Err.	t
cpiinf6	.0848471	.0132925	6.38
pcecinf6	.1848228	.0561598	3.29
_cons	1.88272	.0831243	22.65

Which falls to 27% if the crisis months September 2008 through July 2009 are excluded

. reg break20 cpiinf6 pcecinf6 if (dat<2008.7|dat>2009.6)

```
Number of obs =     104
R-squared     =  0.2756
Root MSE      =  .19296

    break20 |      Coef.        Std. Err.         t
------------+------------------------------------------------------------
      cpiinf6 |   .0345398   .0148237     2.33
    pcecinf6 |   .1710509   .0444021     3.85
       _cons |   2.083016   .0711701    29.27
```

It's obviously not possible to correct for autocorrelation over 20 years with less than 10 years of data, but for what it's worth

```
. newey break20  cpiinf6   pcecinf6, lag(24)

Regression with Newey-West standard errors         Number of obs  =       115
maximum lag: 24                      F(  2,   112)  =     38.58
                                     Prob > F       =    0.0000

                             Newey-West
    break20 |      Coef.       Std. Err.         t
------------+------------------------------------------------------------
      cpiinf6 |   .0848471   .0227564     3.73
    pcecinf6 |   .1848228   .1313907     1.41
       _cons |    1.88272   .1886652     9.98
```

Again there is no evidence that inflation expectations are anchored at all.

Conclusions

Inflation expectations are not anchored. A simple regression model fits both the median Livingston Survey respondent's expected CPI inflation and five year TIPS break evens quite well and fits 20 year breakevens fairly well. There is no sign of some widely alleged credibility effects in the Livingston forecasts. The Livingston forecasts add some useful information not in lagged inflation, but this useful role is strongly concentrated in the period of the oil shocks. They are very poor forecasts. A simple regression model estimated using data from June 1973 and before (so before the oil shocks) fits inflation post December 1989 better than the median Livingston forecast.

The next step is to use Livingston forecasts from 2003 though 2013. I hazard some predictions based on the results reported here. First, I expect lagged inflation, especially lagged PCE core inflation, to fit more recent Livingston forecasts too. I do not expect to find a significant increase in expected inflation (after controlling for lagged inflation) when Bernanke was Fed chairman compared to Greenspan in spite of the fact that Bernanke is the first Fed chairman to declare an inflation target higher than lagged inflation (and in spite of huge efforts at unconventional monetary policy). Finally I do not expect the new median Livingston forecasts to markedly outperform simple autoregressive forecasts.