The Appropriate Role of Long-run Inflation Expectations in the

Monetary Policy Process

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1. Introduction
   a. Wide usage of long-run expectations in central bank models of inflation, and in CB policy framework discussions—LR expectations play a central role in the Fed's framework, for example
      i. Background—long period of below-2% inflation (1998-present, with a few modest deviations). How to get inflation more reliably to return to and center around 2%?
      ii. Asymmetric policy framework—why? Persistent deviations of inflation from 2% will cause an erosion in <u>LR expectations</u>, which will make it more difficult to bring inflation back to 2%. A policy that guides inflation to average (loosely) 2%, with deviations both above and below 2%, will <u>anchor LR expectations</u> more firmly at 2%, thus avoiding the supposed problem articulated above.
   b. Logic: LR expectations reflect public/agents' faith in ability/commitment of CB to return inflation to its target
   c. Deviations of LR expectations from target are a problem
      i. Loss of credibility, and
      ii. Impede return of inflation to target (in theory)
   d. Logic thus far is *okay*, although some serious questions
      i. Long deviations of true LR expectations from target signal a credibility issue—reasonable
      ii. But how LR expectations feed into the determination of inflation is less clear, both theoretically and empirically
      iii. Many have taken the logic in b-c as motivation for very simple empirical models of inflation, *viz*

$$\pi_t = \pi_t^{LR} + by_t + rp_t + \epsilon_t$$

iv. This is at best a reduced-form for a more complex set of interactions among long- and short-run expectations, the central bank's goal, belief in the CB's commitment and ability to attaining that goal

v. [NOTE the implication that this model requires only that inflation expectations be at the CB's target, and that the output gap or equivalent be returned to zero. That means one can have a period of above- or below-target inflation with above- or below-potential output, but there is no need to pursue an offsetting period of below-potential output to pull inflation back down. All that's required is that the CB return output to equilibrium, and inflation should as well. It's not at all clear that this is how inflation works.]

vi. At worst, it is a very weak empirical convenience that is based on the fact that inflation has simply not varied much over the past 20 years. Neither have LR expectations (even less so, see figure below). Thus using LR expectations as the intercept in the inflation equation works well as a practical matter (although not perfectly).
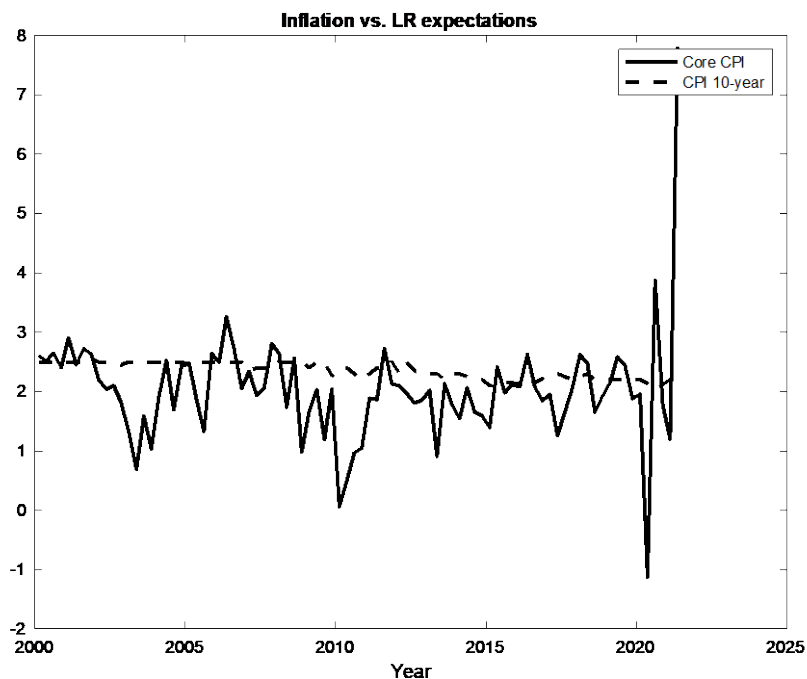
2. Theory

a. Phillips curve logic:

i.   Inflation responds to a measure of aggregate real activity (unemployment gap, output gap, real marginal cost)

ii. Because many prices are set for several quarters (or more), *future* economic conditions—over the period that the price is expected to prevail—should matter

iii. This notion is captured by convenient shorthand in an equation like this:

$$\pi_t = \pi^e_{\{t+1\}} + \beta y_t + shocks$$

iv. Why this equation?

