"Inflation and Unemployment"
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I recently had the opportunity to guest-teach a couple of business school economics classes. It was great to be back in the classroom. Don't get me wrong – I like my current job. But it was nice not to have to vote on anything.

I opened my discussions with a pair of questions, asking students to put themselves in the place of a monetary policymaker choosing a target for the federal funds rate. First I gave them a set of hypothetical facts about the state of the economy – a slowdown in housing in the wake of multi-year housing boom; rising mortgage default rates; preliminary indicators of a possible slowing in business investment. And then I asked them: "What are you going to do?" The students dutifully responded that this situation could call for a reduction in the funds rate. They'd obviously been doing their homework.

Next, I gave them a set of hypothetical facts about inflation – core PCE inflation, on a year-over-year basis, has been above 2 percent for nearly three straight years; after some signs of moderation, recent months' inflation numbers have moved higher; energy prices have been fluctuating around historically elevated levels and futures markets predict further increases to come; and labor compensation is rising after a relatively flat period. Same question: "What are you going to do?" Once again, their response came right out of the textbook – an increase in the funds rate is needed to counter rising inflation, other things equal.

The trick of course is that both sets of hypothetical facts are drawn from the same period – basically right now. My objective was to underscore the fact that sometimes monetary policy decisions are not obvious, and that figuring out the appropriate policy action requires as complete a picture as possible of the state of the economy. Interpreting that picture can be a challenging task.

The situation I presented to the students represents a policy-making dilemma. The actions needed to bring down inflation could work against our desire to see the real outlook solidify. The facts appear to present the policymaker with a tradeoff. You can address one – inflation or real growth – but that puts the other at risk.

There is an element of truth to characterizing this situation as a tradeoff. But that characterization is also, I think, an extreme over-simplification and can be highly misleading. Monetary policy actions today are capable of affecting inflation and

unemployment both now and in the future. Consequently, it is a mistake to view policy decision-making as a sequence of one-shot trade-offs. Some understanding of how inflation and unemployment interrelate over time is essential. I'd like to devote my remarks tonight to the relationship between inflation and the real side of the economy and to what I think that relationship implies for policy-making.

The relationship between inflation and the real economy can be described in terms of a number of alternative measures of real activity. Perhaps the most popular is the unemployment rate, because it captures the extent to which the expansion in employment generated by growth in real output is rapid enough to absorb additions to the labor force. As an indicator of the economy's use of its resources, the unemployment rate is commonly used as rough measure of the extent to which real activity is giving rise to "inflation pressures," but I will have much more to say about this later on.

Unemployment and inflation have, together, been at the center of macroeconomics for at least as long as there has been a field called macroeconomics. The relationship between these two variables is usually summarized by the *Phillips curve*, named for A. W. Phillips, the economist who in 1957 documented an inverse relationship between unemployment and wage inflation in nearly 100 years of data for the United Kingdom.[1] But the notion that rising inflation might at times be associated with rising real growth and falling unemployment had been recognized and discussed by early economists, a fact that has been emphasized by many scholars, including Robert Lucas in his Nobel lecture and by my long-time Richmond Fed colleague, Thomas Humphrey, who retired in 2005.[2]

Since Phillips' original paper, his curve has played a critical role in the evolution of thinking about macroeconomics and monetary policy. It captures the notable correlations between inflation and unemployment, although those correlations vary over time in important ways. But more importantly, it embodies compactly a theoretical understanding of the interplay between inflation and real economic forces. Because of its importance, and because the modern version of the Phillips curve is in some respects starkly different from the early edition, I think it will be worth our time to briefly review some of the Phillips curve's history, before examining the role it plays today in thinking about monetary policy. As always, the views expressed are my own, and not necessarily the same as others in the Federal Reserve.

A.W. Phillips' curve

The Phillips curve began as an atheoretical relationship drawn to fit the data. The form with which people are most familiar – linking unemployment to price inflation – was first set down in 1960 by Paul Samuelson and Robert Solow for U.S. data. Following Samuelson and Solow, the Phillips curve was interpreted as describing a set of choices available to society each time period. According to this view, if the data suggested that price stability tended to coexist, on average, with 5 percent unemployment, we would have to live with higher inflation to enjoy persistently lower unemployment. This thinking led to descriptions of policy as either stimulating real activity at the cost of

rising inflation, or fighting inflation by restraining the real economy. This understanding of the Phillips curve seems to have contributed to a political sentiment that, at least when inflation was relatively low, the costs of a little more inflation were worth the return in reduced unemployment.

