6-1

INFLATION AND UNEMPLOYMENT

Figure 6-1 shows the unemployment rate since 1960. With a quick glance one can see that the economy was in bad shape at the end of 2010. Contrast this with the low unemployment rate that a healthy U.S. economy enjoyed in 2006 and 2007. In this section we discuss the Phillips curve, which gives the tradeoff between unemployment and inflation. Later in the chapter we give a more rigorous derivation, demonstrating the translation between the aggregate supply curve and the Phillips curve. (GDP connects to unemployment; potential GDP connects to the natural rate of unemployment; the price level connects to the inflation rate.) On an everyday basis it's much easier to work with figures for unemployment on the Phillips curve than with GDP numbers on the aggregate supply curve.

THE PHILLIPS CURVE

In 1958 A. W. Phillips, then a professor at the London School of Economics, published a comprehensive study of wage behavior in the United Kingdom for the years 1861–1957.[2] The main finding is summarized in Figure 6-2, reproduced from his article: **The *Phillips curve* is an inverse relationship between the rate of unemployment and the rate of increase in money wages. The higher the rate of unemployment, the lower the rate of wage inflation. In other words, there is a tradeoff between wage inflation and unemployment.**

[2]A. W. Phillips, "The Relation between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861–1957," *Economica*, November 1958.

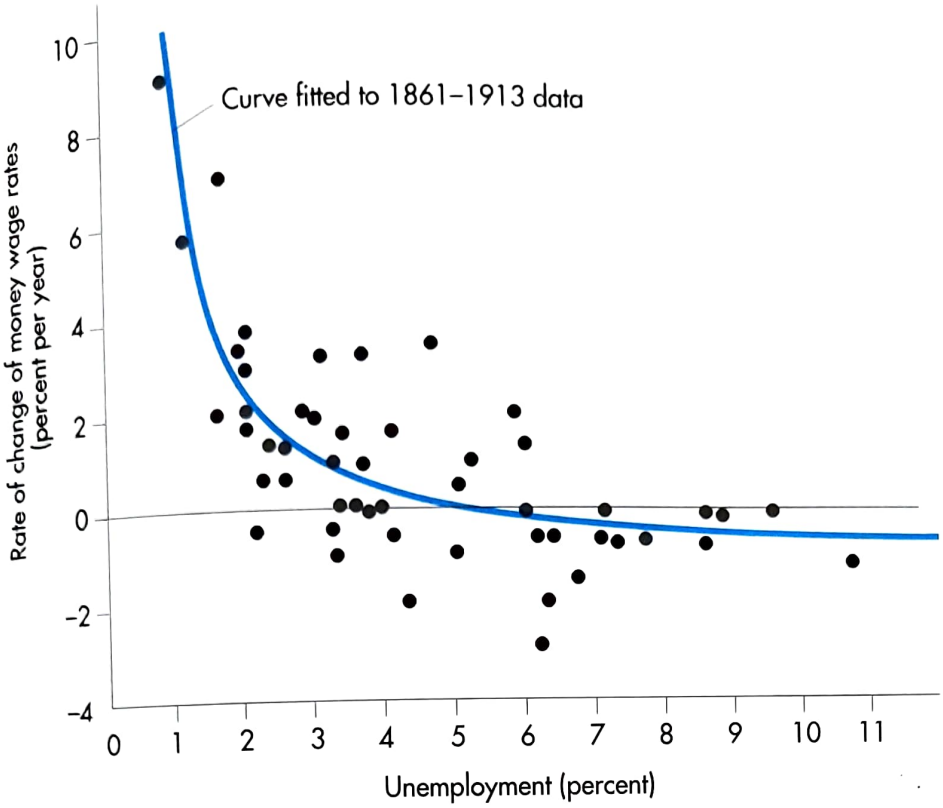

FIGURE 6-2 THE ORIGINAL PHILLIPS CURVE FOR THE UNITED KINGDOM.

(*Source: A. W. Phillips, "The Relation between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861–1957,"* Economica, *November 1958.*)

The Phillips curve shows that the rate of wage inflation decreases with the unemployment rate. Letting W_t be the wage this period, and W_{t+1} the wage next period, the rate of wage inflation, g_w, is defined as

$$g_w = \frac{W_{t+1} - W_t}{W_t} \tag{1}$$

With u^* representing the natural rate of unemployment,[3] we can write the simple Phillips curve as

$$g_w = -\epsilon(u - u^*) \tag{2}$$

where ϵ measures the responsiveness of wages to unemployment. This equation states that wages are falling when the unemployment rate exceeds the natural rate, that is, when $u > u^*$, and rising when unemployment is below the natural rate. The difference between unemployment and the natural rate, $u - u^*$ is called the *unemployment gap*.

