Inflation and Long- and Short-term Unemployment

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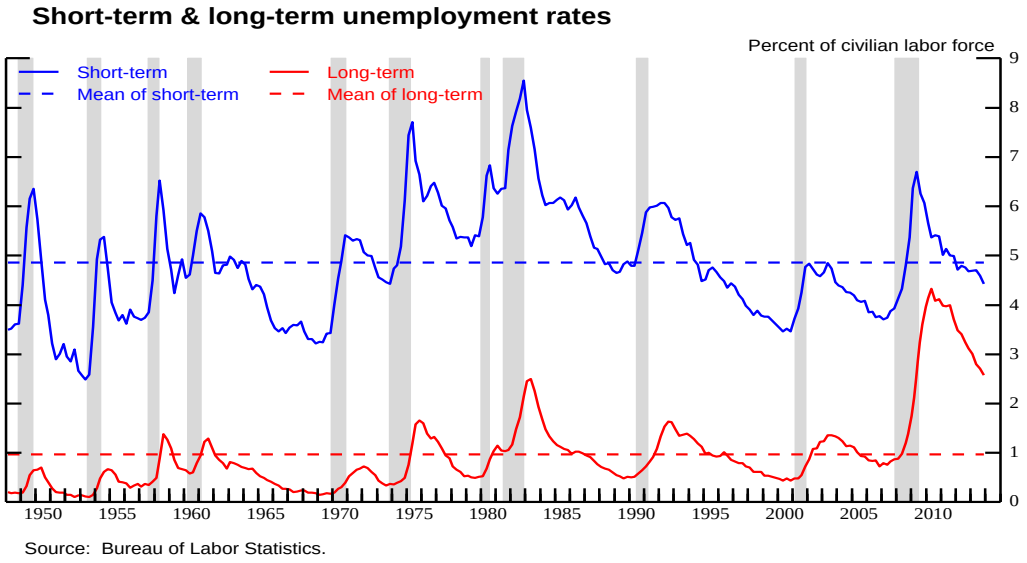
March 11, 2014

Whether long- and short-term unemployment have differential effects on price inflation has been the topic of a number of recent publications.[1] While the question is not new, the interest in this topic was renewed recently by the failure of many Phillips Curve–type models to explain why, in the face of what many perceived as large and persistent labor market slack, inflation remained relatively stable throughout the Great Recession. With long-term unemployed, as a share of the labor force, at historically high levels (see chart below) this failure, and the apparent breakdown in the historical relationship between inflation and unemployment, would be reduced if the long-term unemployed exert little to no downward pressure on wage and price inflation.[2] This, in turn, would suggest that our current procedure of using a measure of slack based on overall unemployment will lead us to underpredict wage and price inflation as the recovery picks up steam.



[1] For example, see Robert J. Gordon's August 2013 NBER working paper: "The Phillips Curve is Alive and Well: Inflation and the NAIRU during the Slow Recovery". More references with brief comments are included in Appendix A.

[2] Alternative explanations for the apparent reduced sensitivity of inflation to unemployment since the recent recession include a higher natural rate of unemployment, a nonlinear coefficient on slack in the Phillips curve, or possibly downward nominal wage rigidity.

In general, however, we find the analyses in these publications unconvincing as many of them tend to be based on Phillips curves that either lack supply shocks or a role for explicit measures of expected inflation, which we feel are important channels for inflation transmission. Further, in some cases the results are extremely fragile to the sample period chosen. Overall, the current evidence for differential effects of long- and short-term unemployment in our preferred inflation models, while not nonexistent, is weak.

This memo does not attempt to provide a comprehensive review of the recent analyses. Rather, the memo examines whether staff models that we regularly consult suggest that we should downweight, more than we currently do, long-term unemployment when setting core PCE and compensation per hour (CPH) inflation forecasts. This memo extends previous work by the staff that found little statistically significant evidence of differential effects of long-term unemployment on wages or prices (the ECI was an exception). In particular, in this memo, we extend the sample period and use the current vintage data, investigate the sensitivity of the results to the time period used for estimation, and check whether using the short-term unemployment rate (without making an assumption about the natural rate of unemployment) in place of the staff measure of slack (which is based on the total unemployment rate *and* the staff estimate of natural rate) improves the models' predictions in dynamic simulations.

