# The Phillips curve. Back to the 60s?

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The behavior of inflation since the crisis appears puzzling to many. To cite Paul Krugman (2015): "The "accelerationist" doctrine that has dominated economic discussion of inflation and unemployment for 40 years has fallen flat. 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 paper reexamines the behavior of inflation and unemployment. It reaches four conclusions:

- The U.S. Phillips curve is alive and well (or at least as well as it has been in the past).
- Inflation expectations however have become steadily more anchored, leading 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 further evidence of a 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 learned from the experience of the 1960s and later will be needed.

**A brief literature review.**

This paper extends Blanchard, Cerutti, and Summers (BCS in what follows, 2015), where we examined the evolution of the relation between inflation and unemployment for 20 advanced economies. That paper builds in turn on an IMF World Economic Chapter (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 U.S. Phillips curve by Samuelson and 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 in BCS the following specification:

$$\pi_t = \theta_t (u_t - u_t^*) + \lambda_t \pi^e{}_t + (1 - \lambda_t) \pi^*{}_{t-1} + \mu_t \pi_{mt} + \varepsilon_t$$
$$\pi_t^e = \alpha_t + \beta_t \pi^*{}_{t-1} + \eta_t$$

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

The first equation specifies the Phillips curve. Inflation depends both on expected long term inflation and on 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 BCS 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 BCS.)

The main results are presented in the three figures below (For lack of space, results about 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 λ, 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-λ, has steadily decreased over time.

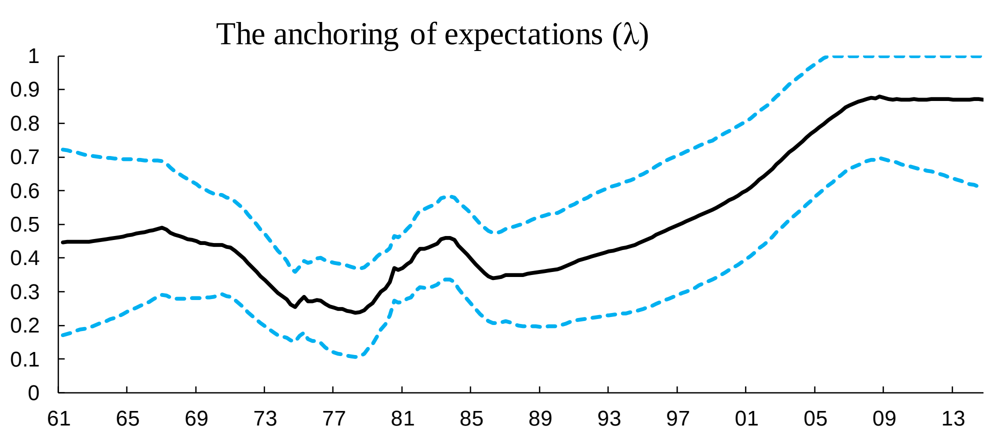
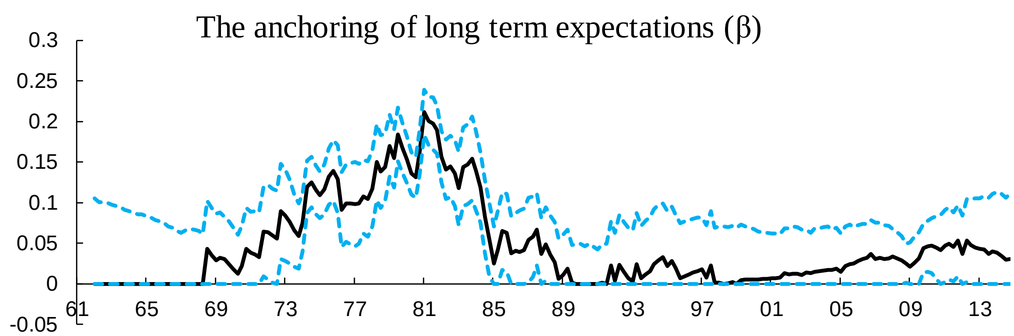
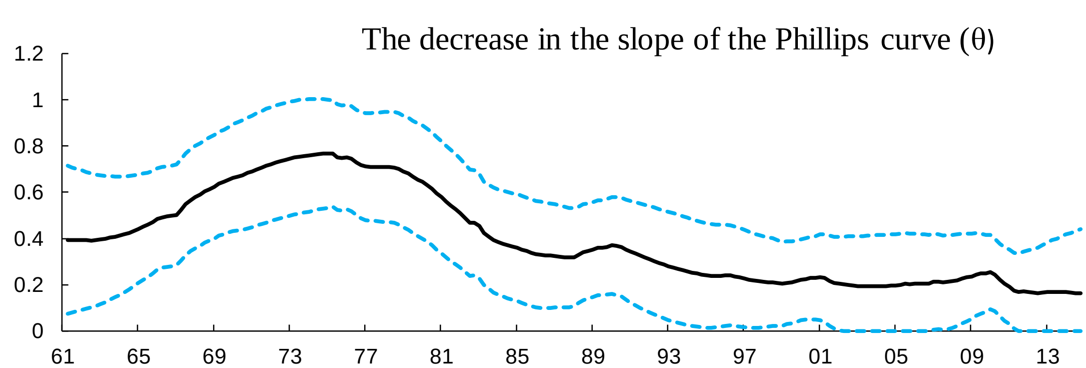


Figure 2 shows the evolution of $\beta_t$, the coefficient reflecting the effect of past inflation on long term expected inflation. After increasing in the 1970s, it decreased in the 1980s, and has been close to zero since the late 1980s.




Putting 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 very 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 $\theta_t$ , 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.



There is no evidence that the slope has decreased further in the crisis. Given expected inflation, a decrease in the unemployment rate led to a decrease in inflation of 0.7% in mid-1970s. The effect is now closer to 0.2%. 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% (at an annual rate) today, a large value relative to an inflation rate around 1-2%. 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, and a slightly lower value for θ (see Ball, and Kiley). 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 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:

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

This implication disappears when (1-λ), the coefficient on lagged inflation is less than one, and a fortiori when, as appears to be the case today, the coefficient 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 or necessity 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 they 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 Fed may have some room to use so long as inflation remains low enough so as to not become salient.

**The (too) appealing trade-off between unemployment and inflation.**

A small slope coefficient θ implies an attractive short-run tradeoff between inflation and unemployment. A value of -0.2 implies that a 1% decrease in unemployment for one quarter increases inflation, measured at an annual rate, by 0.2%. Combine this with the anchoring of expectations and a value of λ close to 1, which implies that, even if unemployment remains lower, inflation will not increase much above 0.2%, and the trade-off becomes even more attractive, 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 BCS, 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 example to not raise rates until it sees "the whites of inflation's eyes." Given the lags in the effect of higher interest rates on activity, this would appear to be a suboptimal policy.

**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 trade-off 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 Phillips curve is still there. But its current shape raises serious challenges for monetary policy in the future.

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