A Phillips Curve with Anchored Expectations and Short-Term Unemployment

Laurence Ball
Johns Hopkins University
Sandeep Mazumder
Wake Forest University

Motivation

- A key perennial question in macroeconomics is: how does unemployment affect inflation?
- Research on the "Phillips curve" has existed for decades, but the Great Recession of 2008-2009 has prompted a fresh look at this well-known model
- In particular, many have sought to solve the puzzle of the "missing deflation" of the recession. Generally speaking, two main solutions have been proposed
- First is the idea that inflation expectations have been anchored, and second, inflation depends not on the aggregate unemployment rate, but on the short-term unemployment rate
- These two ideas are presented in the literature as competing explanations for recent inflation dynamics

Preview of Findings

- We find that a highly parsimonious Phillips curve fits inflation data since 2000 exceedingly well
- We then generalize this simple model to capture inflation dynamics for both pre- and post-2000
- We find that for 2000 onwards, the generalized version of our Phillips curve is close to the simple model with constant expected inflation
- For 1985-1999, our equation is more like the Phillips curve found in textbooks, mainly since adaptive expectations explain inflation expectations well during these years
- Overall we find that U.S. inflation data are consistent with an expectations-augmented Phillips curve with short-term unemployment, where the behavior of inflation expectations became anchored around 2000

Measuring Core Inflation

- Before explaining the behavior of core inflation we must first determine which way to measure core inflation
- The most popular measure is undoubtedly the CPI excluding food and energy (CPIX)
- However it is not obvious, in theory, why changes in certain relative prices should influence inflation: why should inflation depend on food and energy and not on clothing?
- Many (such as Dornbusch and Fischer, 1990, and Blanchard and Gali, 2008) have answered this question by modeling certain sectors (such as food and energy) with flexible prices and other sectors with sticky prices
- In this type of model, a shock that raises food and energy prices while other prices are constant will lead to a rise in aggregate prices

- Ball and Mankiw (1995) address the problem in a different way: rather than assuming certain industries have flexible prices while others are sticky, they make price adjustment endogenous
- Firms experience shocks to their equilibrium relative prices and decide whether to pay a menu cost and adjust prices
- In this model, inflation depends on the distribution of price changes across industries: for instance, if the distribution is skewed to the right, this means that many firms have desired price increases large enough to trigger adjustment, which then leads to a rise in the aggregate price level
- In this setup, supply shocks are best measured by asymmetries in price distributions. Ball and Mankiw find that both supply shocks often behave similarly, but for the period of 1949-1989 only price-change asymmetries are significant

- Therefore we believe that a better measure of core inflation is the weighted median inflation rate, constructed by the Cleveland Fed, as opposed to CPIX prices
- Furthermore, the data seem to argue that the median inflation rate does a good job of filtering out movements in headline inflation caused by large relative-price changes in any industry (not just food and energy)
- This can be seen when using Stock and Watson's (2007) procedure for decomposing inflation into its permanent and transitory components

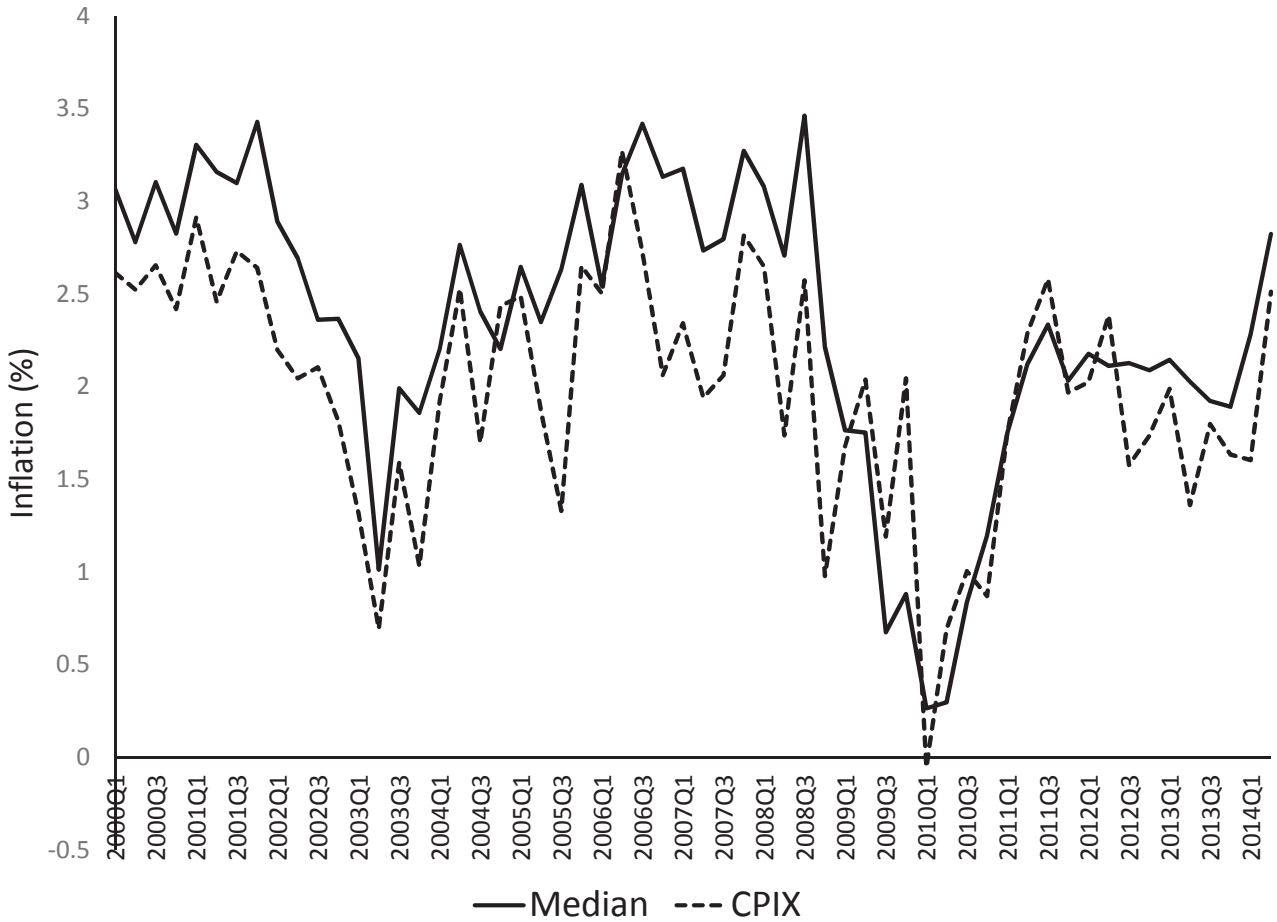
Actual Inflation vs. Permanent Component of Inflation