Before proceeding, it is important to clarify that the staff measure of slack is the difference between the unemployment rate and the staff estimate of the NRU, adjusted to reflect increases in unemployed associated with the availability of emergency and extended unemployment insurance benefits (EEB). Since the availability of the EEB likely extends the unemployment spells of UI recipients, this adjustment is highly correlated with the long term unemployed.[3] Thus the staff measure of slack used in the inflation models already discounts to some extent the effect of long-term unemployment on wages and prices. In addition, the staff natural rate itself is (positively) correlated with the long-term unemployment rate, further discounting the effect of long-term unemployed.[4]

This memo examines two of the staff models of core PCE inflation: (i) an accelerationist Phillips curve (APC) model, and (ii) an empirical implementation of the stylized expectations-augmented Phillips curve (EPC) model that was described in a recent memo to the FOMC on inflation;[5] in this model, we use long-run Michigan inflation

[3] The correlation between the EEB adjustment and the long-term unemployment rate is 0.90 over the period from 1988 to 2013.
[4] The correlation between the staff NRU and the long-term unemployment rate is about 0.60 over the period from 1988 to 2013, while the correlation between the staff NRU and the short-term unemployment rate is about 0.45 over the same period.
[5] See Alan Detmeister, Jean-Philippe Laforte, and Jeremy Rudd's January 17, 2014 memo: "The Staff's Outlook for Price Inflation".

expectations to proxy expected inflation. Both the accelerationist and the expectations-augmented models use the staff measure of labor market slack and allow for supply shocks (through import prices and energy prices). The main difference is that the accelerationist model has six lags of core PCE inflation on the right-hand side of the regression, whereas the expectations-augmented model has four lags of core PCE inflation *and* Michigan long-run inflation expectations.

For wages two models for compensation per hour from the Productivity and Costs release are examined: (i) a wage Phillips curve model that has, among other variables, lagged wages and prices on the right-hand side of the regression, and (ii) a model that replaces lagged prices with Michigan long-run inflation expectations.

Summary of findings:

I. Prices

A. **The coefficients are very unstable.** Exhibit A shows how the coefficients evolve when the staff measure of slack is replaced with separate measures of long-term (LTU) *and* short-term (STU) unemployment as a share of the labor force. For these regressions the end date of the estimation changes, but the start date is fixed at 1988:Q1. In the accelerationist model (Panel 1), the coefficients on the two unemployment rates are nearly identical until the end of the estimation period reaches 2009. After that, the coefficient on the long-term unemployment is mostly zero or slightly positive. In contrast, in the expectations-augmented model (Panel 2), the coefficients are quite different early in the sample period, but once the estimation period reaches the end of 2009 the coefficients become very similar and remain similar (and with the correct sign) through 2011, after which the coefficient on long-term unemployment is about zero. Similar instability is evident (though not shown here) for different choices of the starting date of the regressions with the end date fixed at 2007:Q4.

B. It is worth noting that the correlation between short- and long-term unemployment over the estimation periods reported in the charts varies between 0.45 and 0.65. Given the multicolinearity, it is perhaps not surprising that small changes in the data can produce wide swings in the parameter estimates with coefficients switching signs. As can be seen in the charts, the confidence bands around the two coefficients are quite large and often include zero. Correspondingly, **the null hypothesis that the two coefficients are the same cannot be rejected** for both models and almost all estimation periods.

C. Instability and statistical significance aside, it does look like the coefficient on long-term unemployment is the one that tends to move around and that sometimes has the wrong sign. Then the question is: Would the models have performed better during this last recession if long-term unemployment had not been included in the equations?