But an alternative understanding of the Phillips curve was emerging in the 1960s. Milton Friedman and Edmund Phelps, separately, focused on the role of expectations in the relationship between inflation and unemployment.[3] Specifically, they argued that while inflationary policy actions that were *not* anticipated by the public could have a temporary stimulative effect on the economy, fully anticipated inflation would *not* affect real activity. Similarly, surprise disinflation could have a temporary contractionary effect but fully anticipated disinflation would not. This meant that the observed correlation in the data between inflation and unemployment must have come largely from episodes in which changes in the inflation rate were not expected by the public.

According to the *expectation-augmented* Phillips curve developed by Friedman and Phelps, changes in inflation, and by implication monetary policy, could not have persistent, lasting effects on real economic activity. Over the long run, economic growth and unemployment would tend to return to rates that were determined by productivity growth, population dynamics, and other characteristics of the markets for goods and labor.

To illustrate, suppose a policymaker consults a Phillips curve estimated from historical data that tells him that 3 percent unemployment can be achieved at 5 percent inflation. If the policymaker then eased interest rates in order to bring unemployment down, the policy might initially have the intended effect, provided the public continues to expect the lower previously prevailing inflation rate. But, the Friedman-Phelps framework argues, a sustained effort to maintain inflation at 5 percent would ultimately lead the public to adjust their expectations for inflation. In the long run, unemployment would rise again to its "natural" level given by the real structure of the economy.

In retrospect, many observers have labeled the Friedman-Phelps analysis prescient. They point to the 1970s as a confirmation of the implications of the expectations-augmented Phillips curve, because the period of high and volatile inflation in the 1970s brought no sustained improvement in real economic activity. In fact, not coincidentally, the general performance of the real economy during that period was poor.

The analysis of Friedman and Phelps focused attention on the critical macroeconomic role of expectations. They assumed *adaptive expectations*, meaning that households and firms based their expectations of future inflation on their observations of recent past inflation. This made it very natural to think of an increase in the rate of inflation as necessarily catching people by surprise; only over time would they learn about the altered policy stance. But why wouldn't people try to foresee how the central bank would behave rather than rely on the mechanical adaptive-expectations forecasting formula? For example, why wouldn't they expect the central bank to try to exploit a short-run Phillips curve, even before inflation rises? Such anticipation could rob inflationary policy of even

its short-run stimulative effects. In 1972, Robert Lucas provided an alternative, *rational expectations* analysis of the relationship between inflation and real activity. Under rational expectations, people's expectations are based not just on their past observations, but also on their knowledge of how the economy is likely to behave, including their knowledge of the process driving policymakers' choices.

The rational expectations analysis retained the Friedman-Phelps implication that only unexpected inflation would be associated with falling unemployment. But under rational expectations, the policymaker lacked the ability to systematically exploit even a short-run tradeoff between inflation and unemployment.

In separate work, Lucas also showed how rational expectations presented a challenge to making policy choices based on statistical estimates of such relationships as the Phillips curve. In what has famously become known as the *Lucas Critique*, he showed that shifts in the pattern of policy behavior would cause such relationships like the Phillips curve to shift as well, so that statistical estimates from historical data would no longer be relevant for predicting the economy's response to changing policy.

Rational expectations imply that the public's reaction to policy is more forward-looking than in the case of adaptive expectations. Also in the 1970s, Finn Kydland and Edward Prescott analyzed the problem faced by a policymaker when the public is forward-looking.[4] They dissect the temptation faced by a policymaker choosing inflation period-by-period. They study a setting that features a natural rate of unemployment and in which the best possible policy is one that achieves price stability. In any given period, what the public expected the central bank to do has already been determined. Given those beliefs, the policymaker can pull down unemployment with a little more inflation. But people understand that the policymaker will be so tempted, and thus they don't believe prices will be stable. The result is higher inflation with no gain in real activity. What the policymaker would like to do is find a way to *commit* to price stability. The work of Kydland and Prescott highlighted to role of a central bank's *credibility*; that is, the extent to which the public believes their commitment to price stability. Their work highlights the extent to which establishing credibility requires, indeed is virtually identical to, sacrificing future flexibility.

So the linchpin of the link between inflation, unemployment and monetary policy is the public's expectations for inflation. If a run-up in inflation has been correctly anticipated, then it up will have little or no effect on unemployment. Similarly, if people expect falling inflation, then unemployment will not increase as much as it would if the disinflation were unanticipated. Thomas Sargent demonstrated this dramatically in his analysis of the ends of hyperinflations in a number of countries.[5] When part of a comprehensive monetary and fiscal reform, very large reductions in inflation were achieved at much less cost than would be predicted by a standard Phillips curve.