Median Inflation

CPIX Inflation

Movements in median inflation are almost entirely permanent, especially in the last decade, which is a good property of core inflation.

We can also see the appeal of median by comparing alongside CPIX:



Friedman's Phillips Curve

- In his AEA Presidential Address Friedman (1968) stated that inflation depends on expected inflation and the deviation of unemployment from its natural rate:

$$\pi_t = \pi_t^e + \alpha(u_t - u_t^*) + \epsilon_t, \quad \alpha < 0,$$

- Friedman went further by saying that inflation expectations are generally well-proxied by past inflation:

$$\pi_t = \pi_{t-1} + \alpha(u_t - u_t^*) + \epsilon_t,$$

- This is the accelerationist Phillips curve, a staple of undergraduate textbooks

- This version of the Phillips curve has guided much of the recent literature on U.S. inflation dynamics (such as Gordon, 2013, Stock and Watson, 2009, and Ball and Mazumder, 2011)
- Typically these papers seek to explain quarterly data on core inflation, where expected inflation is captured by four or more lags of past core inflation
- In addition, lags of unemployment and time-varying u^* are commonly implemented
- As Stock and Watson (2010) argue, this accelerationist Phillips curve has had enduring appeal since it captures a "broad historical regularity," at least since 1960 where U.S. recessions led to decreases in the inflation rate

Missing Deflation

The historical regularity of the Phillips curve helps explain why recent U.S. inflation behavior has puzzled many macroeconomists:

"The surprise [about inflation] is that it's fallen so little, given the depth and duration of the recent downturn. Based on the experience of past severe recessions, I would have expected inflation to fall by twice as much as it has." (John Williams, 2010)

- During the Great Recession unemployment rose above 10%, and was still above pre-recession levels at the time of writing this paper
- The accelerationist Phillips curve estimated through 2008 predicts that inflation should have been negative in 2011 and should have continued to fall ever since
- In reality, the current level of core inflation is close to its 2007 level: from 2007Q4 to 2014Q2 the 4-quarter moving average of CPIX inflation fell from 2.3% to 1.9% (3.0% to 2.2% with median inflation)

Anchored Expectations

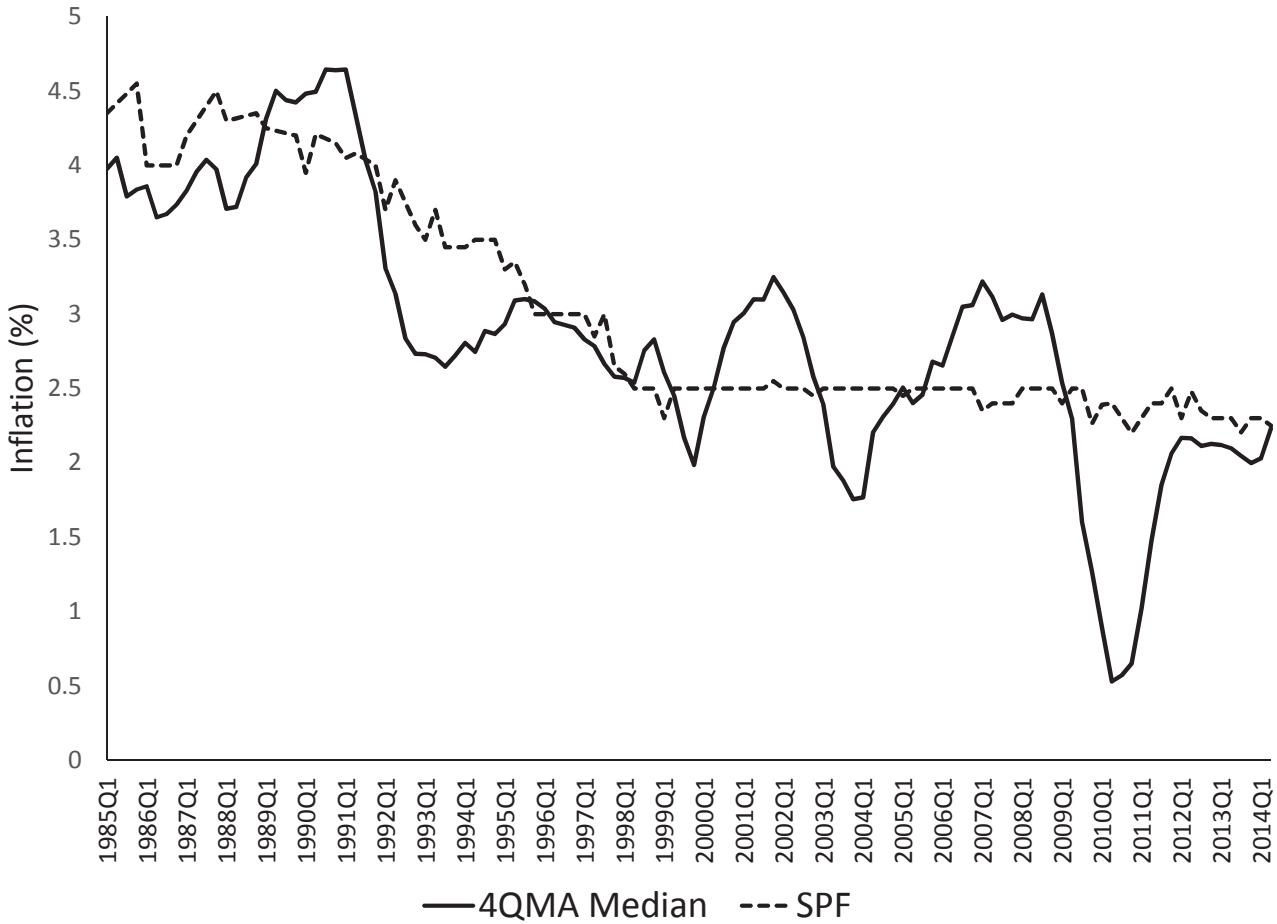
Why haven't we seen deflation? Many policymakers have advocated the anchoring of inflation expectations:

"Inflation expectations appear reasonably well-anchored, and both inflation expectations and actual inflation remain within a range consistent with price stability." (Ben Bernanke, 2010)

"Well-anchored inflation expectations have proven to be an immense asset in conducting monetary policy. They've helped keep inflation low and stable while monetary policy has been used to help promote a healthy economy. After the onset of the financial crisis, these stable expectations also helped the United States avoid excessive disinflation or even deflation." (Janet Yellen, 2013)

- In other words, the expectations-augmented Phillips curve still holds, but the behavior of expectations has changed
- In the past π^e may have depended on lagged inflation, but today it is fixed at the Fed's 2% inflation target
- With a constant π^e, the Phillips curve becomes a relationship between unemployment and the level of inflation, not the change in inflation
- According to an accelerationist Phillips curve, a recession leads to lower inflation as long as $u > u^*$
- With anchored expectations, a period of high unemployment implies a low level of inflation, but *not* an ever-declining level

- The idea of anchored expectations is firmly supported by the long-term inflation forecasts in the Survey of Professional Forecasters
- From 1985 to 2000, SPF forecasts drift down along with the realized levels of median inflation
- In contrast, SPF forecasts are almost constant at 2.5% from 2000 onwards, despite substantial movements in median inflation
- Note that the Fed's 2% target is for core PCE. On average core CPI inflation has been 0.5% higher than core PCE inflation since 1980


Inflation (%)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1985Q1
1986Q1
1987Q1
1988Q1
1989Q1
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
2002Q1
2003Q1
2004Q1
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
4QMA Median
SPF

Short-Term Unemployment

- The traditional Phillips curve includes the aggregate unemployment rate. A growing number of researchers replace this variable with short-term unemployment (% of labor force unemployed for $\leq$ 26 weeks)
- The rationale is that the long-term unemployed are "on the margins of the labor force" (Krueger et al., 2014). In other words, the long-term unemployed are less attractive to employers than the short-term unemployed and thus exert less influence on prices
- Plotting short-term unemployment against total unemployment, we see that long-term unemployment rose sharply over 2008-2009
- Total unemployment has remained high even in 2014, whereas short-term unemployment is almost back to its pre-recession level


Unemployment (%)
12
10
8
6
4
2
0
1985Q1
1986Q1
1987Q1
1988Q1
1989Q1
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
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2013Q1
2014Q1
STU
U

Explaining Core Inflation Since 2000

- Next we turn to our central econometric results
- We will see that from 2000 to 2014Q2, core inflation is well-explained by a Phillips curve with anchored expectations and short-term unemployment
- There is also no evidence of a shift in this relationship during the Great Recession
- The fit of the model deteriorates markedly if we measure expected inflation with lagged inflation, or if we use total rather than short-term unemployment
- Both adjustments to traditionally-estimated Phillips curves are vital

Our Preferred Specification

- We consider a version of the expectations-augmented Phillips curve (Friedman's model), but with constant expected inflation and short-term unemployment
- Following Staiger et al. (1997) and Gordon (2013) we specify an equation for quarterly data which uses four lags of the unemployment 'gap':

$$\pi_t = \pi^e + \sum_{j=1}^{4} \alpha_j (u^s_{t-j} - u^{s*}_{t-j}) + \epsilon_t$$

- For parsimony we impose two restrictions on this equation: first we assume the natural rate u^{s*} is constant over time, and second we assume that the coefficients on the four unemployment lags are equal

- This leaves us with the following equation to estimate:

$$\pi_t = \phi + \alpha \overline{u}^s_{t-1} + \epsilon_t$$

- where $\overline{u}^s_{t-1}$ is the average level of short-term unemployment from $t-4$ to $t-1$, and $\phi = \pi^e - \alpha u^{s*}$
- In this parsimonious Phillips curve, inflation depends on a constant and a single variable capturing labor slack
- We can see that π^e and u^{s*} are not separately identified, but assuming $\pi^e = 2.5$ allows us to easily back out $u^{s*} = (2.5 - \phi)/\alpha$

Preferred Specification Results

$$\pi_t = \phi + \alpha \overline{u}^s_{t-1} + \epsilon_t$$

(1) Median Inflation			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	6.670	7.177	6.781
	(0.704)	(0.401)	(0.332)
α	-0.960	-1.053	-0.981
	(0.175)	(0.083)	(0.076)
$\overline{R}^2$	0.568	0.823	0.809
Stability Test	—	—	0.594
(2) CPIX Inflation			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	5.879	4.325	4.690
	(0.798)	(0.841)	(0.417)
α	-0.891	-0.519	-0.597
	(0.201)	(0.174)	(0.098)
$\overline{R}^2$	0.401	0.266	0.412
Stability Test	—	—	0.314

- With median inflation, the fit of this Phillips curve is excellent: the $\overline{R}^2$ is 0.81 for the full sample, and there is no evidence of a structural break between the first and second subsamples
- The coefficient on short-term unemployment is approximately -1.0, which means that a one percentage point rise in average short-term unemployment (over the previous four quarters) lowers core inflation by one percentage point
- With $\pi^e = 2.5\%$, this implies a natural rate of short-term unemployment of 4.4%
- Measuring core inflation with CPIX prices sees the fit of the model decline: the $\overline{R}^2$ falls to 0.41, although we still do not find a structural break
- However the point estimate of the coefficient on short-term unemployment changes from -0.89 to -0.52 from the pre- to post-2008 periods