The two panels in Exhibit B show dynamic simulations from the accelerationist and expectations-augmented models, starting in 2008:Q1 and ending in 2013:Q4. The black lines are the actual one-quarter changes in core PCE prices, the green lines (STU) are the models' projections when the published short-term unemployment rate is used in place of the staff measure of slack, and the blue lines (UR_total) are the projections if the published total unemployment rate is used in place of the staff measure of slack. For the accelerationist model (Panel 1), using the short-term unemployment rate (and thereby ignoring the long-term unemployed) leads to a noticeably different projection compared to using the total unemployment rate. However, despite the different projection the overall fit is little different—the out-of-sample root mean square error is about 0.8 percentage point for the accelerationist model regardless of whether short-term or total unemployment is used. (Appendix B summarizes in tables the errors based on one-quarter changes at annual rates and four-quarter changes.[6]) In our standard specification which uses the staff unemployment rate gap (ugap), the model's projection (the red line) is very similar to the projection made using the total unemployment rate. As for the expectations-augmented model (Panel 2), the measure of slack used does not make a big difference— root mean square errors are about 0.5 percentage point for the one-quarter changes for all three versions of the model. In short, **the expectations-augmented model—to which we give the most weight in our staff forecast—would not have been much affected by the use of short-term unemployment instead of the total unemployment rate or the staff measure of labor market slack.**

II. Wages

The two panels in Exhibit C show dynamic simulations from the wage Phillips curve (WPC) and the expectations-based wage Phillips curve (EWPC) models for compensation

[6] The tables also contain RMSEs from the two price models when both short and long-term unemployment are used and the coefficients are allowed to be different. As can be seen in tables, the prices models perform worse when separate measures of both short and long-term unemployment are included, as compared to including either only short-term unemployment or total unemployment.

per hour, starting in 2008:Q1 and ending in 2013:Q4. The black lines are the actual four-quarter changes in compensation per hour, the green lines are the models' projections when the published short-term unemployment (STU) rate is used, and the blue lines are the projections if the total unemployment (UR_total) rate is used. Using the short-term unemployment rate instead of the total unemployment rate produces a noticeably different and better projection when the wage Phillips curve model is used – Panel 1. (Section B in Appendix B summarizes in tables the errors based on one- and four-quarter changes.) The root mean square errors when the staff ugap is used (the red line) are only a touch higher than when short-term unemployment is used. For the expectations-based model, which is our preferred model, using short-term unemployment instead of total unemployment also leads to an improvement in the out-of-sample projection (the green and the blue lines in the lower panel). However, the staff measure of slack performs slightly better than simply using short-term unemployment.

The forecasts shown in Exhibits B and C were based on simulations in which the estimation period ended in 2007:Q4—prior to the recent recession. However, results do not change notably when forecasts are produced with rolling estimation periods (see Appendix C). For wages, the expectations-based model has the smallest root mean square errors when the staff measure of slack is used. For prices, which measure of slack is used does not make a material difference for the expectations-augmented model.

Implications for forecast

These are not definitive findings, as the various recent analyses summarized in Appendix A suggest that different specifications can reach different conclusions. Nonetheless, our analysis does not appear to call for a change to the staff forecast models that use survey expectations—the models to which we give the most weight in setting the Tealbook forecast of inflation. That said, because the current composition of unemployment is very different from the past experience used to inform our models, we will continue to assess this conclusion on an ongoing basis.

Exhibit A.
Coefficients on short- and long-term unemployment in recursive (expanding window) core PCE price Phillips curve with 90 percent confidence intervals

Panel 1. Accelerationist Phillips Curve Model, start date 1988:Q1, end date varies

Panel 2. Expectations-Augmented Phillips Curve Model, start date 1988:Q1, end date varies