The role of expectations figured prominently in the disinflation that took place in the early 1980s under Fed Chairman Paul Volcker. The Fed had delayed taking strong enough action against inflation before Volcker took office in 1979, in part out of a belief

that the slope of the Phillips curve was such that a fairly large increase in unemployment would be required to reduce inflation. The cost of the Volcker disinflation turned out to be substantially less than predicted however. The recent release of the FOMC transcripts from that era reveals that the public's inflation expectations were prominent in the Committee's discussions.[6]

The Modern Phillips Curve

Prior to the 1970s and 1980s, a significant methodological divide separated macroeconomics and microeconomics. That divide broke down when economists learned how to study models of the aggregate economy that were built on sound microeconomic foundations – general equilibrium models, in other words – but were also capable of addressing macroeconomic issues. The latter required models that were dynamic, because investment and interest are central to macroeconomics, and stochastic as well, because business cycle fluctuations seem to be to some extent unanticipated.[7] The first generation of such models had no substantive interaction between inflation and real economic activity, and they displayed business cycles that were driven entirely by real phenomenon. The challenge was to build models that captured the inflation-unemployment link in a compelling way.

The modern Phillips curve emerged out of one approach to understanding monetary non-neutrality in (otherwise) general equilibrium settings. The approach involves specifying price-setting frictions that make a firm's choice of the price of its goods a dynamic decision that depends on expectations of future inflation. In addition, a monopolistic competition feature provides firms with the scope for meaningful price setting decisions. Under common forms of this friction, only a fraction of sellers reset their prices each period. Anticipating a length of time before the next opportunity to adjust their price, sellers will choose a price depending on what they think will happen to the overall level of prices during that interval. Aggregating across sellers, one finds that current prices (and thus current inflation) depend on expected future inflation.[8]

In this class of models, current inflation also depends on real economic variables, particularly the real marginal cost of production, since prices are set as markups over marginal costs. Under certain heroic assumptions, a one-for-one relationship emerges between the real marginal cost of production and a measure of the scale of aggregate economic activity, like output or the unemployment rate. That case results in an equation one could describe as a Phillips curve, relating current inflation to current real activity and expected future inflation.[9]

Although this approach has broad acceptance, I should note that it is not without its critics. Many economists view the price-setting frictions that are at the core of this approach as ad hoc and unpersuasive. Moreover, there are alternative frictions, such as spatial separation and limited information, that can also rationalize monetary non-neutrality. Nonetheless, a Phillips curve derived from price-setting frictions has become the workhorse for applied central bank policy analysis.

This modern form of the Phillips curve closely resembles the expectations-augmented Phillips curve of Friedman and Phelps, and thus shares many of the same properties. For example, a marked movement in inflation will be associated with a move in unemployment only if the inflation is different from what the public expects to prevail in the near future. Furthermore, inflation expectations in these models are forward-looking, so expected inflation, just like inflation itself and unemployment, is an endogenous variable determined by the interaction of the conduct of monetary policy with private sector decisions and shocks to the economy.

When economists take this new Phillips curve to the data, they often find that past inflation helps explain inflation dynamics, even after attempting to control for expected inflation. This finding has led some to formulate versions of the Phillips curve in which both forward-looking and backward-looking price-setting behavior play a role.[10] Backward-looking price-setters are assumed to form expectations as a weighted average of past inflation, consistent with the adaptive expectations assumption in Friedman and Phelps, or else set prices using a simple rule of thumb based on recent inflation.

This so-called "hybrid" Phillips curve implies an intrinsic persistence to inflation, beyond that implied by the persistence of external shocks, the effect of expected inflation on current inflation, or the conduct of policy. Moreover, in the presence of significant backward-looking price-setting behavior, inflation would be prone to respond more slowly to changes in policy. Consequently, a backward-looking component implies that the real economic costs of bringing down inflation may be higher than would the case with a purely forward-looking Phillips curve. For the same reasons, backward-looking features would mean that inflation does not respond as rapidly to a change in policy as it otherwise might, even if that change itself is well explained by the policymaker and well anticipated and understood by the public.

A small cottage industry of economists is now devoted to estimating hybrid Phillips curves to try to find the appropriate weight to put on backward-looking price-setting. Common estimates are that around 25 percent of agents form expectations in a backward-looking fashion, although estimates of up to 60 percent have been obtained. Many such estimates assume that the conduct of monetary policy has been constant over this period, in the sense that it was guided by a single pattern of behavior. If instead one allows for shifts in monetary policy, then the estimated weight on a backward-looking component in the Phillips curve is far lower – in fact, often zero. By not allowing persistent swings in monetary policy, the standard approach can mistakenly attribute inflation persistence to backward-looking expectations. The observed persistence of inflation thus might arise from forward-looking behavior combined with uncertainty in the public's mind about policy trends. If people are uncertain about the policymaker's objectives or strategy, then their expectations will adjust more slowly as they learn about these features of policy by observing actual policy outcomes.