While the CPIX results are not as favorable as the median inflation results, comparing the paths of core inflation to the fitted values (from the full sample), still shows that the model does well

Core Inflation vs. Fitted Values from Preferred Phillips Curve, 2000Q1-2014Q2

Weighted Median Inflation-Quarterly

CPIX Inflation-Quarterly

Explaining Core Inflation Since 2000

Weighted Median Inflation-4QMA

CPIX Inflation-4QMA

- These figures confirm that our Phillips curve explains median inflation well throughout the 2000s
- Median inflation has gone through two cycles of decline and recovery, with troughs during the "deflation scares" of 2003 and 2010
- These two inflation cycles correspond closely to movements in short-term unemployment in the opposite direction
- The fit of the model for CPIX does fairly well also, particularly when considering the smoothed series

More Conventional Specifications

- Our preferred specification departs from the textbook Phillips curve in two ways: with fixed inflation expectations and short-term rather than total unemployment
- We can next demonstrate the importance of these two modifications
- The following table shows our preferred specifications against some alternatives: switching to total unemployment, switching to lagged inflation expectations, and doing both at the same time

(1) $\pi_t = \phi + \alpha \overline{u}^s_{t-1} + \epsilon_t$			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	6.670	7.177	6.781
	(0.704)	(0.401)	(0.332)
α	-0.960	-1.053	-0.981
	(0.175)	(0.083)	(0.076)
$\overline{R}^2$	0.568	0.823	0.809
Stability Test	—	—	0.594
(2) $\pi_t = \phi + \alpha \overline{u}_{t-1} + \epsilon_t$			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	5.542	4.168	4.282
	(0.584)	(0.668)	(0.366)
α	-0.567	-0.291	-0.309
	(0.121)	(0.095)	(0.069)
$\overline{R}^2$	0.536	0.334	0.553
Stability Test	—	—	0.206

$$(3)\ \pi_t = \phi + \tfrac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) + \alpha \overline{u}^s_{t-1} + \epsilon_t$$

	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	1.994	0.972	1.070
	(1.143)	(1.130)	(0.743)
α	-0.465	-0.206	-0.233
	(0.289)	(0.245)	(0.180)
$\overline{R}^2$	0.206	0.238	0.448
Stability Test	—	—	0.710

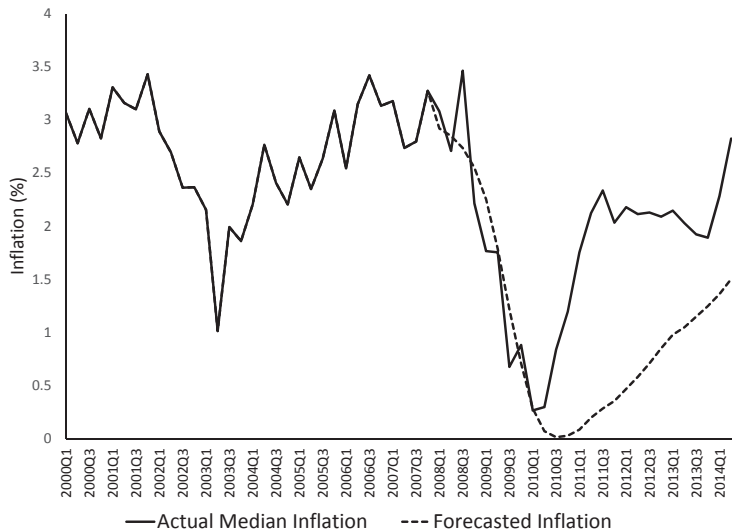
$$(4)\ \pi_t = \phi + \tfrac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) + \alpha \overline{u}_{t-1} + \epsilon_t$$

	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	1.042	-1.049	0.017
	(0.833)	(0.805)	(0.393)
α	-0.193	0.126	-0.0003
	(0.178)	(0.104)	(0.068)
$\overline{R}^2$	0.131	0.275	0.401
Stability Test	—	—	0.021

- In regression (2) [with total unemployment], we see the fit of the model declines from 0.81 to 0.55
- In addition, the coefficient on unemployment is almost double in the first subsample compared to the second, rather than staying stable (although we do not reject stability of the equation)
- In models (3) and (4) we use lagged inflation expectations as in Ball and Mazumder (2011), with short-term and total unemployment respectively
- In both cases the full sample $\overline{R}^2$ falls below 0.50 and the point estimates of the unemployment coefficient differ markedly across subsamples
- To see where the missing deflation puzzles come from, we then take the Phillips curve estimates from the 2000-2007 regressions, and use these estimates to produce forecasts for 2008-2014

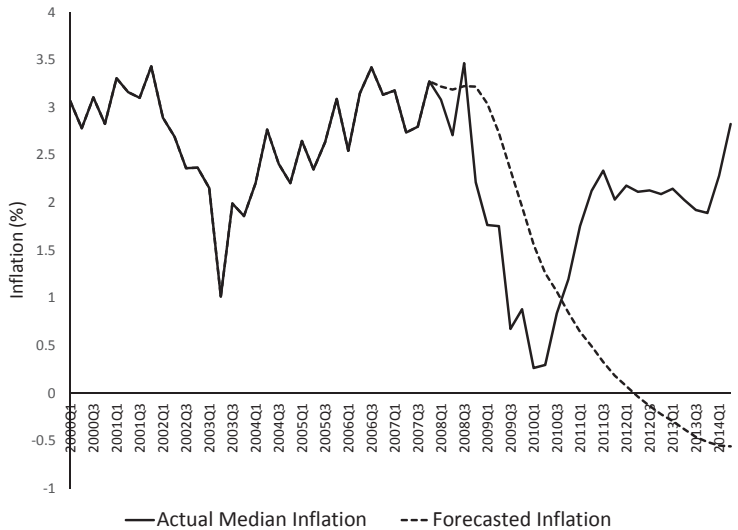
Forecasts for Median Inflation for 2008Q1-2014Q2