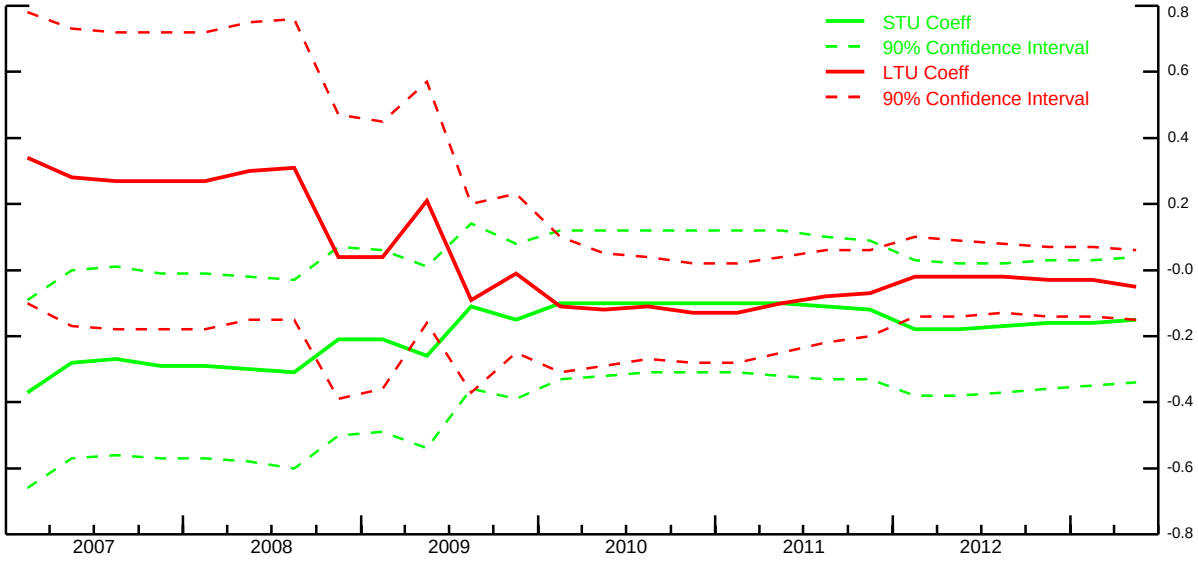
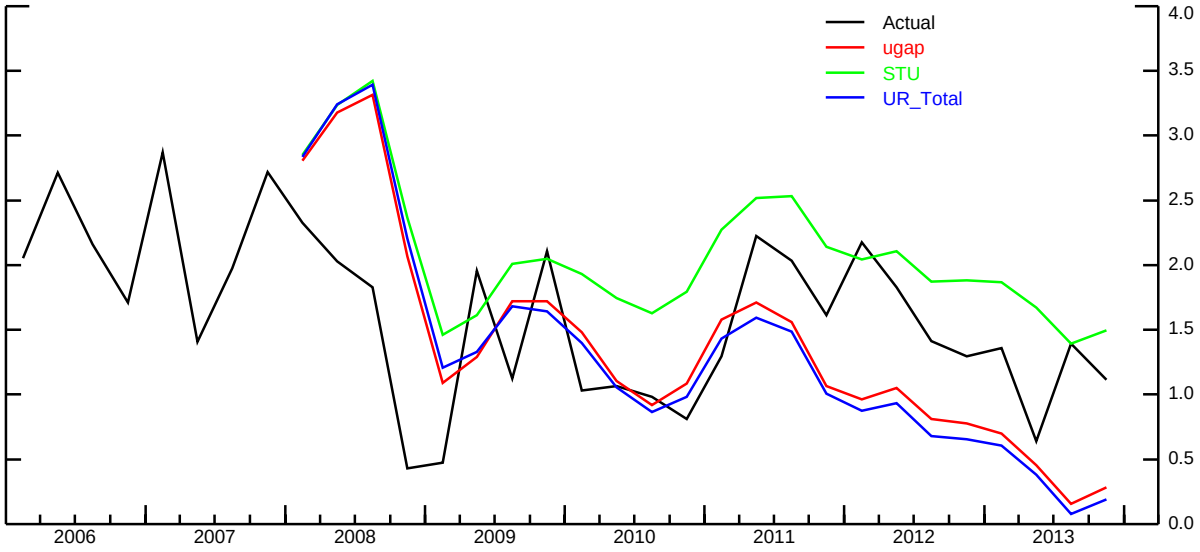
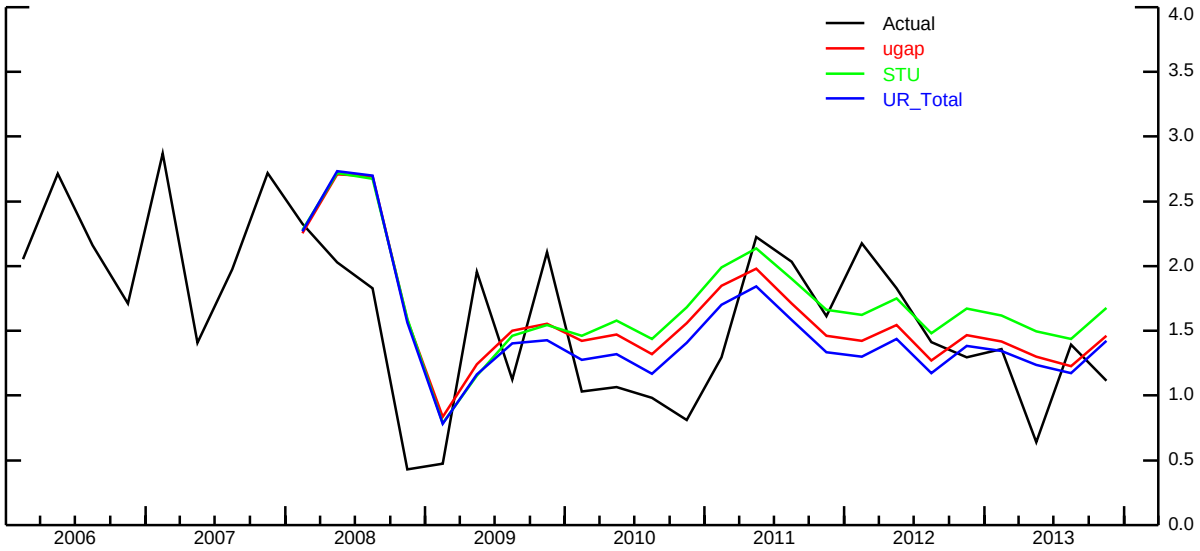


