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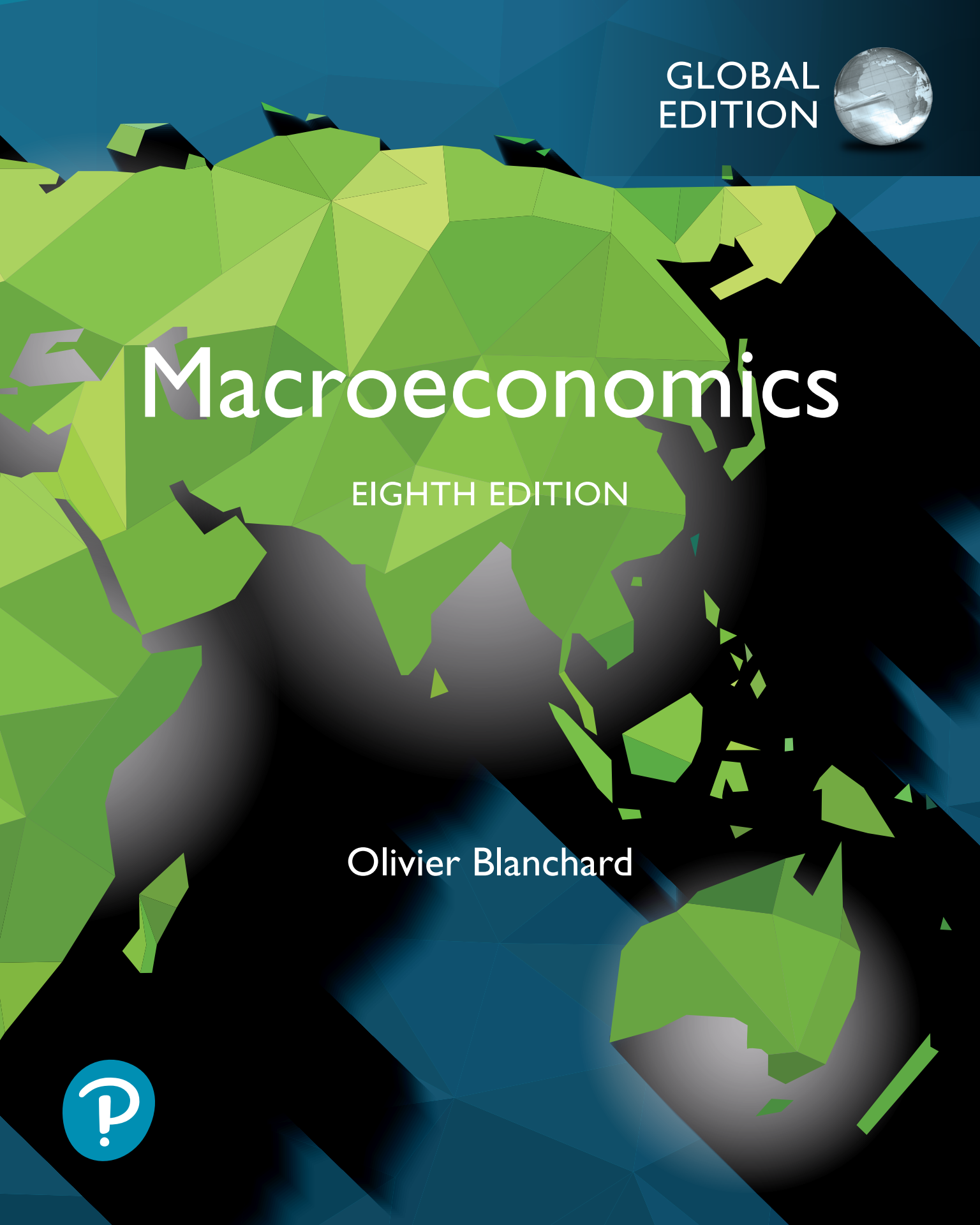

Macroeconomics

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APPENDIX: Wage- and Price-Setting Relations versus Labor Supply and Labor Demand

If you have taken a microeconomics course, you probably saw a representation of labor market equilibrium in terms of labor supply and labor demand. You may therefore be asking yourself: How does the representation in terms of wage setting and price setting relate to the representation of the labor market I saw in that course?

