

## The US Phillips Curve: Back to the 60s?

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The behavior of inflation since the global financial crisis appears puzzling to many. To cite Paul Krugman (2015): “If inflation had responded to the Great Recession and aftermath the way it did in previous slumps, we would be deep in deflation by now: we aren’t.”

With this in mind, this *Policy Brief* reexamines the behavior of inflation and unemployment. It reaches four conclusions:

- Low unemployment still pushes inflation up; high unemployment pushes it down. Put another way, the US Phillips curve is alive. (I wish I could say “alive and well,” but it would be an overstatement: The relation has never been very tight.)
- Inflation expectations, however, have become steadily more anchored, leading to a relation between the unemployment rate and the *level of inflation* rather than *the change in inflation*. In this sense, the relation resembles more the Phillips curve of the 1960s than the accelerationist Phillips curve of the later period.
- The slope of the Phillips curve, i.e., the effect of the unemployment rate on inflation given expected inflation, has substantially declined. But the decline dates back to the 1980s rather than to the crisis. There is no evidence of a further decline during the crisis.
- The standard error of the residual in the relation is large, especially in comparison to the low level of inflation.

Each of the last three conclusions presents challenges for the conduct of monetary policy. Wisdom gained from the experience of the 1960s and later will be needed.

### A BRIEF LITERATURE REVIEW

This *Policy Brief* extends Blanchard, Cerutti, and Summers (2015), where we examined the evolution of the relation between inflation and unemployment for 20 advanced economies. That paper builds in turn on chapter 3 in the IMF *World Economic Outlook* (2013) on the same topic. Our conclusions mostly coincide with the empirical conclusions of the two closest papers we know of on this topic, Ball and Mazumder (2011) and Kiley (2015) (which includes a review of other papers).

### AN ECONOMETRIC EXERCISE

Since the estimation of the US Phillips curve by Paul Samuelson and Robert Solow, macroeconomists have learned, often painfully, that while low unemployment creates inflation pressure, the form of the relation can change and has changed over time. To examine its evolution, we estimated the following specification in Blanchard, Cerutti, and Summers (2015):

$$\pi_t = \theta_t(u_t - u_t^*) + \lambda_t \pi_t^e + (1 - \lambda_t) \pi_{t-1}^* + \mu_t \pi_m + \varepsilon_t \quad (1)$$

$$\pi_t^e = \alpha_t + \beta_t \pi_{t-1}^* + \eta_t \quad (2)$$

where  $\pi_t$  is headline consumer price inflation (defined as quarterly inflation, annualized),  $u_t$  is the unemployment rate,  $u_t^*$  is the natural rate,  $\pi_t^e$  is long-term inflation expectations,  $\pi_{t-1}^*$  is the average of the last four quarterly inflation rates,  $\pi_m$  is import price inflation relative to headline inflation, and the parameters  $\lambda_t$ ,  $\theta_t$ ,  $\mu_t$ ,  $\beta_t$ ,  $\alpha_t$ , and the natural rate  $u_t^*$  follow constrained random walks.

The first equation specifies the Phillips curve. Inflation depends on both expected long-term inflation and past inflation. The coefficient on past inflation reflects the dependence of short-term inflation expectations on past inflation as well as the direct effects of past inflation on current inflation. Inflation also depends on the deviation of the unemployment rate from the