Exhibit B.
Dynamic simulations of price Phillips Curve Models for core PCE price inflation

Panel 1. Accelerationist Phillips Curve Model, estimated 1988:Q1-2007:Q4, simulated forward
(1Q changes at annual rates)

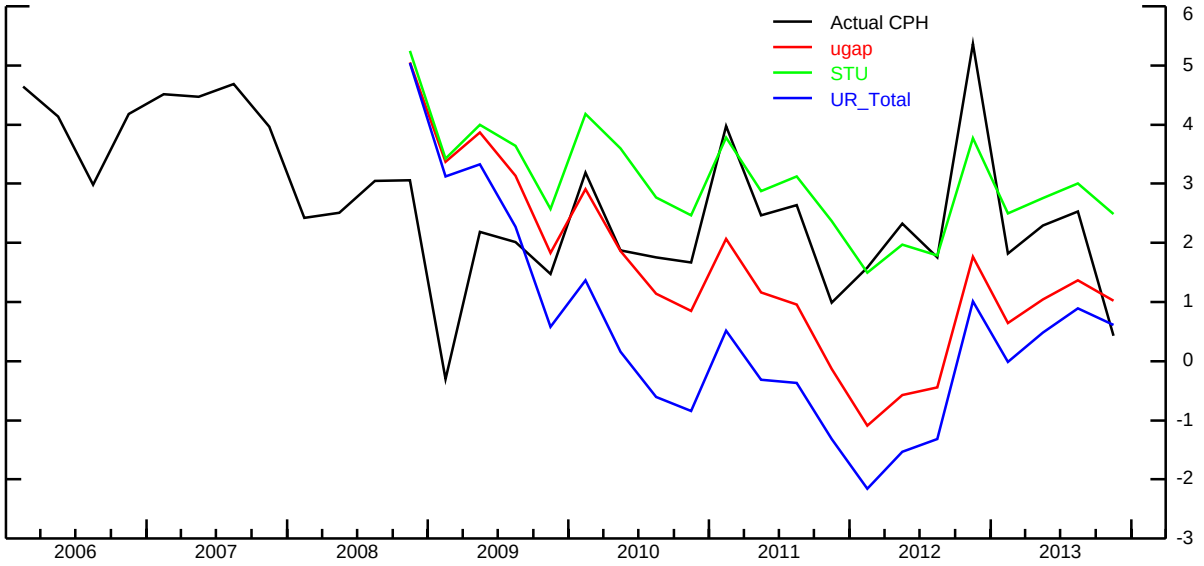


Panel 2. Expectations-Augmented Phillips Curve Model, estimated 1988:Q1-2007:Q4, simulated forward
(1Q changes at annual rates)