In an important sense, the two representations are similar.

To see why, let's redraw Figure 7-6 in terms of the real wage on the vertical axis, and the level of *employment* (rather than the unemployment rate) on the horizontal axis. We do this in Figure 1.

Employment, N, is measured on the horizontal axis. The level of employment must be somewhere between zero and L, the labor force. Employment cannot exceed the number of people available for work (i.e., the labor force). For any employment level N, unemployment is given by $u = L - N$. Knowing this, we can measure unemployment by starting from L and *moving to the left* on the horizontal axis. Unemployment is given by the distance between L and N. The lower is employment, N, the higher is unemployment, and by implication the higher the unemployment rate, u.

Let's now draw the wage-setting and price-setting relations and characterize the equilibrium.

- An increase in employment (a move to the right along the horizontal axis) implies a decrease in unemployment and therefore an increase in the real wage chosen in wage setting. Thus, the wage-setting relation is now *upward sloping*. Higher employment implies a higher real wage.
- The price-setting relation is still a horizontal line at $W/P = 1/(1 + m)$.
- The equilibrium is given by point A, with "natural" employment level N_n (and an implied natural unemployment rate equal to $u_n = (L - N_n)/L$).

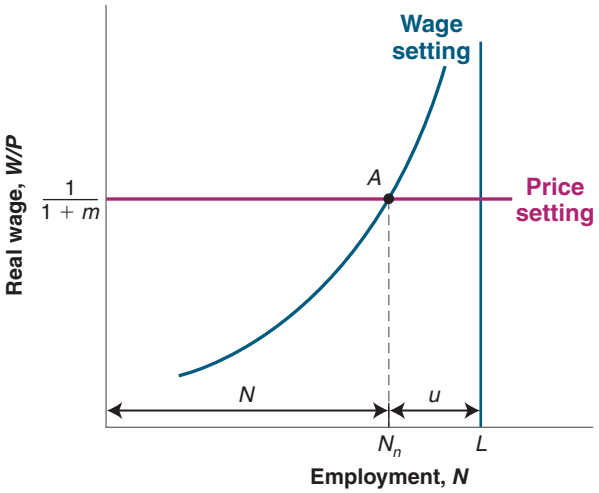


Figure 1

Wage and Price Setting and the Natural Level of Employment

In this figure the wage-setting relation looks like a labor supply relation. As the level of employment increases, the real wage paid to workers increases as well. For that reason, the wage-setting relation is sometimes called the "labor supply" relation (in quotes).

What we have called the *price-setting relation* looks like a flat labor demand relation. The reason it is flat rather than downward sloping has to do with our simplifying assumption of constant returns to labor in production. Had we assumed, more conventionally, that there were decreasing returns to labor in production, our price-setting curve would, like the standard labor demand curve, be downward sloping: As employment increased, the marginal cost of production would increase, forcing firms to increase their prices given the wages they pay. In other words, the real wage implied by price setting would decrease as employment increased.

But in a number of ways, the two approaches are different:

- The standard labor supply relation gives the wage at which a given number of workers are willing to work. The higher the wage, the larger the number of workers who are willing to work.

  In contrast, the wage corresponding to a given level of employment in the wage-setting relation is the result of a process of bargaining between workers and firms or unilateral wage setting by firms. Factors like the structure of collective bargaining or the use of wages to deter quits affect the wage-setting relation. In the real world, they seem to play an important role. Yet they play no role in the standard labor supply relation.
- The standard labor demand relation gives the level of employment chosen by firms at a given real wage. It is derived under the assumption that firms operate in competitive goods and labor markets and therefore take wages and prices—and by implication the real wage—as given.

  In contrast, the price-setting relation takes into account the fact that in most markets firms actually set prices. Factors such as the degree of competition in the goods market affect the price-setting relation by affecting the markup. But these factors aren't considered in the standard labor demand relation.
- In the labor supply–labor demand framework, those who are unemployed are *willingly unemployed*. At the equilibrium real wage, they prefer to be unemployed rather than work.