Constant Expectations, STU

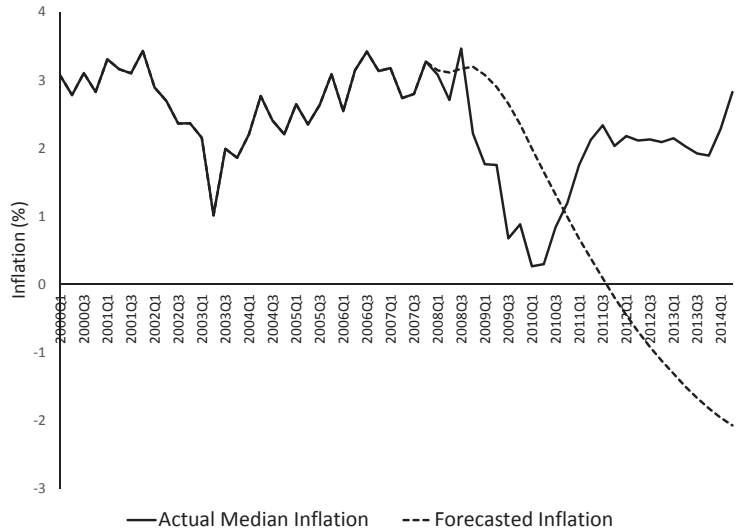


Constant Expectations, U

Explaining Core Inflation Since 2000



Lagged Expectations, STU



Lagged Expectations, U

- With constant inflation expectations and short-term unemployment, the forecasts from the pre-recession data match up very closely with the post-recession inflation dynamics
- If we switch to total unemployment, forecasts are accurate until 2010, but then under-predict inflation: forecasted inflation is 2.1% below actual inflation in 2011Q3, and 1.3% at the end of the sample
- This reflects the fact that the Great Recession raised total unemployment more sharply and persistently than short-term unemployment. As a result, the model with total unemployment predicts lower levels of inflation
- When using lagged inflation (i.e. an accelerationist model), we see predictions of deflation (with either short-term or total unemployment)
- With short-term unemployment, the model predicts -0.6% inflation by 2014Q2, while total unemployment suggests -2.1% (actual quarterly median inflation was 2.8%)

- Ball and Mazumder (2011) argue that an accelerationist Phillips curve fits inflation data well during the Great Recession
- However the data in that paper ends in 2010Q4, which happens to be near the trough for inflation in its most recent cycle
- As the above figures show, accelerationist equations do a decent job of predicting inflation for 2007-2010, but also predict that inflation will continue to fall whereas it has not
- This has persuaded us that inflation expectations are strongly anchored; something we doubted in our 2011 paper
- Next consider the same regressions again, this time with CPIX inflation

(1) $\pi_t = \phi + \alpha \overline{u}^s_{t-1} + \epsilon_t$			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	5.879	4.325	4.690
	(0.798)	(0.841)	(0.417)
α	-0.891	-0.519	-0.597
	(0.201)	(0.174)	(0.098)
$\overline{R}^2$	0.401	0.266	0.412
Stability Test	—	—	0.314
(2) $\pi_t = \phi + \alpha \overline{u}_{t-1} + \epsilon_t$			
	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	4.763	2.666	3.104
	(0.616)	(0.658)	(0.360)
α	-0.513	-0.121	-0.178
	(0.135)	(0.095)	(0.062)
$\overline{R}^2$	0.357	0.054	0.248
Stability Test	—	—	0.024

$$(3)\ \pi_t = \phi + \tfrac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) + \alpha \overline{u}^s_{t-1} + \epsilon_t$$

	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	1.013	0.332	0.454
	(1.198)	(1.213)	(0.633)
α	-0.240	-0.073	-0.101
	(0.305)	(0.251)	(0.148)
$\overline{R}^2$	-0.020	-0.259	0.030
Stability Test	—	—	0.864

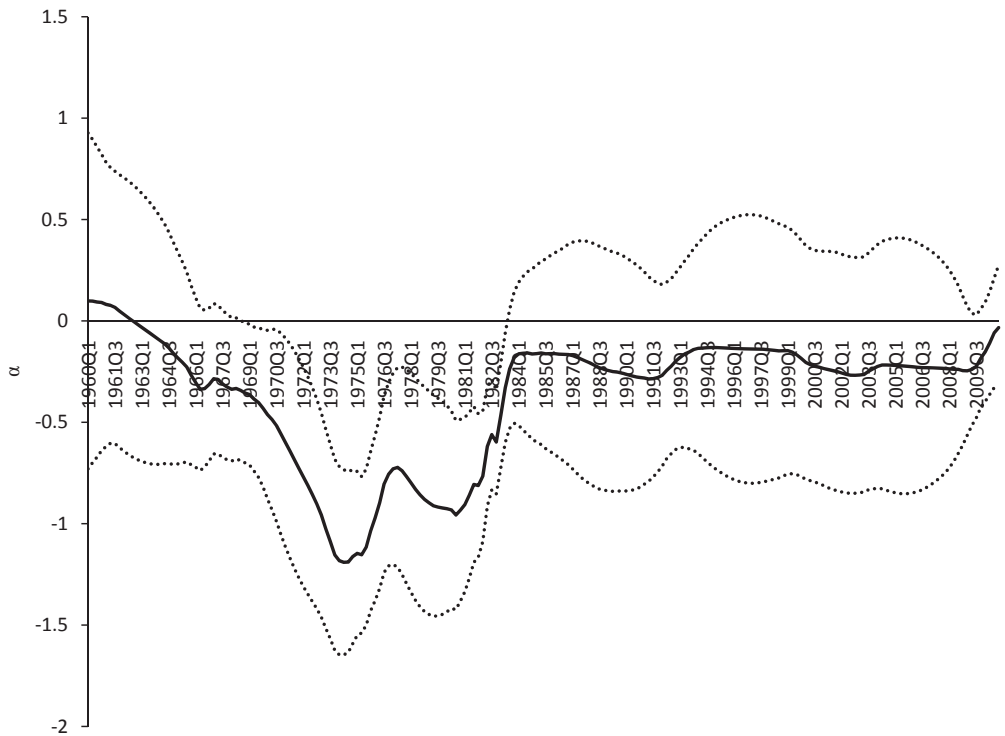
$$(4)\ \pi_t = \phi + \tfrac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) + \alpha \overline{u}_{t-1} + \epsilon_t$$