1. If inflation depends on current activity (y_t) and inflation also depends on <u>next period's inflation</u>, then implicitly inflation depends on next period's activity, as well as the *following* period's inflation.

2. This logic can be carried forward indefinitely to imply that inflation depends on a long sequence of (expected) future activity

3. So these Phillips curves are a simple way of reflecting dependence of inflation on expected conditions over the life of a fixed price

v. Where do long-run expectations fit in?

1. If a central bank is actively controlling inflation to move it toward a target (say 2%), then the one-period-ahead expectations in the equation should show a tendency to revert toward that target <u>over time</u>.

2. Longer-term expectations should show that tendency even more clearly[1]

3. One can think of short-run expectations as "anchored" by the longer-run expectations, although that in fact reflects the belief that the central bank will anchor inflation to the target π^*, over time.

$$\pi \to \pi^* \ implies \ \pi^{LR}_t \to \pi^* \ and \ \pi^e_t \to \pi^{LR}_t$$

Where the arrow should be understood to mean "tends toward."

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[1] In practice, how clearly depends in part on the exact definition of the long-run expectation. An expectation measure that captures the *average* over the next ten years, as in the Survey of Professional Forecasters, embodies both near-term and longer-term expectations. The one-year expectation for inflation 10 years hence would likely be a better measure of the CB's commitment to its target. The TIPS "5/5" measure displayed below, which captures the five-year average expectation five years from now, is an intermediate case.

vi. Does this mean that long-run expectations fundamentally <u>determine</u> actual inflation?

    1. Not quite—they're an indication of whether agents understand the tendency for the central bank to return inflation to target.

    2. So they're an interesting <u>measure</u> of how much faith people put in the CB's inflation-guiding policy

    3. But in theory, they don't <u>independently</u> move inflation to or away from its target. The state of economic activity, together with the public's expectations of how the CB will respond to deviations of inflation from target (by influencing activity), determine inflation.

    4. That latter mechanism acts through price-setters' <u>expectations</u> of future activity—as future activity is influenced by the CB's policy actions in response to deviations of inflation from its target.

vii. At a more pragmatic level, one can question a number of aspects of this Phillips curve logic:

    1. How forward-looking are price-setters in determining today's prices? That is, how much do <u>any</u> expectations matter for the determination of inflation and prices? A huge amount of literature has wrestled with this question. A brief summary of the results might read:

        a. Inflation appears to respond to <u>some</u> expectations, to some extent.

        b. Those expectations are not well-represented by the rational expectations paradigm, as expectations tend to respond more sluggishly to information than the RE paradigm would suggest.

    2. Does the shorthand of using expectations for next period's inflation work well in the real world as a proxy for some forward-looking concern for economic conditions over the horizon during which a price may be fixed?

    3. Does any price-setter actually pay significant attention to his own or anyone else's expectations for long-run inflation rates in setting today's prices? (Some evidence bearing on that is presented below)

4. Some of these matters will be taken up in the next section on the empirics of inflation determination.

b. Why this all matters:

    i. If the assumed role that LR expectations play in influencing actual inflation is wrong, then basing one's policy framework on that assumption can lead to undesirable outcomes, for a number of reasons:

        1. One might choose to push inflation above 2% so as to move LR expectations up, hoping that will return inflation to 2% more reliably. If that linkage does not exist, the benefits of pushing inflation up above 2% will not occur.