  In contrast, in the wage- and price-setting framework, unemployment is likely to be involuntary. For example, if firms pay an efficiency wage—a wage above the reservation wage—workers would rather be employed than unemployed. Yet, in equilibrium, there is still involuntary unemployment. This also seems to capture reality better than does the labor supply–labor demand framework.

  These are the three reasons why we have relied on the wage-setting and price-setting relations rather than on the labor supply–labor demand approach to characterize equilibrium in this chapter.

8

The Phillips Curve, the Natural Rate of Unemployment, and Inflation

In 1958, A. W. Phillips drew a diagram plotting the inflation rate against the unemployment rate in the United Kingdom for each year from 1861 to 1957. He found clear evidence of an inverse relation between inflation and unemployment. When unemployment was low, inflation was high, and when unemployment was high, inflation was low, often even negative.

A. W. Phillips was a New Zealander who taught at the London School of Economics. He had been, among other things, a crocodile hunter in his youth. He also built a hydraulic machine to describe the behavior of the macroeconomy. A working version of the machine is still on display in Cambridge, England.

Two years later, two US economists, Paul Samuelson and Robert Solow, replicated Phillips's exercise for the United States, using data from 1900 to 1960. Figure 8-1 reproduces their findings using consumer price index (CPI) inflation as a measure of the inflation rate. Apart from the period of high unemployment during the 1930s (the years from 1931 to 1939 are denoted by triangles and are well to the right of the other points in the figure), there was a clear negative relation between inflation and unemployment in the United States. This relation, which Samuelson and Solow labeled the **Phillips curve**, rapidly became central to macroeconomic thinking and policy. It appeared to imply that countries could choose between different combinations of unemployment and inflation. A country could achieve low unemployment if it were willing to tolerate higher inflation, or it could achieve price level stability—zero inflation—if it were willing to tolerate higher unemployment. Much of the discussion about macroeconomic policy became a discussion about which point to choose on the Phillips curve.

During the 1970s, however, this relation broke down. In the United States and most OECD countries, there was both high inflation *and* high unemployment, clearly contradicting the original Phillips curve. A relation reappeared, but as a relation between the *change* in the inflation rate and the unemployment rate. In the 1990s, the relation changed once again, and the old relation between inflation and unemployment reappeared. The purpose of this chapter is to explore these mutations of the Phillips curve and, more generally, to understand the relation between inflation and unemployment. We shall derive the Phillips curve from the model of the labor market we saw in Chapter 7. And you will see how the mutations of the Phillips curve have come from changes in the way people and firms have formed expectations.

The chapter has four sections:

Section 8-1 shows how the model of the labor market we saw previously implies a relation between inflation, expected inflation, and unemployment.

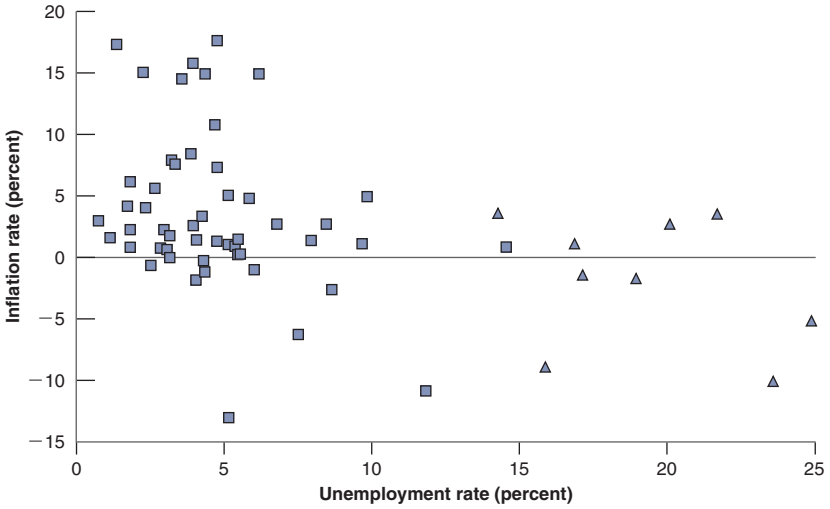
Section 8-2 uses this relation to interpret the mutations of the Phillips curve over time.