Suppose the economy is in equilibrium with prices stable and unemployment at the natural rate. Now there is an increase in the money stock of, say, 10 percent. Prices and

[3](1) You will see below that there is a close connection between the natural rate of unemployment, u^*, and potential output, Y^*. (2) Many economists prefer the term "nonaccelerating inflation rate of unemployment" (NAIRU) to the term "natural rate." See Laurence M. Ball and N. Gregory Mankiw, "The NAIRU in Theory and Practice," *Journal of Economic Perspectives,* November 2002. See also Chap. 7, footnote 13 in this text.

wages both have to rise by 10 percent for the economy to get back to equilibrium. But the Phillips curve shows that, for wages to rise by an extra 10 percent, the unemployment rate will have to fall. That will cause the rate of wage increase to go up. Wages will start rising, prices too will rise, and eventually the economy will return to the full-employment level of output and unemployment. This point can be readily seen by rewriting equation (1), using the definition of the rate of wage inflation, in order to look at the level of wages today relative to the past level:

$$W_{t+1} = W_t[1 - \epsilon(u - u^*)] \tag{2a}$$

For wages to rise above their previous level, unemployment must fall below the natural rate.

Although Phillips's own curve relates the rate of increase of wages or wage inflation to unemployment, as in equation (2) above, the term "Phillips curve" gradually came to be used to describe either the original Phillips curve *or* a curve relating the rate of increase of *prices*—the rate of inflation—to the unemployment rate. Figure 6-3 shows inflation and unemployment data for the United States during the 1960s that appear entirely consistent with the Phillips curve.

THE POLICY TRADEOFF

The Phillips curve rapidly became a cornerstone of macroeconomic policy analysis. It suggested that policymakers could choose different combinations of unemployment and inflation rates. For instance, they could have low unemployment as long as they put up with high inflation—say, the situation in the late 1960s in Figure 6-3. Or they could maintain low inflation by having high unemployment, as in the early 1960s.

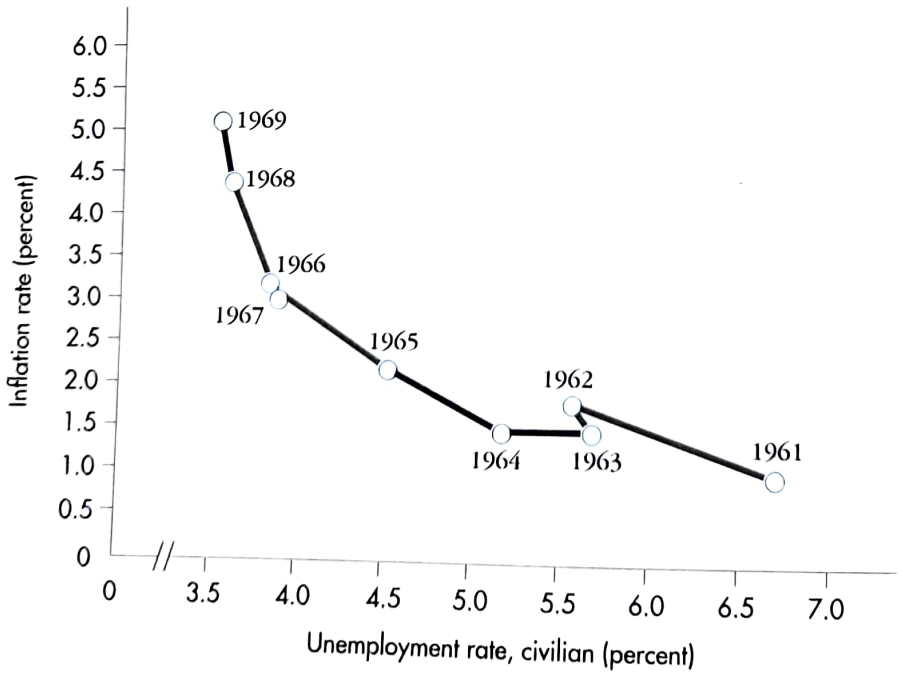

FIGURE 6-3 RELATIONSHIP OF INFLATION AND UNEMPLOYMENT: UNITED STATES, 1961–1969. *(Source: DRI/McGraw-Hill.)*

You already know that the idea of a *permanent* unemployment-inflation tradeoff must be wrong because you know that the long-run aggregate supply curve is vertical. The piece of the puzzle that is missing in the simple Phillips curve is the role of price expectations. But the data in Figure 6-3 should leave you with two impressions that are clear and correct. First, there *is* a short-run tradeoff between unemployment and inflation.[4] Second, the Phillips curve (and therefore the aggregate supply curve) really is quite flat in the short run. Applying ocular econometrics to Figure 6-3,[5] you should see that lowering unemployment by a full percentage point (which is a lot) increases the inflation rate in the short run by about half a point (a relatively modest amount). Note too that at very low unemployment rates the inflation/unemployment tradeoff becomes quite a bit steeper.