        2. If one hopes that the <u>expectation</u> of future looser monetary policy will help stimulate activity (and inflation) today, but expectations don't work that way, then the economy could get stuck in a bad situation in which inflation falls, policy promises more vigorous action in the future, but that has no effect on inflation or employment today, and the economy remains stuck—perhaps for a prolonged period—in a low-inflation, low employment equilibrium. This sounds reminiscent of the past 20 years of inflation experience in the US and around the developed world.
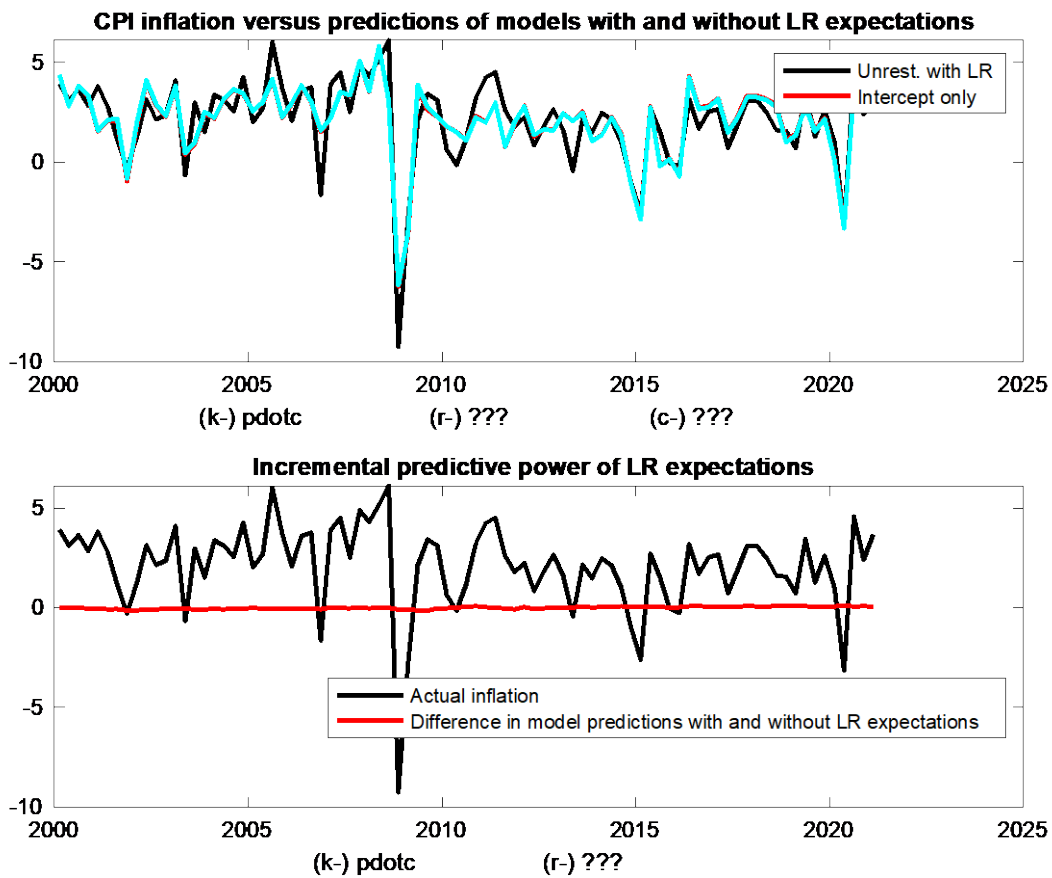
c. Relevance today

    i. Inflation is above 2% today.

    ii. Policymakers take some comfort from the fact that LR expectations have not moved up much to date.

    iii. This, in their thinking, should "anchor" inflation, pulling it back down to 2% over the longer run.

    iv. If that "anchoring" logic is wrong, inflation may not come back to 2% as policymakers hope. That could in turn necessitate engineering a recession to bring inflation down. That would not be fun.

    v. As an aside, I am less concerned that high inflation will be the problem in coming years. Not because LR expectations will save the day, but because I think most all of the recent price changes reflect a complicated and unprecedented set of one-time adjustments coming out of an unprecedented,

pandemic-driven downturn. It doesn't seem like this is the time for all price and wage setters to believe that 5% will become the new inflation norm, so they will build that into their price increases, on average. Instead, businesses are coping with supply shortages and bursts in demand that are *industry-specific*, and that should work themselves out over time without producing always-faster-rising prices.