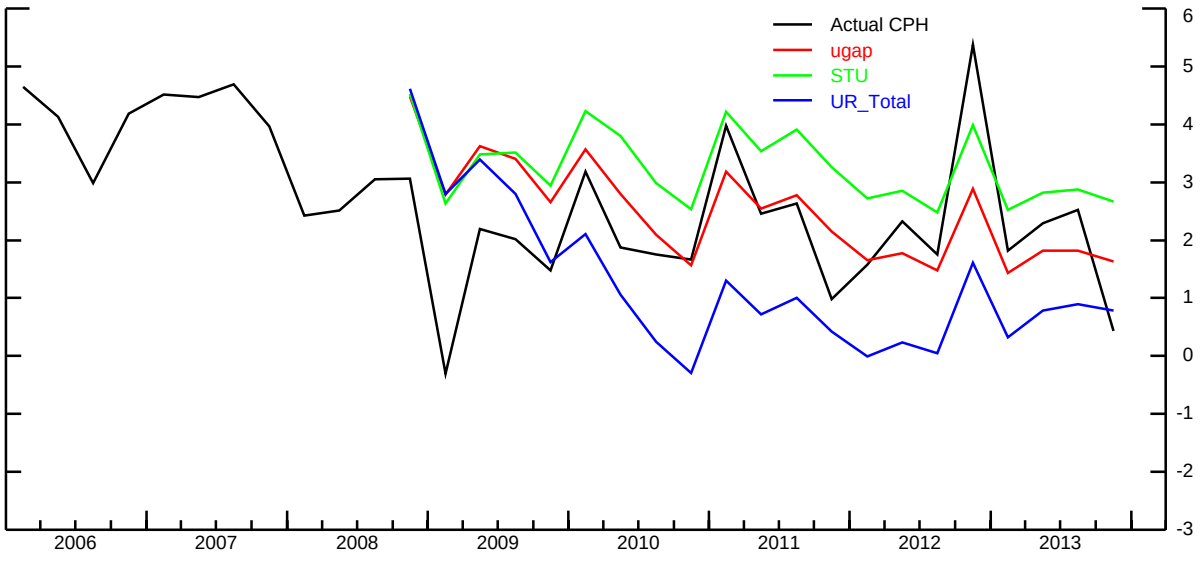


Dynamic simulations of CPH Phillips Curve Models

Panel 1. Wage Phillips Curve Model, estimated 1988:Q1-2007:Q4, simulated forward, 4Q changes



Panel 2. Expectations-based Wage Phillips Curve Model,
estimated 1988:Q1-2007:Q4, simulated forward, 4Q changes



Appendix A

References and some brief comments on selected recent analyses of the effect of short versus long-term unemployment on inflation

Deutsche Bank "US Inflation: About to turn the corner", Global Economic Perspectives, January 30, 2014

Deutsche Bank mentions the issue of short- versus long-term unemployment briefly. In their model, where core PCE inflation is a function of its lagged values, (SPF CPI) inflation expectations, the unemployment gap and relative import prices, they find that the long-term unemployed do not impact inflation meaningfully. That said, the forecast from a model that separates unemployment into STU and LTU is not materially different from the forecast based on their standard Phillips curve approach.

Goldman Sachs "US Daily: What Does Wage Growth Tell Us About Labor Market Slack? (David Mericle)" Global Macro Research, February 5, 2014.

Goldman Sachs focuses on the effect of short- versus long-term unemployment on wage growth as measured by their "wage-tracker". They compare wage Phillips curve models with lagged wage growth, long-run Michigan inflation expectations, and competing measures of slack on the RHS. They find that the long-term unemployment rate has a significant effect on wage growth, but that the magnitude is half as big as that of the short-term unemployment rate. They also find that a model using only the short-term unemployment rate has predicted considerably higher wage growth than we have seen and conclude that the short-term unemployment rate is an "overly narrow measure" of labor market slack.

