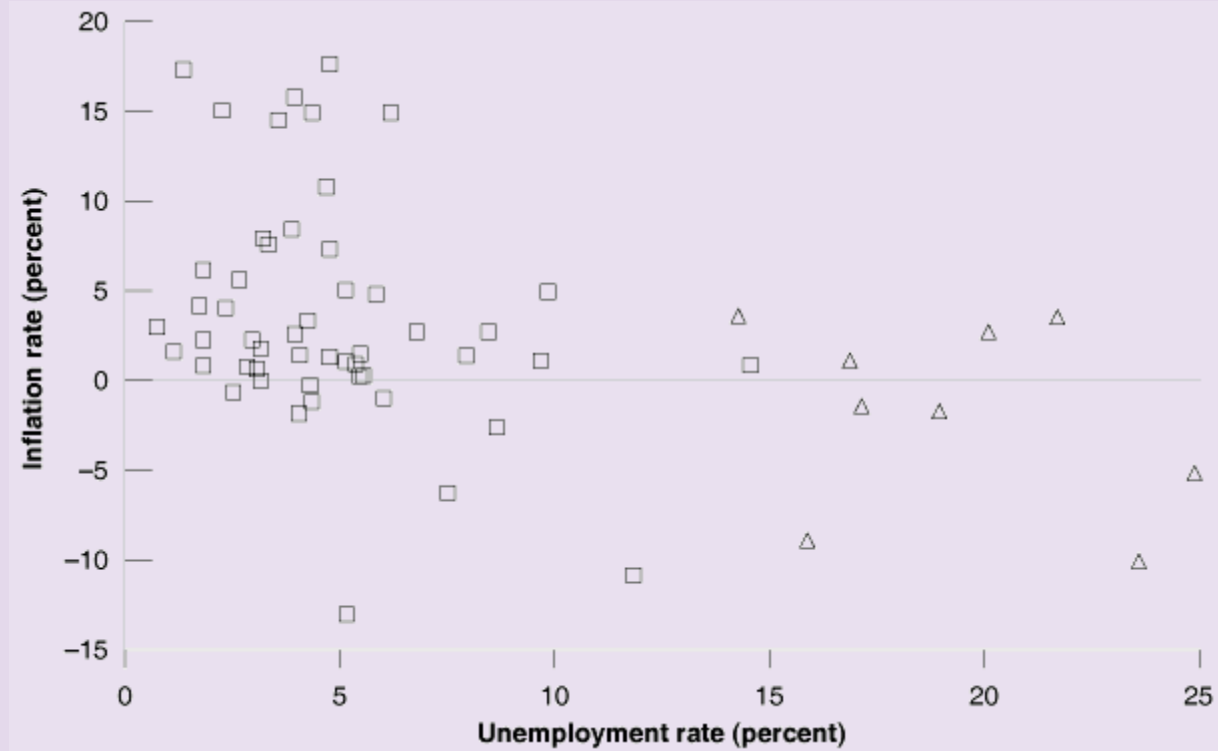# The Natural Rate of Unemployment and the Phillips Curve

◼ Figure 8 - 1

Inflation versus Unemployment in the United States, 1900 to 1960

During the period 1900 to 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.

The Phillips curve, based on the data above, shows a negative relation between inflation and unemployment.

8-1 Inflation, Expected Inflation, and Unemployment

$$P = P^e(1+\mu)F(u,z)$$

The above equation is the aggregate supply relation derived in Chapter 7. This relation can be rewritten to establish a relation between inflation, expected inflation, and the unemployment rate.

First, the function *F*, assumes the form:

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

Then, replace this function in the one above:

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

$$P = P^e(1+\mu)F(u,z)$$

The appendix to this chapter shows how to go from the equation above to the relation between inflation, expected inflation, and the unemployment rate below:

$$\pi = \pi^e + (\mu + z) - \alpha u$$

8-1 Inflation, Expected Inflation, and Unemployment

According to this equation: $\pi = \pi^e + (\mu + z) - \alpha u$

- *An increase in the expected inflation, π^e, leads to an increase in inflation, π.*

- *Given expected inflation π^e, an increase in the markup, μ, or an increase in the factors that affect wage determination, z, lead to an increase in inflation π.*

- *Given expected inflation, π^e, an increase in the unemployment rate, u, leads to a decrease in inflation, π.*

8-1 Inflation, Expected Inflation, and Unemployment

$$\pi = \pi^e + (\mu + z) - \alpha u$$

When referring to inflation, expected inflation, or unemployment in a specific year, the equation above needs to include time indexes, as follows:

$$\pi_t = \pi_t^e + (\mu + z) - \alpha u_t$$

The variables π, $\pi^e{}_t$, and u_t refer to inflation, expected inflation and unemployment in year t. μ and z are assumed constant and don't have time indexes.

8-2 The Phillips Curve

The Early Incarnation

If we set $\pi^e_t = 0$, then:

$$\pi_t = (\mu + z) - \alpha\, u_t$$

This is the negative relation between unemployment and inflation that Phillips found for the United Kingdom, and Solow and Samuelson found for the United States (or the original **Phillips curve**).

8-2 The Phillips Curve

The Early Incarnation

The **wage-price spiral**:

Given *Pet =Pt-1*: $\downarrow u_t \Rightarrow \uparrow W_t \Rightarrow P_t \uparrow \Rightarrow \dfrac{P_t - P_{t-1}}{P_{t-1}} \uparrow \Rightarrow \pi_t \uparrow$

- Low unemployment leads to a higher nominal wage.
- In response to the higher nominal wage, firms increase their prices and the price level increases.
- In response, workers ask for a higher wage.
- Higher nominal wage leads firms to further increase prices. As a result, the price level increases further.
- This further increases wages asked for by workers.

And so the race between prices and wages results in steady wage and price inflation.