vi. In some locations, wages may well rise as companies adjust wages for their lowest-paid workers, in part as a matter of social justice, in part in response to a shortage of workers who are willing to return to work at their previous wage. Adjustments at the lower end will very likely necessitate adjustments in wage brackets above the lowest. While such adjustments will be staggered across time, they do not necessarily imply a rise in <u>inflation</u>, but rather a one-time adjustment in the level of wages.

vii. For goods prices, the lumber industry is a good case in point: Prices spiked as demand rose with largely fixed mill capacity, in the short run. But over time, demand was curtailed by the higher prices, and mills were brought back on line in response to higher prices, increasing supply and dramatically reducing market prices for lumber. It's likely that similar dynamics will operate, with specifics of timing and magnitude that will vary by market, for other goods and services.

3. Empirics
   a. Consider two simple (somewhat reduced-form) models for inflation:
      i. Inflation depends on LR expectations, short-run expectations, activity, a relative price shifter, and an intercept
      ii. Inflation depends on the same determinants <u>except</u> that it excludes LR expectations
      iii. Run simple OLS regressions of core CPI on these determinants (for these purposes, with survey-based expectations, OLS is not a bad estimator)
      iv. Compare the "fit" of these regressions for the two models

CPI inflation versus predictions of models with and without LR expectations

Legend: Unrest. with LR | Intercept only

(k-) pdotc   (r-) ???   (c-) ???

Incremental predictive power of LR expectations

Legend: Actual inflation | Difference in model predictions with and without LR expectations

(k-) pdotc   (r-) ???

b. Results

    i. The top panel shows that you can't see the difference between the two fitted values. It's not as if the LR expectation is explaining any important fluctuations in inflation over the past 20 years

    ii. The bottom panel shows actual inflation plotted with the difference in fitted values. Nothing much going on there.

    iii. Because scaling could obscure an important correlation, the following figure shows the difference plotted against actual inflation, on separate scales. The correlation is 0.028. The correlation looks like it might have improved in recent years, but looks can be deceiving: the simple correlation from 2014-present is -0.057.[2]