	2000Q1-2007Q4	2008Q1-2014Q2	2000Q1-2014Q2
ϕ	0.289	-0.668	-0.074
	(0.855)	(0.697)	(0.375)
α	-0.054	0.080	0.011
	(0.185)	(0.099)	(0.064)
$\overline{R}^2$	-0.047	-0.223	0.019
Stability Test	—	—	0.391

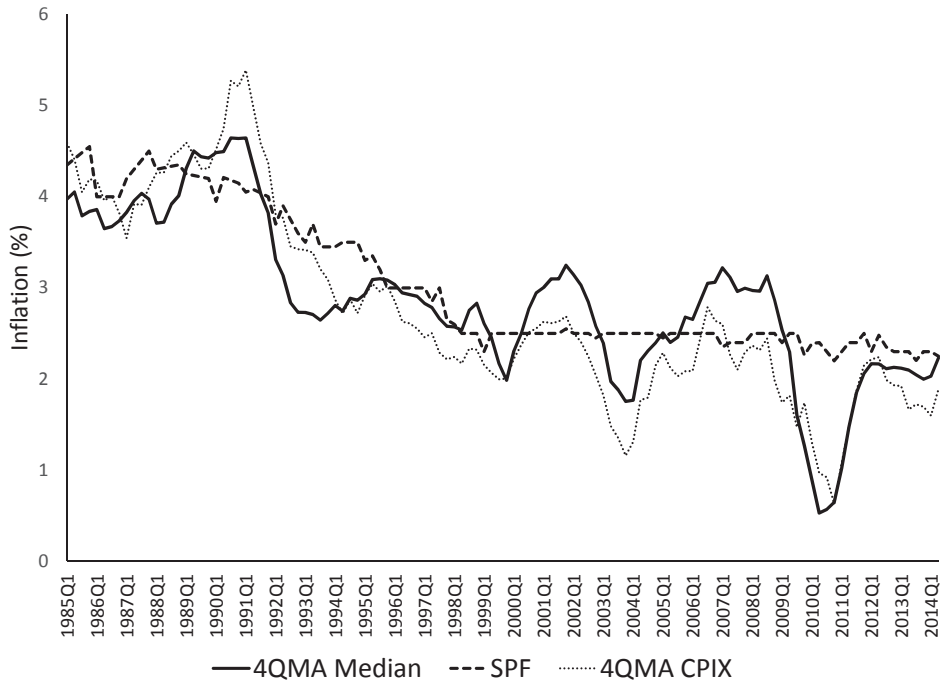
- Again we see the specification with constant expectations and short-term unemployment fits best with $\overline{R}^2$=0.41
- The fit of the model is much lower in the other specifications
- Most notably $\overline{R}^2$ is just 0.02 when core inflation is measured with CPIX, expected inflation is measured with past inflation, and slack is measured with total unemployment. And yet this Phillips curve is the most traditional of any we consider, and it fails miserably to capture inflation behavior since 2000!
- Switching to median inflation, to anchored expectations, or to short-term unemployment improves the model's fit, and doing all simultaneously is even better still

Explaining Core Inflation Since 1985

We next start our sample in 1985 (instead of 2000), because the level and volatility of inflation have been low since then, in contrast to the 1970s and 1980s:



We clearly do not expect our parsimonious Phillips curve specification to fit the data from 1985, particularly since expectations were not anchored then:



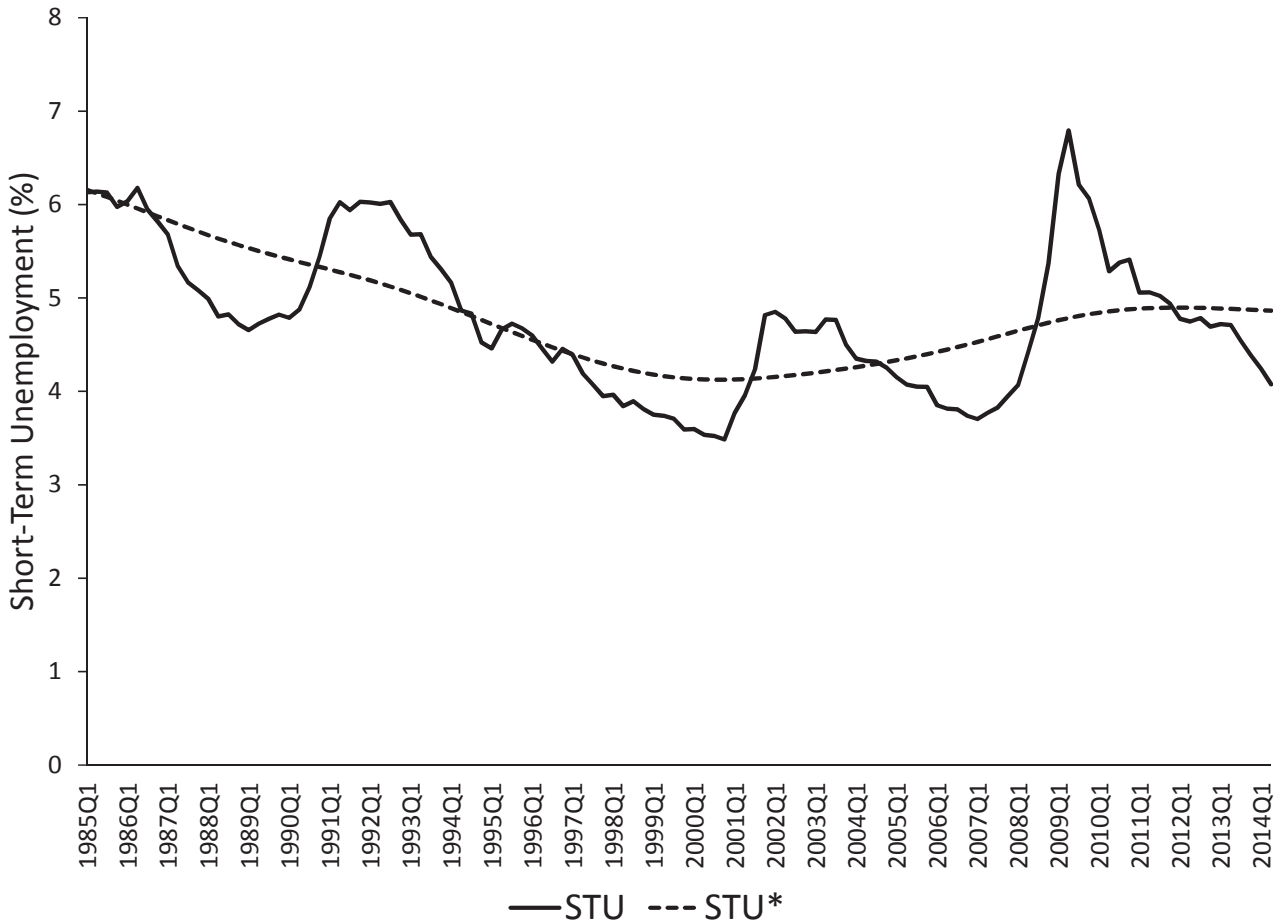
Long-term SPF inflation expectations become anchored around 2000, but not before then: it starts at about 4.5% in 1985 and drifts down during the late 1980s and 1990s, seemingly tracking the downward trend in actual inflation