6-2

STAGFLATION, EXPECTED INFLATION, AND THE INFLATION-EXPECTATIONS-AUGMENTED PHILLIPS CURVE

The *simple* Phillips curve relationship fell apart after the 1960s, both in Britain and in the United States. Figure 6-4 shows the behavior of inflation and unemployment in the United States over the period since 1960. The data for the 1970s and 1980s do not fit the simple Phillips curve story.

Something is missing from the simple Phillips curve. That something is *expected,* or *anticipated, inflation.* When workers and firms bargain over wages, they are concerned with the real value of the wage, so both sides are more or less willing to adjust the level of the nominal wage for any inflation expected over the contract period. Unemployment depends not on the level of inflation but, rather, on the excess of inflation over what was expected.

A little introspection illustrates the issue. Suppose that on the first of the year your employer announces a 3 percent across-the-board raise for you and your coworkers. While not massive, 3 percent is a nice increase, and you and your colleagues might be reasonably pleased. Now suppose we tell you that inflation has been running 10 percent a year and is expected to continue at this rate. You will understand that if the cost of living rises 10 percent while your nominal wage rises only 3 percent, your standard of living is actually going to fall, by about 7(= 10 – 3) percent. In other words, you care about wage increases *in excess* of expected inflation.

We can rewrite equation (2), the original wage-inflation Phillips curve, to show that it is the excess of wage inflation over expected inflation that matters:

$$(g_w - \pi^e) = -\epsilon(u - u^*) \tag{3}$$

where π^e is the level of expected price inflation.

[4]N. Gregory Mankiw, "The Inexorable and Mysterious Tradeoff between Inflation and Unemployment," *Economic Journal* 111, May 2001.

[5]In other words, applying eyeball to data.

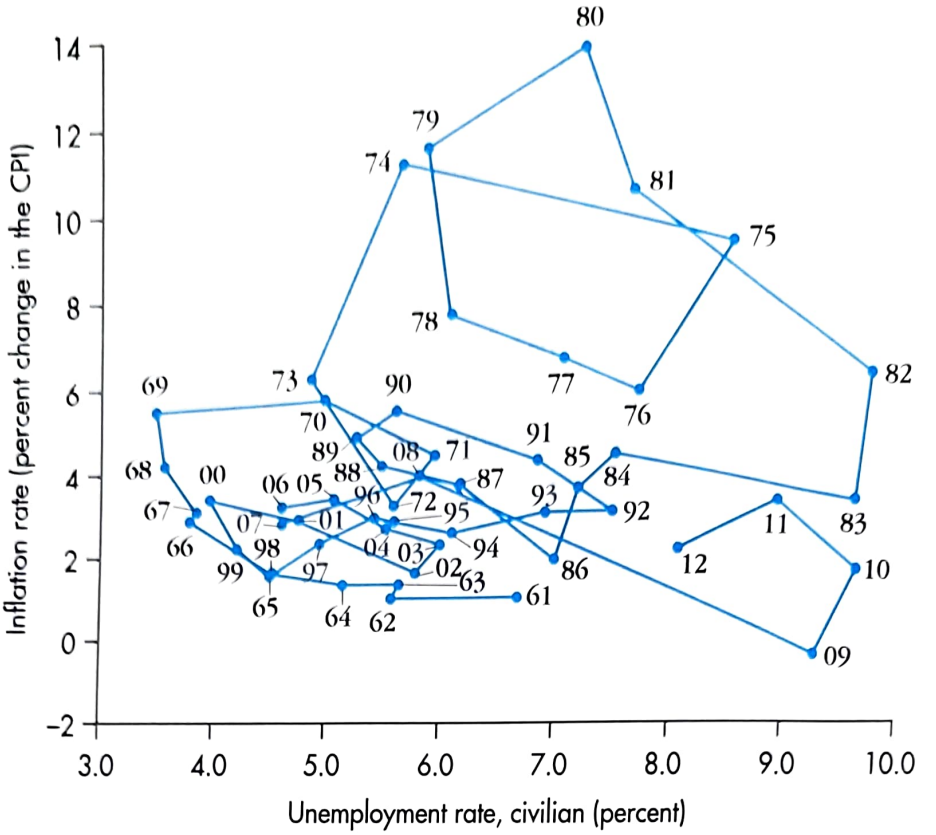

FIGURE 6-4 RELATIONSHIP OF INFLATION AND UNEMPLOYMENT: UNITED STATES, 1961–2012.

(Source: Bureau of Labor Statistics.)

Maintaining the assumption of a constant real wage, actual inflation, π, will equal wage inflation. Thus, the equation for the modern version of the Phillips curve, the *(inflation-) expectations-augmented Phillips curve,* is

$$\pi = \pi^e - \epsilon(u - u^*) \tag{4}$$

Note two critical properties of the modern Phillips curve:

- Expected inflation is passed one for one into actual inflation.
- Unemployment is at the natural rate when actual inflation equals expected inflation.