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[2] The long-run expectation enters insignificantly in these models, hence it is not surprising that we see little evidence of correlation between the difference in the fitted values with and without long-run expectations, and the actual inflation rate.
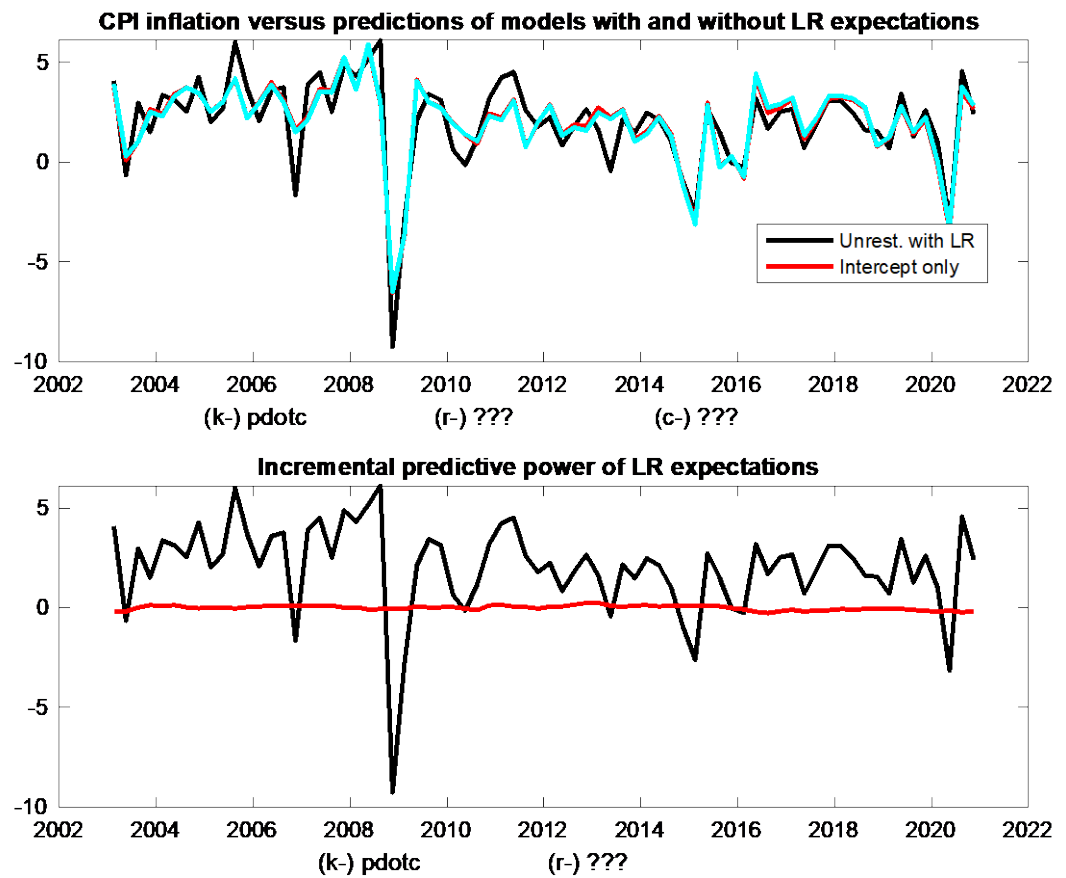
Are we missing something?
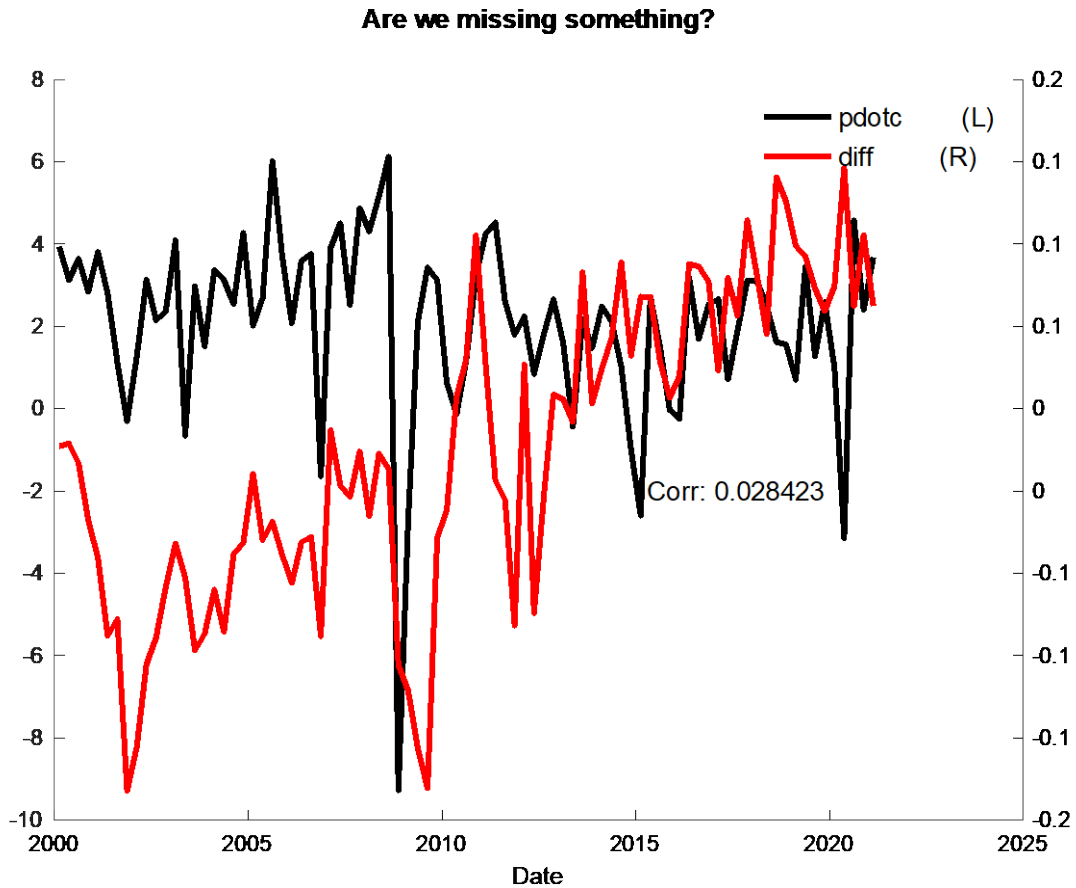
The exercise is repeated using the TIPS 5-year forward 5-year inflation rate as the LR inflation expectation. The result is essentially the same.[3] In the few cases in which the prediction that includes the LR expectation differs from the one that does not, the differences sometimes lie closer to the actual, sometimes not. There is clearly no distinct advantage to including the LR expectation in this simple predictive model context.