Gordon, Robert J. "The Phillips Curve is Alive and Well: Inflation and the NAIRU during the Slow Recovery," August 2013, NBER working paper.

Gordon argues that using short-run unemployment improves the fit of a Phillips curve in recent years. However, Gordon focuses on a long-lags accelerationist model, and it uses a different measure of inflation than we do (total PCE inflation, instead of core). Even in his model, the improvement in fit from using short-term unemployment versus total unemployment seems modest.

Macroeconomic Advisers "Inflation, NAIRU and Long-term Unemployment" Macro Focus, January 14, 2014.

Macro Advisers argues that in a parsimonious model of inflation (based on inflation expectations and without supply shocks), the coefficient on the long-term unemployment rate is small, sometimes positive and, in general, insignificant. In their model, the hypothesis that the coefficients on the two measures of unemployment are equal is rejected. Also, in dynamic simulations, their model predicts inflation over the Great Recession better if long-term unemployment is ignored. We construct a very similar model and find that their results are very

sensitive to the estimation period chosen. In addition, their model does not include import prices. Including import prices, for example, closes a big gap between the coefficient on LTU and the coefficient on STU when the model is estimated starting in 1987.

Michael Kiley "An Evaluation of the Inflationary Pressure Associated with Short- and Long-term Unemployment," February 25, 2014, mimeo.

Kiley shows that the typical approach (i.e. using national data) to determine if the long-term unemployed exert less downward pressure on prices than the short-term unemployed is incapable of discriminating between these two measures of slack as they are highly correlated. Kiley then uses a simple model and regional data on unemployment and inflation to help inference. His results suggest that in recent decades the long- and short-term unemployment have exerted similar downward pressure on price inflation.

New York's Fed's Liberty Street blog "The Long and Short of It: The Impact of Unemployment Duration on Compensation Growth" February 12, 2014

The NY Fed specify a nonlinear compensation Phillips curve model, where the four-quarter CPH growth is a function of trend productivity growth, long-run inflation expectations and resource utilization. In their out-of-sample forecast starting in 2008:Q1, they find that using a STU gap does a better job tracking the actual CPH growth than a model that uses an unemployment gap based on the overall unemployment rate.

Appendix B

Out-of-Sample Root Mean Square Errors
Based on estimation though 2007:Q4 and simulations from 2008:Q1 to 2013:Q4

A. Core PCE prices:

	one-quarter changes (annual rates)				four-quarter changes			
	STU	**total U**	**ugap**	**ST and LT***	**STU**	**total U**	**ugap**	**ST and LT***
Accelerationist	0.8	0.8	0.8	1.0	0.7	0.7	0.7	0.9
Expectations-augmented	0.5	0.5	0.5	1.2	0.4	0.4	0.4	1.2

* Long- and short-term unemployment are included separately in the regression without restrictions on coefficients

B. CPH:

	one-quarter changes (annual rates)			four-quarter changes		
	STU	**total U**	**ugap**	**STU**	**total U**	**ugap**
Wage PC	3.2	3.8	3.4	1.6	2.4	1.8
Expectations-based	3.3	3.5	3.3	1.7	1.9	1.4

Appendix C

Out-of-Sample Root Mean Square Errors based on recursive (expanding window) estimation

Models are re-estimated every quarter and a forecast for the next 8 quarters are produced. RMSEs are calculated for the 2007-2013 period.

A. Core PCE prices:

		RMSEs for average inflation over	
		the 4 quarters following end of estimation	the 8 quarters following end of estimation
Accelerationist	**UGAP**	0.6	0.7
	STU	0.5	0.5
	UR_total	0.7	0.8
Expectations-augmented	**UGAP**	0.4	0.3
	STU	0.4	0.3
	UR_total	0.4	0.3

B. CPH:

		RMSEs for average inflation over	
		the 4 quarters following end of estimation	the 8 quarters following end of estimation
Wage PC	**UGAP**	1.5	1.3
	STU	1.3	1.0
	UR_total	1.7	1.7
Expectations-based	**UGAP**	1.2	0.8
	STU	1.3	1.0
	UR_total	1.4	1.1