Figure 8-1

Inflation versus Unemployment in the United States, 1900–1960

During the period 1900–1960 in the United States, a low unemployment rate was typically associated with a high inflation rate, and a high unemployment rate was typically associated with a low or negative inflation rate.

Source: Based on Historical Statistics of the United States. http://hsus.cambridge.org/HSUSWeb/index.do.



Section 8-3 shows the relation between the Phillips curve and the natural rate of unemployment.

Section 8-4 further discusses the relation between unemployment and inflation across countries and over time.

If you remember a basic message from this chapter, it should be: Low unemployment puts upward pressure on inflation, but the form of the relation depends very much on how people and firms form expectations. ▶▶▶

8-1 INFLATION, EXPECTED INFLATION, AND UNEMPLOYMENT

In Chapter 7, we derived the following equation for wage determination (equation (7.1)):

$$W = P^e F(u, z)$$

The nominal wage W, set by wage setters, depends on the expected price level, P^e, the unemployment rate, u, and a variable, z, that captures all the other factors that affect wage determination, from unemployment benefits to the form of collective bargaining.

It will be convenient to assume a specific form for the function, F:

$$F(u, z) = 1 - \alpha u + z$$

This captures the notion that the higher the unemployment rate, the lower the nominal wage; and the higher z (for example, the more generous unemployment benefits are), the higher the nominal wage. The parameter α (the Greek lowercase letter alpha) captures the strength of the effect of unemployment on the wage. Replacing the function, F, by this specific form in the equation above gives:

$$W = P^e(1 - \alpha u + z)$$

Also in Chapter 7, we derived the following equation for price determination (equation (7.3)):

$$P = (1 + m) W$$

The price, P, set by firms (equivalently, the price level) is equal to the nominal wage, W, times 1 plus the markup, m.

We then used these two relations together with the additional assumption that the actual price level was equal to the expected price level. Under this additional assumption, we then derived the natural rate of unemployment. We now explore what happens when we do not impose this additional assumption.

Replacing the nominal wage in the second equation by its expression from the first gives:

$$P = P^e(1 + m)(1 - \alpha u + z) \tag{8.1}$$

This gives us *a relation between the price level, the expected price level, and the unemployment rate.*

Let π denote the inflation rate and π^e the expected inflation rate. Then equation (8.1) can be rewritten as *a relation between inflation, expected inflation, and the unemployment rate:*

From now on, to lighten your reading, I shall often refer to the inflation rate simply as *inflation*, and to the unemployment rate simply as *unemployment*.

$$\pi = \pi^e + (m + z) - \alpha u \tag{8.2}$$

Deriving equation (8.2) from equation (8.1) is not difficult, but it is tedious, so it is left to an appendix at the end of this chapter. Equation (8.2) is one of the most important equations in macroeconomics. It is important that you understand each of the effects at work:

- *An increase in expected inflation, π^e, leads to an increase in actual inflation, π.*
  To see why, start from equation (8.1). An increase in the expected price level P^e leads, one for one, to an increase in the actual price level, P: If wage setters expect a higher price level, they set a higher nominal wage, which leads in turn to an increase in the price level.

  Now note that, given last period's price level, a higher price level this period implies a higher rate of increase in the price level from last period to this period—that is, higher inflation. Similarly, given last period's price level, a higher expected price level this period implies a higher expected rate of increase in the price level from last period to this period—that is, higher expected inflation. Thus the fact that an increase in the expected price level leads to an increase in the actual price level can be restated as: An increase in expected inflation leads to an increase in inflation.

  ◀ Increase in $\pi^e \Rightarrow$ Increase in π.
- *Given expected inflation, π^e, an increase in the markup, m, or an increase in the factors that affect wage determination—an increase in z—leads to an increase in actual inflation, π.*
  From equation (8.1): Given the expected price level, P^e, an increase in either m or z increases the price level, P. Using the same argument as in the previous bullet to restate this proposition in terms of inflation and expected inflation: Given expected inflation, π^e, an increase in either m or z leads to an increase in inflation π.