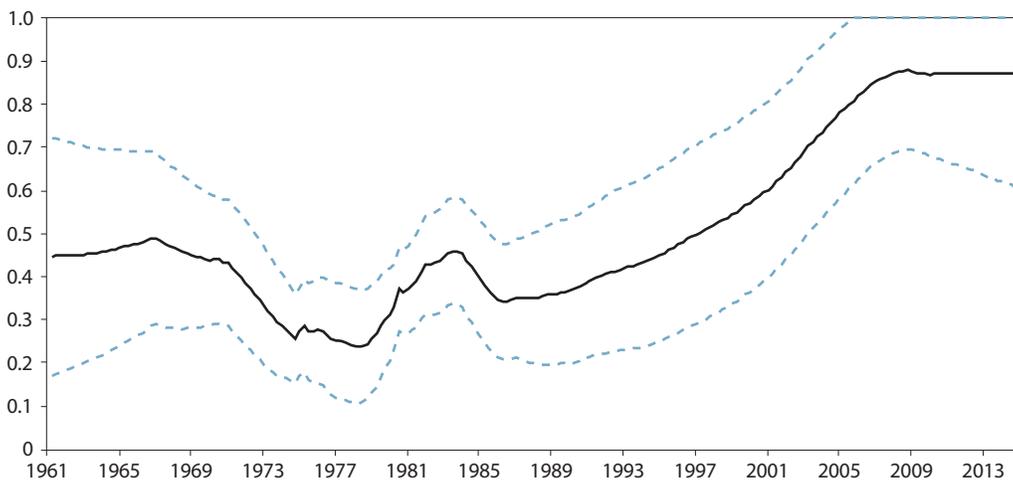
natural rate, as well as on the relative price of imports. The second equation (which was not estimated in the Blanchard, Cerutti, and Summers paper) captures the dependence of long-term expected inflation on lagged inflation. To capture the evolution of the two relations over time, the slope of the Phillips curve, the coefficients on long-term inflation expectations in the Phillips curve and on lagged inflation in the expectation equation, the intercept of the expectation equation, and the natural rate of unemployment, are allowed to follow random walks. (Estimation is done using quarterly data since 1960. Data sources, and details of estimation for the first equation, are given in Blanchard, Cerutti, and Summers.)

The main results are presented in the three figures below. (For lack of space, results on the evolution of the natural rate are not presented here. The data suggest a slow decline in the natural rate by about 1 percentage point since the early 1980s.)

Figure 1 shows the evolution of  $\lambda$ , the weight of long-term expectations in the Phillips curve. It shows how, after going down in the 1970s, it has steadily gone up since the mid-1980s, and is now close to one. Equivalently, the weight of past inflation,  $(1 - \lambda)$ , has steadily decreased over time.

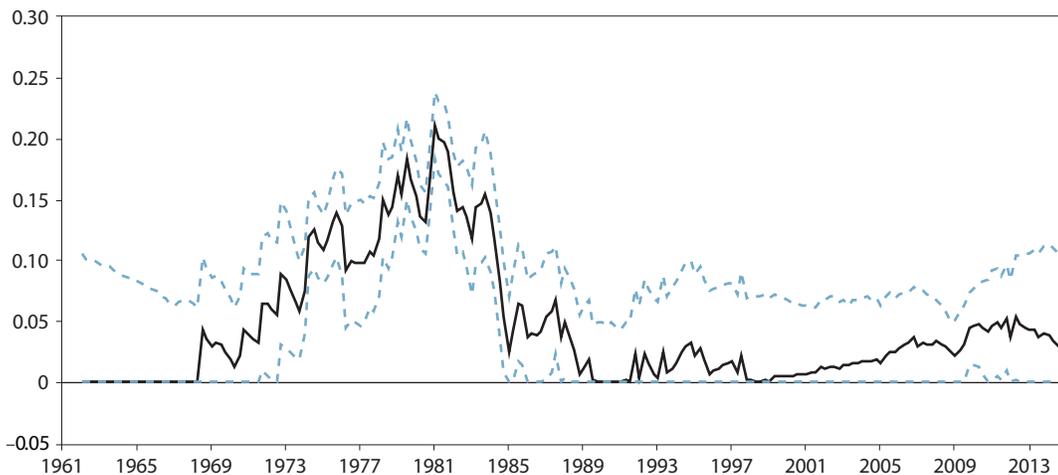
Figure 2 shows the evolution of  $\beta_t$ , the coefficient reflecting the effect of past inflation on long-term expected inflation. After