- To estimate a Phillips curve from 1985 we treat the long-term SPF inflation expectations as our direct measure of expected inflation, as is done in Fuhrer et al. (2009)
- We once again use short-term unemployment deviated from its natural rate, averaged over the previous four quarters:

$$\pi_t = \pi_t^F + \alpha(\overline{u}_{t-1}^s - \overline{u}_{t-1}^{s*}) + \epsilon_t$$

- We measure the natural rate by smoothing the series for short-term unemployment (HP filter with a smoothing parameter of 16,000)

Explaining Core Inflation Since 1985



Phillips Curve Estimates

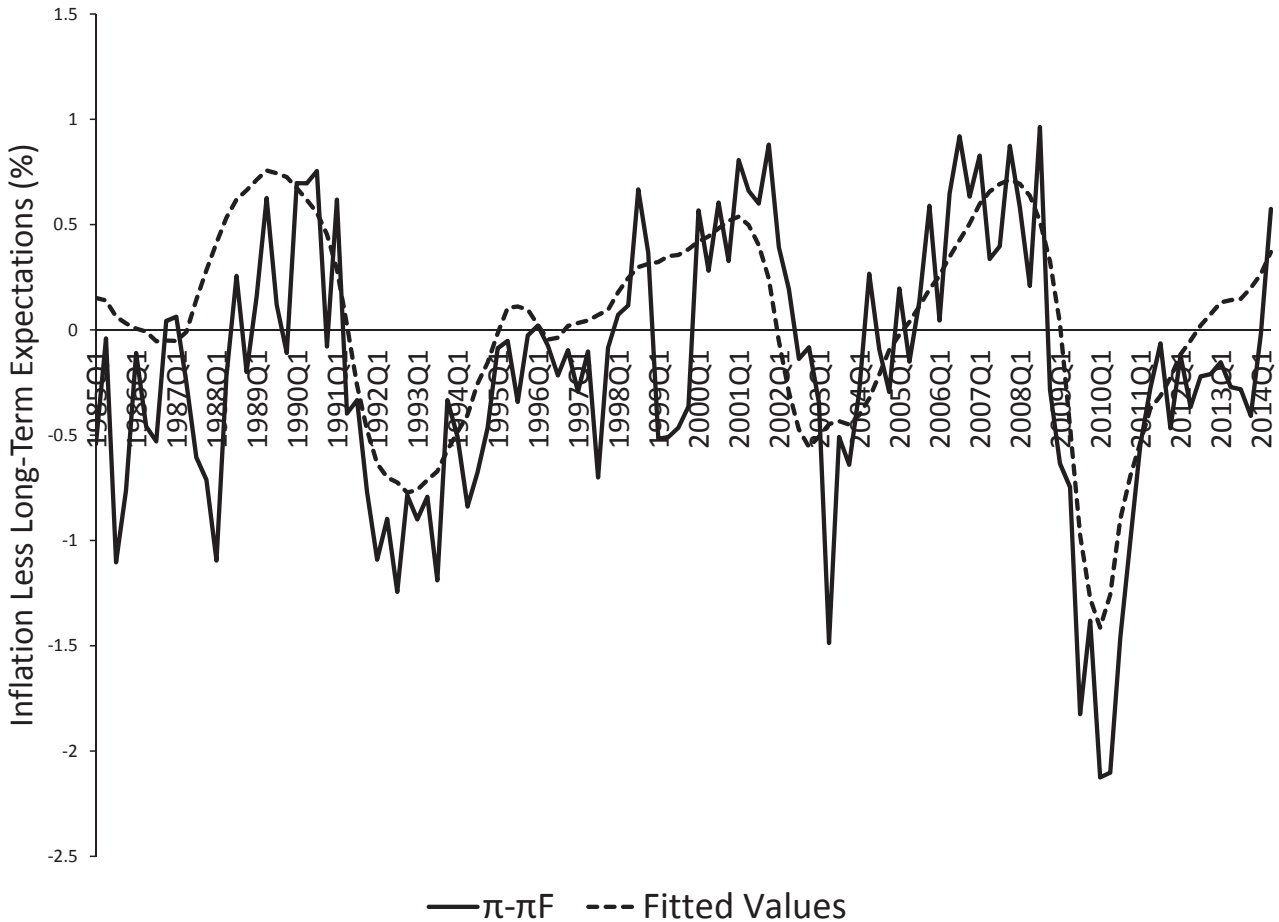
$$\pi_t = \pi_t^F + \alpha(\overline{u}_{t-1}^s - \overline{u}_{t-1}^{s*}) + \epsilon_t$$