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[3] The TIPs data begin in 2003, so we lose the 2000-2002 portion of the sample that is available for the SPF expectation.

CPI inflation versus predictions of models with and without LR expectations

(k-) pdotc   (r-) ???   (c-) ???

Incremental predictive power of LR expectations

(k-) pdotc   (r-) ???

c. More constrained Phillips-curve type models

    i.

d. Do real people forecast inflation using long-run expectations? Evidence from micro data on survey expectations

In an earlier working paper, I provide evidence that professional (and household) forecasters do not use the information in <u>aggregate</u> and publicly-available forecasts of long-run inflation. This is true across time periods and forecast horizons.

Perhaps of equal interest is whether forecasters use <u>their own</u> long-run inflation forecasts to "anchor" or otherwise guide their short- to medium-run inflation forecasts. The following table provides evidence bearing on this question. There are no information issues in these regressions—all the data are provided by the forecasters in the survey at survey time, and thus all information is properly timed and available to the forecasters. The regressions are

cast in terms of forecast revisions, so that they capture whether <u>news</u> in the long-run forecasts affects the revision of shorter-term forecasts.[4]

The results suggest strongly that forecasters do not use their own long-run forecasts as important inputs to their own inflation forecasts. In no case does the long-run forecast enter with even 5% significance, and once one adds additional controls to the regression (other forecasts provided by the survey respondents that might plausibly enter their forecasts, such as unemployment forecasts), none of the results breach the 10% significance level. For these forecasters, neither aggregate nor individual forecasts materially influence their inflation outlook, counter to the centrality of such expectations that is assumed by many central banks today.

Professional forecasters: Inflation forecast revision related to revision in individuals' long-run expectations?								
Horizon	t	t+1	t+2	t+3	t	t+1	t+2	t+3
10-year	-0.43	0.33	0.19	0.08	-0.64	0.31	0.10	-0.05
	(0.425)	(0.057)	(0.288)	(0.687)	(0.223)	(0.120)	(0.592)	(0.795)
Addit. Controls?	N	N	N	N	Y	Y	Y	Y
p-value in parentheses Sample 1991-2020 quarterly								

(Reproduce key results in table from working paper on response to revisions in the <u>aggregate</u> 10-year inflation expectation.)

  e. What determines long-run inflation expectations?

A leading model of long-run expectations posits simply that expectations are determined by the long history of realized inflation. If inflation has been, on average, near two percent, then long-run expectations recognize that fact and center on two percent. If realized inflation lies persistently

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[4] Can explain the rationale for this a bit more.

below two percent—where persistence is measured not in months but in years—then expectations may slip below two percent.

Of equal interest is whether the way in which actual inflation feeds into long-run expectations changes with significant changes in the monetary policy regime. In particular, much of the literature suggests that expectations today should be <u>less</u> responsive to fluctuations in inflation than they were 20-30 years ago. The rationale is that, compared to the 1960s and 70s, most people expect the Fed to be more systematic and aggressive in moving inflation towards its two percent objective, and thus temporary fluctuations in inflation are less likely to be persistent.