**Figure 1 The anchoring of expectations ( $\lambda$ )**



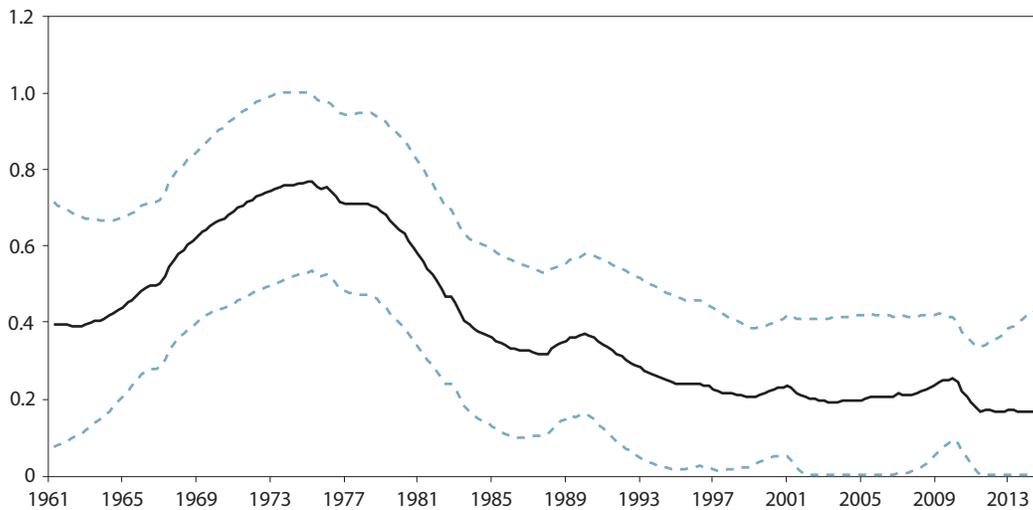
Note: Dotted blue lines show +/-1 standard deviation.  
 Source: Blanchard, Cerutti, and Summers (2015).

**Figure 2 The anchoring of long-term expectations ( $\beta$ )**



Note: Dotted blue lines show +/-1 standard deviation.  
 Source: Data are from figure 1.

**Figure 3 The decrease in the slope of the Phillips curve ( $\theta$ )**



Note: Dotted blue lines show +/-1 standard deviation.  
 Source: Blanchard, Cerutti, and Summers (2015).

increasing in the 1970s, it decreased in the 1980s, and has been close to zero since the late 1980s.

Figures 1 and 2 together suggest that inflation now depends mostly on long-term expected inflation rather than past inflation, and that long-term expected inflation in turn depends little on past inflation. This implies that the Phillips curve relation is now close to a level-level relation, with the *level* of the inflation rate relative to stable long-term expected inflation depending on the *level* of the unemployment rate.

Figure 3 shows the evolution of  $\theta$ , the slope of the Phillips curve. The slope increased from the 1960s until the late 1970s, then steadily decreased until the late 1980s and has remained roughly constant and low since then. Perhaps surprisingly, given the relevance of an effective zero lower bound on nominal wage decreases (Daly and Hobijn 2014), there is no evidence that the slope has decreased further in the crisis. Given expected inflation, a decrease in the unemployment rate led to an increase in inflation of 0.7 percent in the mid-1970s. The effect is now closer to 0.2 percent. Various explanations have been offered for this evolution. The most convincing is that, as the level of inflation has decreased, wages and prices are changed less often, leading to a smaller response of inflation to labor market conditions. (In the Calvo formalization of price stickiness, for example, the slope coefficient is roughly proportional to  $p^2$ , where  $p$  is the probability that a price will be changed in a given period.)

The last relevant result is that the fit of the relation remains fairly poor. The standard deviation of the residual is roughly equal to 1 percent (at an annual rate) today, a large value relative to an inflation rate around 1 to 2 percent. This suggests that the US economy is far from satisfying the “divine coincidence,”

the condition that keeping inflation constant delivers the best unemployment rate policy can deliver.

Results vary slightly, depending on the exact choice of variables and the exact specification. Some specifications, using different measures of inflation, give a slightly larger slope, a slightly higher value for  $\theta$  (see Ball and Mazumder 2011 and Kiley 2015). But the three evolutions shown in the previous figures appear robust. They have important implications for the conduct of monetary policy.