	1985Q1-1999Q4	2000Q1-2014Q2	1985Q1-2014Q2
α	-0.606 (0.222)	-1.112 (0.116)	-0.909 (0.150)
$\overline{R}^2$	0.619	0.762	0.759
Stability Test	—	—	0.062

Explaining Core Inflation Since 1985

- For the full sample, the estimated coefficient on short-term unemployment is -0.91, which is close to the result (-0.98) from our preferred specification for post-2000
- The $\overline{R}^2$ for the full sample is 0.76, and the previous figure shows the good fit from the model when compared to actual data
- The fit of this model partly reflects the fact that actual inflation and SPF forecasts moved together from 1985 to 2000. But this does not mean short-term unemployment is not important
- To see this point clearly, we move π^F to the left side of the equation and obtain an $\overline{R}^2$ of 0.47, which indicates that approximately half of the variation in $\pi - \pi^F$ is explained by short-term unemployment
- The fitted values from this regression also confirm this idea

Explaining Core Inflation Since 1985



- For the post-2000 subsample, the estimated coefficient on short-term unemployment is -1.11, which again is close to the estimate of -0.98 from our favored specification. Except we have here relaxed the assumption of constant π^e and u^{s*}, but it makes little difference after 2000
- For the 1985-1999 subsample, the estimated coefficient on short-term unemployment is -0.61, with a large standard error of 0.22
- When testing the hypothesis that the unemployment coefficient is equal across the two subsamples, the result is borderline ($p = 0.062$)
- If we estimate the full sample model and allow the coefficients to differ before and after 2000, we find that the $\overline{R}^2$ only marginally improves to 0.78 (compared to 0.76)
- Overall, we find that inflation over the past 30 years is well explained by a stable Phillips curve with long-term SPF expectations and short-term unemployment

The Changing Behavior of Expectations

- Finally, we consider how expectations were formed in the 1980s and 1990s, since they were clearly not anchored
- A natural hypothesis, which has been widely considered, is that expectations were adaptive. This is supported by our earlier figure
- To test this more formally we estimate an equation where SPF inflation forecasts depend on past levels of median inflation
- We follow Gordon (2013) by including a large number of lags (thereby allowing expectations to adjust slowly to changes in actual inflation), where the coefficients sum to 1

- For parsimony, we assume the coefficients on lagged inflation decline exponentially over time
- This yields a single parameter to be estimated, where we truncate our lags at 40 quarters:

$$\pi_t^F = \frac{1}{1-\gamma^{40}}\left[(1-\gamma)\pi_{t-1} + \gamma(1-\gamma)\pi_{t-2} + \ldots + \gamma^{39}(1-\gamma)\pi_{t-40}\right] + \epsilon_t$$

- Estimating this regression for 1985-1999 yields $\gamma = 0.86$, with $\overline{R}^2$ equal to 0.85
- The high value of γ supports Gordon's view that long lags of inflation influence expectations

- As a final exercise, we jointly test the ideas of anchored and lagged inflation expectations jointly, where we believe that expectation formation changes around 2000:

$$\pi_t^F = \beta 2.5 + (1-\beta)\frac{1}{1-\gamma^{40}}\left[(1-\gamma)\pi_{t-1} + \ldots + \gamma^{39}(1-\gamma)\pi_{t-40}\right] + \epsilon_t$$

- We estimate this equation for 1985-1999 and 2000-2014Q2, using 2000 as the break date
- We then also use the Andrews (1993) sup-Wald test, assuming the break date is unknown, which selects 1997Q4 as the break date (close to 2000). We then also estimate the model around the break date of 1997Q4

$$\pi_t^F = \beta 2.5 + (1-\beta)\frac{1}{1-\gamma^{40}}\left[(1-\gamma)\pi_{t-1} + \gamma(1-\gamma)\pi_{t-2} + \ldots + \gamma^{39}(1-\gamma)\pi_{t-40}\right] + \epsilon_t$$

	1985Q1-1999Q4	2000Q1-2014Q2	1985Q1-1997Q3	1997Q4-2014Q2
β	0.061	0.809	0.064	0.834
	(0.044)	(0.082)	(0.043)	(0.062)
γ	0.874	0.895	0.877	0.876
	(0.016)	(0.060)	(0.017)	(0.058)
$\overline{R}^2$	0.850	0.128	0.741	0.145

- In the first two columns (break of 2000), we find β to be 0.06 in the first period (and not significant), and is 0.81 in the second period, where the data strongly reject stability across these two periods
- This suggests a sharp regime shift in 2000, from backward-looking to strongly anchored inflation expectations
- In the last two columns (break of 1997Q4), we again see rejection of stability, where the estimates of β across the two periods are close to what we just reported (0.06 and 0.83 respectively)

Concluding Remarks

- The Phillips curve is critically important for monetary policy and for forecasting inflation, so finding a version that fits the data reliably is important for macroeconomists
- Unfortunately researchers have had to repeatedly modify the model to fit new data. For example:
  - Friedman added expectations to the Samuelson-Solow specification
  - Gordon (1982) added supply shocks
  - Ball et al. (1988) added time-variation to the slope
  - Staiger et al. (1997) added time-varying natural rates of unemployment

- As Stock and Watson (2010) observe, the history of the Phillips curve "is one of apparently stable relationships falling apart upon publication" (Ball and Mazumder, 2011, for example!)
- Nonetheless due to its practical usefulness, the search for a robust model continues, and in this paper we argue that a simple Phillips curve with constant inflation expectations and short-term unemployment fits the data remarkably well
- Our fingers are crossed that this will not change upon publication of this paper!