A simple test of both propositions is presented in the figure and table below. The figure displays the fit from a model that makes long-run expectations a function of a long moving-average of realized inflation.[5] When estimated from 1990 to the present, the model shows a very long "memory"—inflation realizations from years earlier still have some effect on long-run expectations today. But that sample mixes the era in which the Fed did not have an explicit inflation target, and during which inflation varied between 2 and 5 percent. Still, the fit, as shown in the figure, is quite good.

Breaking the sample into pre- and post-2011, the year in which the Fed announced its explicit inflation objective, is revealing in two ways. First, the amount of "memory" implicit in the model declines in the more recent period. Long-run expectations are "forgetting" earlier inflation realizations more rapidly.

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[5] The regression model is

$$\pi_t^{LR} = \alpha \pi_{t-1}^{LR} + \beta \pi_{t-1}$$

Simple model of gradual inflation feed into long-run expectations
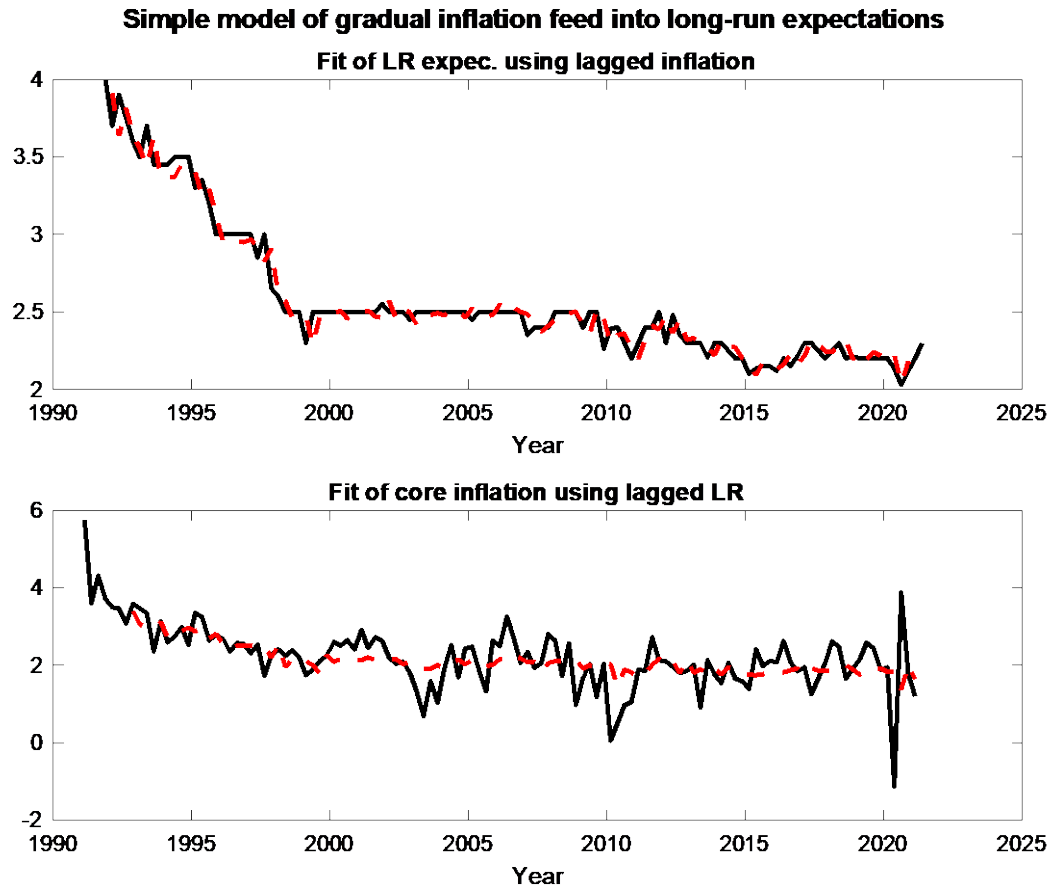
Second, a test of equality of the model's coefficients across the two regimes decisively rejects equality. The likelihood that the two sets of coefficients differ due to change has a *p*-value of 1.e-13. This suggests strongly that expectations behavior has changed over time, in a way that is consistent with a central bank that more vigorously anchors inflation at its two percent objective. As a consequence, long-run expectations are even more firmly anchored at two percent, and less perturbed by short-term deviations of inflation from its goal.