### THE END OF THE ACCELERATIONIST CURSE?

One of the most dramatic implications of the accelerationist Phillips curve is that every boom must be followed by an equal size bust. Or, more accurately, if inflation is going to remain constant in the long run, any negative unemployment gap must eventually be offset by an equal sum of positive unemployment gaps later:

$$\pi_t = \pi_{t-1} - \theta(u - \bar{u}) \Rightarrow [(\pi_T = \pi_0) \Rightarrow \sum_0^T (u - \bar{u}) = 0] \quad (3)$$

This implication disappears when  $(1 - \lambda)$ , the coefficient on lagged inflation, is less than one, and a fortiori when, as appears to be the case today,  $(1 - \lambda)$  is close to zero. In this case, a boom will be associated with higher inflation, but inflation will decrease as unemployment returns to the natural rate, and there is no need for the boom to be followed by a bust.

Put another way, there may be no cost to having a temporary boom, except for temporary higher inflation. This is where the echo of the policies followed in the 1960s, the painful lessons of the 1970s, and the Lucas critique, come in. They raise

the question of what exactly lies behind the anchoring of expectations. It must be in large part due to monetary policy credibility and a long period of low inflation; in this case, prolonged deviations of inflation from target may de-anchor expectations. Inflation below target does not appear to have had this effect so far, but it is hard to know what margin monetary policy has before expectations do get de-anchored. Another possibility is that the anchoring of expectations reflects a lack of salience: At very low rates of inflation, people may not focus on inflation, and thus may not adjust expectations in response to movements in inflation. If this is the case, it implies that the Federal Reserve may have some room to use so long as inflation remains low enough so as to not become salient.

### THE (TOO) APPEALING TRADEOFF BETWEEN UNEMPLOYMENT AND INFLATION

A small coefficient  $\theta$  implies an attractive short-run tradeoff between inflation and unemployment. A value of  $-0.2$  implies that a 1 percent decrease in unemployment for one quarter increases inflation, measured at an annual rate, by 0.2 percent. Together, the anchoring of expectations and a value of  $\lambda$  close to 1 imply that, even if unemployment remains lower, inflation will not increase much above 0.2 percent. This leads to a very attractive tradeoff between inflation and unemployment, raising strong Barro-Gordon temptations to lower unemployment below the natural rate for some time. (Hysteresis arguments may provide a valid reason to do so, and this is what led us to re-explore hysteresis in Blanchard, Cerutti, and Summers [2015], and conclude that hysteresis may indeed well be present. But they may also provide a smokescreen for succumbing to temptation.) One can already see the pressure on the Fed, for

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example, to not raise rates until it sees “the whites of inflation’s eyes.” If this means waiting for inflation to start exceeding the target, then, given the substantial lags in the effect of higher interest rates on activity, it is an invitation to the Fed to go below the natural rate for some time.

### THE FAILURE OF THE DIVINE COINCIDENCE

In the benchmark New Keynesian model, stabilizing inflation keeps the unemployment rate at the natural rate, and the natural rate in turn is the “constrained efficient rate,” i.e., the best rate that can be achieved by policy. Jordi Gali and I have called this proposition the “divine coincidence.” Additional distortions typically lead to deviations of the natural rate from the constrained efficient rate, but the divine coincidence remains a useful theoretical benchmark. The evidence from above is, however, that it fails badly empirically: This is reflected by the large standard deviation of the residual in the Phillips curve.

The residual can be interpreted in two ways: First as capturing unobserved movements in the natural rate. If so, it implies large, high frequency movements in the natural rate. As the constrained efficient rate is likely to move slowly, this in turn implies large, high frequency deviations of the natural rate from the constrained efficient rate. Or it can be interpreted as the result of misspecification, for example, the use of the wrong inflation series, or the wrong dynamic specification. In either case, it implies that the Fed faces a tradeoff between stabilizing unemployment and stabilizing inflation. In the language of monetary policy, it needs to go for very flexible inflation targeting, with potentially difficult communication problems, especially given the temptations discussed earlier.

In short, the US Phillips curve is still there. But its current shape raises serious challenges for monetary policy in the future.

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