Policy

While there is reasonably strong statistical evidence of shifts in monetary policy, the premise that inflation expectations are forward-looking and that the conduct of monetary policy has evolved over time is also broadly consistent with the postwar history of U.S. monetary policy. Moreover, that history is intimately intertwined with the evolution of scientific understanding of the relationships embodied in the Phillips curve.[11] Widely held views about the Phillips curve in the 1960s suggested that tolerating a small amount of inflation would allow permanently lower unemployment. As trend inflation steadily rose into the early 1970s, the public came to expect higher inflation to persist and the Phillips curve shifted out. Policymakers had overlooked the endogeneity of inflation expectations, and their influence on future inflation outcomes. In the 1970s, policymakers were reluctant to attack inflation aggressively out of a belief, based on the estimated slope of the Phillips curve, that high sustained unemployment would be required to reduce inflation. Belief in backward-looking expectations led policymakers to underestimate the extent to which they could influence the evolution of expectations and thereby reduce the cost of disinflation. Unemployment did increase during the disinflation that Chairman Volcker initiated in 1979, but by substantially less than had been predicted by backward-looking Phillips curves. On several occasions after that, identified as "inflation scares" by my former colleague Marvin Goodfriend, inflation expectations rose and the Fed responded aggressively by raising real interest rates above what otherwise would have been warranted.[12] These episodes helped gain credibility for the Fed's commitment to low inflation.

As realized inflation fell in the 1990s, available measures of expected inflation fell as well, and since then they have been fairly low and stable. But this apparent stability, relative to the wide swings they displayed in prior decades, should not be cause for complacency, particularly with inflation currently running uncomfortably high. Some observers, for example, have noted that the decline in the persistence of inflation in recent decades makes it more likely that inflation will soon decline toward its recent trend. This much is unobjectionable, but they go on to argue that policymakers can be more patient as a result, relying on the "gravitational pull" of inflation expectations rather that interest rate increases that might push unemployment up. But the decline in persistence is most likely a consequence of the way policy has generally responded when inflation rises. If so, then failing to respond is inconsistent with the expectations underlying the recent tendency for inflation to return to trend. This takes current expectations for granted, and runs the risk of eroding credibility.

The nature of the Phillips curve is particularly relevant to evaluating alternative policy strategies for restoring price stability. Would reducing inflation require large increases in unemployment? Again, the key is the behavior of inflation expectations, which now seem to hover between 2 and 2 ½ percent, a bit below inflation itself. If expectations are backward-looking, tied to past experience, one might favor a very gradual decline in inflation so as to minimize the effect on unemployment. Forward-looking expectations, however, suggest a strategy of attempting to influence expectations directly through clear and forceful communications. If such a communication strategy were successful, a more

rapid return to price stability would be feasible and would require less policy tightening than would otherwise be the case.

How responsive to policymaker influence are inflation expectations? General prescriptions are unlikely, because results will depend on the nature of central bank actions and communication, and the context in which they are received. There are many examples of significant shifts in expectations induced by convincing people of a break from past practice. Examples include the fiscal reforms accompanying the ends of hyperinflations, the governance changes accompanying the adoption of explicit inflation objectives, and the operational regime shift adopted by the Volcker FOMC in 1979. In many recent instances, FOMC actions or statements have induced short run movements in market participants' expectations regarding the path of the federal funds rate and inflation. Although there may be no precise historical analogs for potential communications and actions to restore price stability in circumstances like the present day, these examples suggest that significant shifts in inflation expectations are possible.

In any case, the centrality of inflation expectations in the modern Phillips curve reinforces the importance of consistency and credibility in monetary policy making, since these are traits that reduce people's uncertainty about future policy and stabilize expected inflation. It suggests that central banks should not take inflation expectations for granted by acting in ways that are inconsistent with expectations but assuming expectations will not change. Moreover, central banks should guard against underestimating the degree to which they are capable of influencing the evolution of inflation expectations. To paraphrase the late Milton Friedman, inflation is always and everywhere an expectational phenomenon. To put it another way, inflation expectations are an *outcome* of monetary policy, *not* an autonomous help or hindrance. Central banks are as responsible for the behavior of inflation expectations as they are for the behavior of inflation.

John Weinberg contributed to these remarks.

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[9] Some in the literature refer to this as the "New Keynesian Phillips Curve," and to the underlying model as the "New Neoclassical Economics."

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