

CHAPTER 8

The Natural Rate of Unemployment and the Philips Curve



INFLATION, EXPECTED INFLATION, AND UNEMPLOYMENT

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

The above equation is the aggregate supply. 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:

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

INFLATION, EXPECTED INFLATION, AND UNEMPLOYMENT

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

The appendix of the book shows how to go from the equation above to the relation between inflation, expected inflation, and the unemployment rate below. You do not need to know the derivation.

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

INFLATION, EXPECTED INFLATION, AND UNEMPLOYMENT

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

According to this equation:

- *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 .*

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 , π_t^e , 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.

THE PHILLIPS CURVE

If we set $\pi_t^e = 0$, 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**).

THE EARLY INCARNATION

The **wage-price spiral**:

Given : $P_t^e = P_{t-1}$ $\downarrow u_t \Rightarrow \uparrow W_t \Rightarrow P_t \uparrow \Rightarrow \frac{P_t - P_{t-1}}{P_{t-1}} \uparrow \Rightarrow \pi_t \uparrow$

- Low unemployment leads to a higher wage.
- In response to the higher wage, firms increase their prices.
- In response, workers ask for a higher wage.
- Higher wage leads firms to further increase prices.
- This further increases wages asked for by workers.
- The race continues over wages and price inflation.

MUTATIONS

The negative relation between unemployment and inflation held throughout the 1960s, but it vanished after that, for two reasons:

- An increase in the price of oil, but more importantly,
- Change in the way wage setters formed expectations due to a change in the behavior of the rate of inflation.
 - The inflation rate became consistently positive, and
 - Inflation became more persistent.

MUTATIONS

Suppose expectations of inflation are formed according to

$$\pi^e_t = \theta \pi_{t-1}$$

The parameter θ captures the effect of last year's inflation rate, π_{t-1} , on this year's expected inflation rate, π^e_t .

The value of θ steadily increased in the 1970s, from zero to one.

MUTATIONS

We can think of what happened in the 1970's as an increase in the value of θ over time:

- As long as inflation was low and not very persistent, it was reasonable for workers and firms to ignore past inflation and to assume that the price level this year would be roughly the same as the price level last year.
- But, as inflation became more persistent, workers and firms started changing the ways they formed expectations.

MUTATIONS

$$\pi_t = \theta\pi_{t-1} + (\mu + z) - \alpha u_t$$

- In the equation above, when θ equals zero, the relation between the inflation rate and the unemployment rate is:

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

- When θ is positive, the inflation rate depends on both the unemployment rate and last year's inflation rate:

$$\pi_t = \theta\pi_{t-1} + (\mu + z) - \alpha u_t$$

- When θ is positive, the inflation rate depends on both the unemployment rate and last year's inflation rate:

$$\pi_t - \pi_{t-1} = (\mu + z) - \alpha u_t$$

MUTATIONS

$$\pi_t - \pi_{t-1} = (\mu + z) - \alpha u_t$$

When $\theta=1$, the unemployment rate affects not the *inflation rate*, but the *change in the inflation rate*.

Since 1970, a clear negative relation emerged between the unemployment rate and the change in the inflation rate.

MUTATIONS

The original Phillips curve is:

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

The **modified Phillips curve**, also called the **expectations-augmented Phillips curve**, or the **accelerationist Phillips curve**, is:

$$\pi_t - \pi_{t-1} = (\mu + z) - \alpha u_t$$

BACK TO THE NATURAL RATE OF UNEMPLOYMENT

The natural rate of unemployment is the unemployment rate such that the actual inflation rate is equal to the expected inflation rate.

$$0 = (\mu + z) - \alpha u_n \quad \text{then,} \quad u_n = \frac{\mu + z}{\alpha}$$

BACK TO THE NATURAL RATE OF UNEMPLOYMENT

$$u_n = \frac{\mu + z}{\alpha} \text{ then, } \alpha u_n = \mu + z$$

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

$$\pi_t - \pi_t^e = \alpha u_n - \alpha u_t$$

Finally, assuming that π_t^e is well approximated by π_{t-1} , then:

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

This is an important relation because it gives another way of thinking about the Phillips curve in terms of the actual and the natural unemployment rates, and the change in the inflation rate.

BACK TO THE NATURAL RATE OF UNEMPLOYMENT

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

The equation above is an important relation for two reasons:

- It gives us another way of thinking about the Phillips curve: as a relation between the actual unemployment rate u_t , the natural unemployment rate u_n , and the change in the inflation rate $\pi_t - \pi_{t-1}$
- It also gives us another way of thinking about the *natural rate of unemployment*. The non-accelerating-inflation rate of unemployment, (or NAIRU), is the rate of unemployment required to keep the inflation rate constant.

A SUMMARY AND MANY WARNINGS

Let's summarize what we have learned so far:

- The aggregate supply relation is well captured by a relation between the change in the inflation rate and the deviation of the unemployment rate from the natural rate of unemployment.
- When the unemployment rate exceeds the natural rate of unemployment, the inflation rate decreases. When the unemployment rate is below the natural rate of unemployment, the inflation rate increases.

VARIATIONS IN THE NATURAL RATE ACROSS COUNTRIES

Variations in the Natural Rate of Unemployment
Across Countries

$$u_n = \frac{\mu + z}{\alpha}$$

The factors that affect the natural rate of unemployment above differ across countries. Therefore, there is no reason to expect all countries to have the same natural rate of unemployment.

VARIATIONS IN THE NATURAL RATE OVER TIME

$$\pi_t - \pi_{t-1} = (\mu + z) - \alpha u_t$$

In the equation above, the terms μ and z may not be constant but, in fact, vary over time, leading to changes in the natural rate of unemployment.

The U.S. natural rate of unemployment has decreased to a level between 4% and 5% today.

VARIATIONS IN THE NATURAL RATE OVER TIME

Figure 8 - 6

Change in Inflation versus Unemployment: Euro Area since 1961 (Squares denote the 1960's, diamonds the 1970's, triangles the dates since 1980)

The Phillips curve relation between the change in the inflation rate and the unemployment rate has shifted to the right over time, suggesting a steady increase in the natural unemployment rate in Europe since 1960.