  ◀ Increase in m or $z \Rightarrow$ Increase in π.
- *Given expected inflation, π^e, a decrease in the unemployment rate, u, leads to an increase in actual inflation π.*

  From equation (8.1): Given the expected price level, P^e, a decrease in the unemployment rate, u, leads to a higher nominal wage, which leads to a higher price level, P. Restating this in terms of inflation and expected inflation: Given expected inflation, π^e, an increase in the unemployment rate, u, leads to an increase in inflation, π.

  ◀ Decrease in $u \Rightarrow$ Increase in π.

We need to take one more step before we return to a discussion of the Phillips curve. When we look at movements in inflation and unemployment in the rest of the chapter, it will be convenient to use time indexes so that we can refer to variables such as inflation, expected inflation, or unemployment in a specific year. So we rewrite equation (8.2) as:

$$\pi_t = \pi^e_t + (m + z) - \alpha u_t \tag{8.3}$$

The variables π_t, π_t^e, and u_t refer to inflation, expected inflation, and unemployment in year t. Note that there are no time indexes on m and z. This is because although m and z may move over time, they are likely to move slowly, especially relative to movement in inflation and unemployment. Thus, for the moment, we shall treat them as constant.

Equipped with equation (8.3), we can now return to the Phillips curve and its mutations.

8-2 THE PHILLIPS CURVE AND ITS MUTATIONS

Let's start with the relation between unemployment and inflation as it was first discovered by Phillips, Samuelson, and Solow.

The Original Phillips Curve

Assume that inflation varies from year to year around some value $\overline{\pi}$. Assume also that inflation is not persistent, so that inflation this year is not a good predictor of inflation next year. This happens to be a good characterization of the behavior of inflation over the period that Phillips or Solow and Samuelson were studying. In such an environment, it makes sense for wage setters in particular to expect that, whatever inflation was last year, inflation this year will simply be equal to $\overline{\pi}$. In this case, $\pi_t^e = \overline{\pi}$ and equation (8.3) becomes:

$$\pi_t = \overline{\pi} + (m + z) - \alpha u_t \tag{8.4}$$

In this case, we should observe a negative relation between unemployment and inflation. This is precisely the negative relation between unemployment and inflation that Phillips found for the United Kingdom and Solow and Samuelson found for the United States. When unemployment was high, inflation was low, even sometimes negative. When unemployment was low, inflation was positive.

When these findings were published, they suggested that policymakers faced a trade-off between inflation and unemployment. If they were willing to accept more inflation, they could achieve lower unemployment. This looked like an attractive trade-off, and starting in the early 1960s, US macroeconomic policy aimed at steadily decreasing unemployment. Figure 8-2 plots the combinations of the inflation rate and the unemployment rate in the United States for each year from 1961 to 1969. Note how well the negative relation between unemployment and inflation corresponding to equation (8.4) held during the long economic expansion that lasted throughout most of the 1960s. From 1961 to 1969, the unemployment rate declined steadily from 6.8% to 3.4%, and the inflation rate steadily increased, from 1.0% to 5.5%. Put informally, the US economy moved up along the Phillips curve. It indeed appeared that, if policymakers were willing to accept higher inflation, they could achieve lower unemployment.

The De-anchoring of Expectations

Around 1970, however, the relation between the inflation rate and the unemployment rate, so clear in Figure 8-2, broke down. Figure 8-3 shows the combination of the inflation rate and the unemployment rate in the United States for each year from 1970 to