We have now an additional factor determining the height of the short-run Phillips curve (and the corresponding short-run aggregate supply curve). Instead of intersecting the natural rate of unemployment at zero, the modern Phillips curve intersects the natural rate at the level of expected inflation. Figure 6-5 shows stylized Phillips curves for the early 1980s (when inflation had been running 6 to 8 percent) and the early oughts (when inflation had been running at about 2 percent).

Firms and workers adjust their expectations of inflation in light of the recent history of inflation.[6] The short-run Phillips curves in Figure 6-5 reflect the low level of inflation that was expected in the early oughts and the much higher level that was expected in the early 1980s. The curves have two properties you should note. First, the

[6]How quickly firms and workers adjust and the extent to which they look to the future rather than to recent

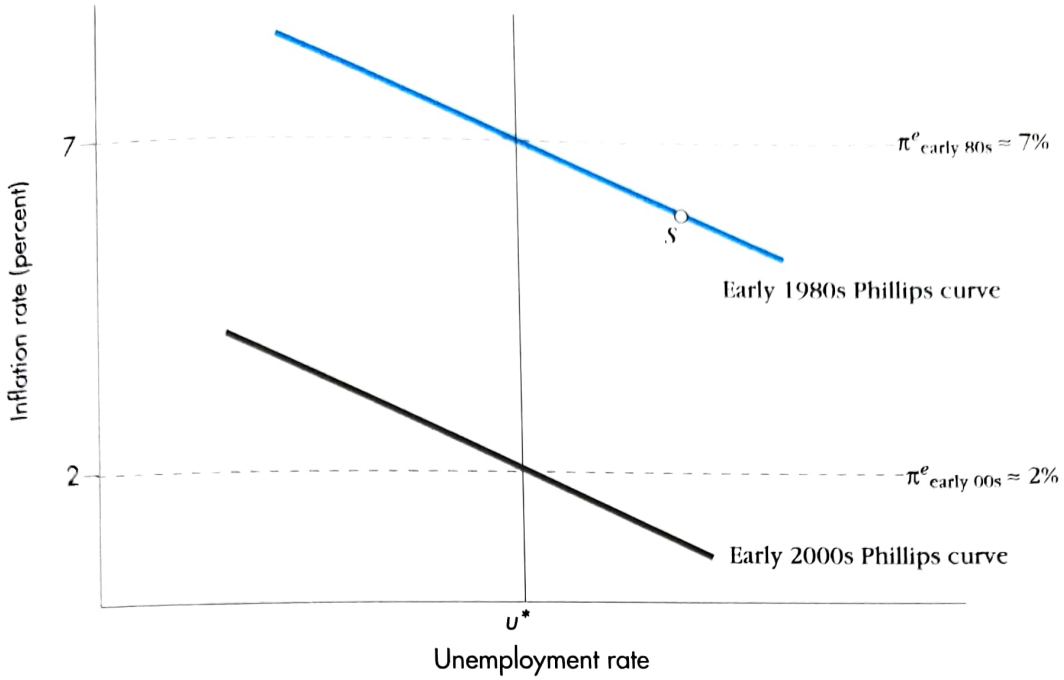

FIGURE 6-5 INFLATION EXPECTATIONS AND THE SHORT-RUN PHILLIPS CURVE.

curves have the same short-run tradeoff between unemployment and inflation; that is to say, the *slopes are equal.* Second, in the early oughts full employment was compatible with roughly 2 percent annual inflation; in the early 1980s full employment was compatible with roughly 7 percent inflation.

The height of the short-run Phillips curve, the level of expected inflation, π^e, moves up and down over time in response to the changing expectations of firms and workers. *The role of expected inflation in moving the Phillips curve adds another automatic adjustment mechanism to the aggregate supply side of the economy.* When high aggregate demand moves the economy up and to the left along the short-run Phillips curve, inflation results. If the inflation persists, people come to expect inflation in the future (π^e rises) and the short-run Phillips curve moves up.

STAGFLATION

Stagflation is a term coined to mean high unemployment ("stagnation") and high inflation. For example, in 1982 unemployment was over 9 percent and inflation approximately 6 percent. Point *S* in Figure 6-5 is a stagflation point. It is easy to see how stagflation occurs.[7] Once the economy is on a short-run Phillips curve that includes significant expected inflation, a recession will push actual inflation down below expected inflation (e.g., a movement to the right on the 1980s Phillips curve in Figure 6-5), but

[7]For some reason, journalists delight in reporting that economists don't understand stagflation. This was probably true in the 1960s and early 1970s, before the role of inflation expectations was fully appreciated. The 1960s were a long time ago. As you see, stagflation is no longer a puzzle.