All of which would be more interesting if such expectations fed convincingly into inflation. But as we have shown, neither realized inflation nor shorter-term inflation expectations appear to bear much relation to the modest fluctuations in long-run expectations. In sum, long-run expectations (from professional forecasters) appear to be cognizant of important changes in monetary policy behavior. As an indication of whether these forecasters believe the Fed's commitment to its goal, they can be quite useful. But as a determinant of actual inflation, they are far less compelling.

4. Implications for monetary policy

Recall that a key link in the chain of logic underlying the Fed's monetary policy framework (announced August 2020) is this: Persistently low inflation pulls down long-run expectations, which in turn slows the return of inflation to its objective, because below-2% long-run expectations exert a drag on realized inflation.

The problem with this chain of logic is that it does not hold in the data. In examining aggregate data, there is no evidence that long-run expectations play a significant role in determining the path of actual inflation. In (survey) expectations data, there is no evidence that forecasters modeling the inflation rate take into account either the aggregate or their own individual long-run inflation forecasts.

Thus the concept that lies at the center of the policy framework should instead be accorded a secondary role: As a monitor of the public's belief in the Fed's commitment to—and ability to achieve—its inflation objective. As a high-level performance metric, long-run expectations may have some value. As a lynchpin in how the Fed influences inflation, and how it should structure its framework, it is rather unconvincing.

What are the risks in basing monetary policy on the premise that long-run expectations are so central? To my mind, they are several-fold:
- If monetary policy takes comfort when long-run expectations are stable and near two percent, they might base policy on this comfort and mistakenly infer that inflation will naturally return to its objective. That could be a mistake.
- The design of the new framework, which critically hinges on an important causal role for long-run expectations in determining inflation, could go seriously awry if that causal linkage does not exist.
    - An explicit strategy embodied in the framework is to offset periods of below- (above-) goal inflation with periods of above- (below-) goal inflation. The rationale is that if inflation averages two percent, with roughly equal time above and below, then

long-term inflation expectations will more likely center reliably on two percent. That in turn will keep inflation centered on two percent.

o But if the second part of that linkage is not operative, then two undesirable outcomes are possible:

- The Fed is successful in pushing inflation above two percent following a sub-2% period, but long-run expectations do <u>not</u> then pull inflation back down, and the Fed is now stuck with above-target inflation that requires a recession to pull it back down. That conundrum is compounded by the fact that the gearing from the Fed's policy tools through real activity appears to be lower now, requiring a larger recession to move inflation back down.

- The whole rationale for pursuing an "average inflation targeting" regime (formally or informally) rests on the effects of inflation on long-run expectations (plausible), coupled with the effects of long-run expectations on inflation (dubious). If this second linkage does not exist, the rationale for the framework starts to unravel.

o Another potential flaw in the new framework's approach is whether expectations embody the Fed's plan to exploit these inflation dynamics. That is, some of the benefits of the framework derive from the front-loading of stimulus that is promised down the road—the additional policy easing that will be required to raise inflation above its target. If people believe that will happen and have approximately rational expectations, then they will lower the expected path of nominal rates today, and raise the expected path of inflation later, lowering real rates at the onset of a low-inflation episode. If on the other hand expectations are more on the Missouri "Show Me" side of things, requiring actual rises in inflation to occur before anyone believes inflation will actually rise later, then these benefits evaporate. Worse yet, they could imply that the economy gets stuck in a cycle of low inflation, low expectations, higher real rates, lower inflation, etc. This would make it very difficult to raise inflation, and could leave the economy in more prolonged recessionary periods. The evidence in hand suggests that, on average, inflation expectations are not rational in the limited sense that macroeconomists employ, but exhibit a fair amount of inertia and backward-looking behavior (cite the Fed's summary from the Framework documents, which summarizes the empirical literature on this point).

5. Conclusion