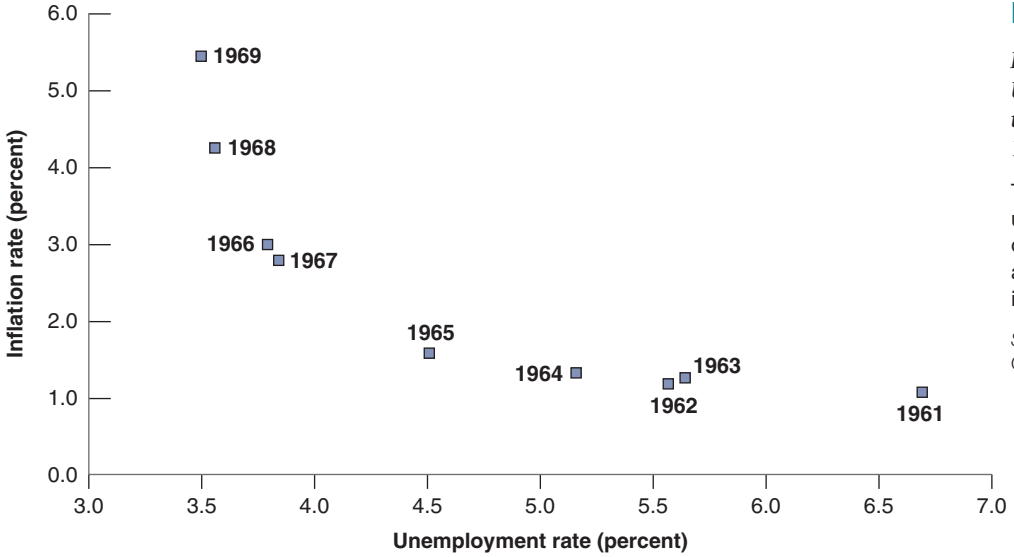


Figure 8-2

Inflation versus Unemployment in the United States, 1961–1969

The steady decline in the US unemployment rate throughout the 1960s was associated with a steady increase in the inflation rate.

Source: FRED: Series UNRATE, CPIAUSCL

1995. The points are scattered in a roughly symmetric cloud. There is no longer any visible relation between the unemployment rate and the inflation rate.

Why did the original Phillips curve vanish? *Because wage setters changed the way they formed their expectations about inflation.*

This change came from a change in the behavior of inflation. The rate of inflation became more persistent. High inflation in one year became more likely to be followed by high inflation the next year. As a result, people, when forming expectations, started to take into account the persistence of inflation, and this change in expectation formation

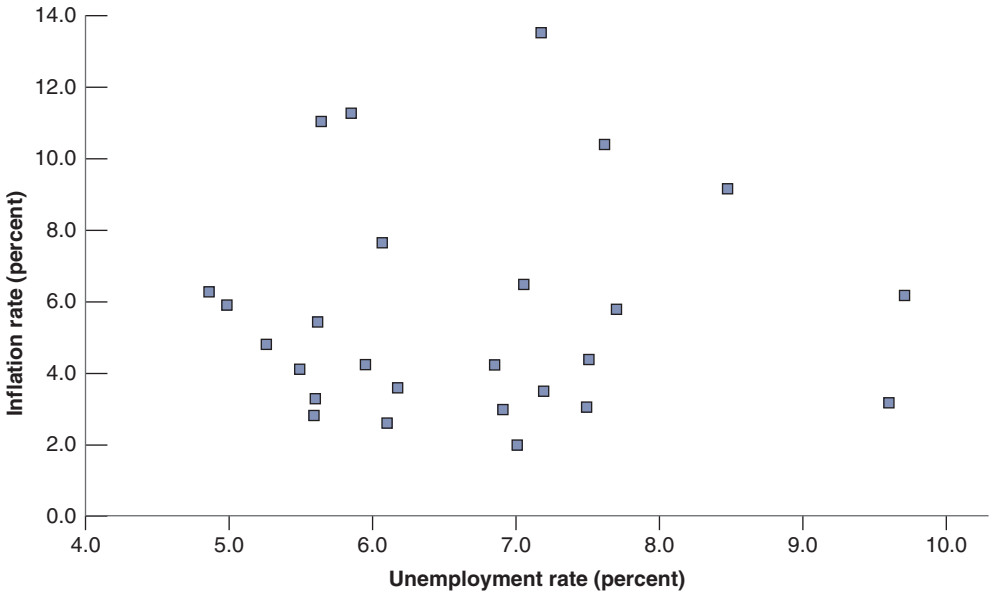


Figure 8-3

Inflation versus Unemployment in the United States, 1970–1995

Beginning in 1970 in the United States, the relation between the unemployment rate and the inflation rate disappeared.

Source: FRED: UNRATE, CPIAUSCL