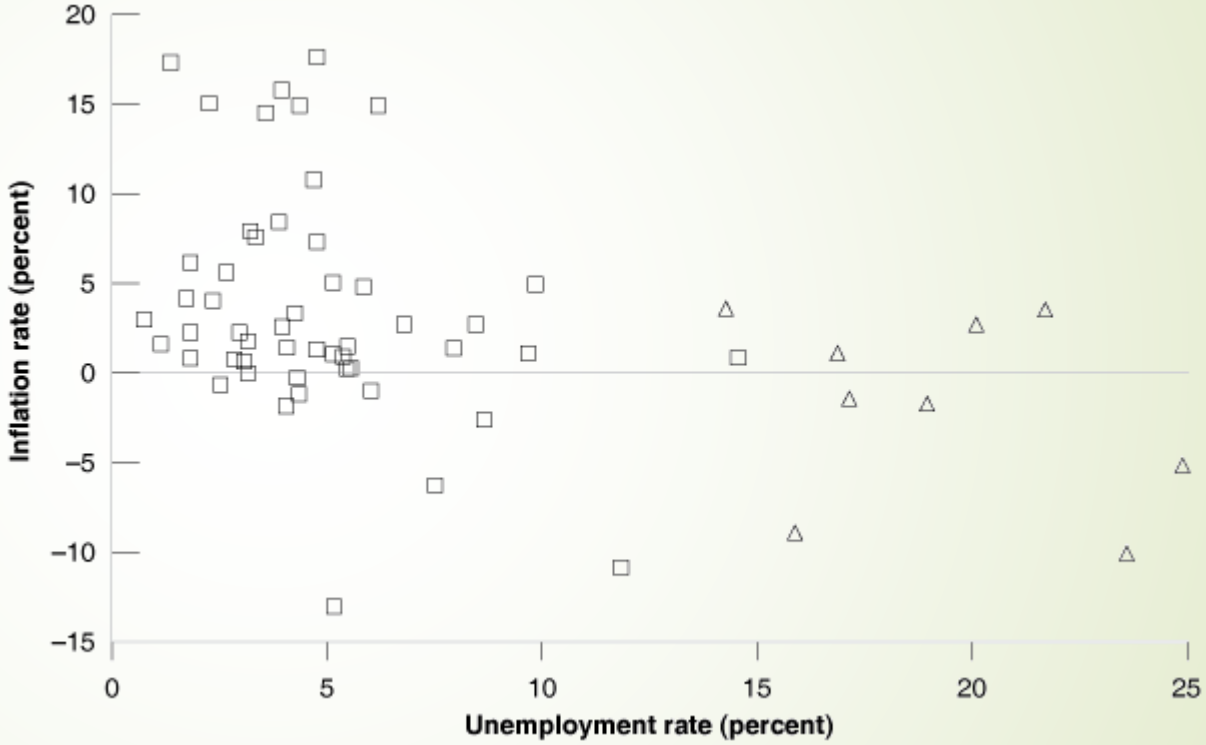
Unemployment and Phillips curve

The Natural Rate of Unemployment and the Phillips Curve

Figure 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.

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:

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

Inflation, Expected Inflation and Unemployment

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

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:

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

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.*

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^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.

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**).

The Phillips Curve

The Early Incarnation

The **wage-price spiral**:

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

- 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.

The Phillips Curve

Mutations

Figure 2

Inflation versus Unemployment in the United States, 1948 to 1969

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

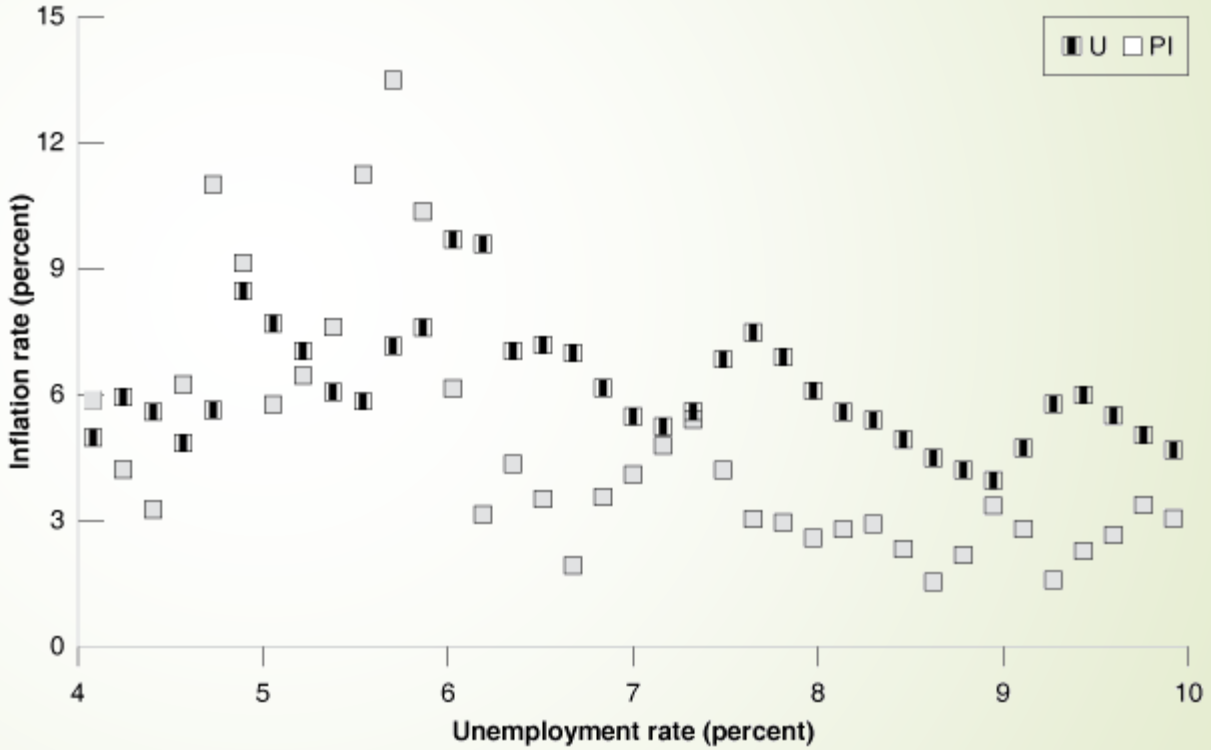
The Phillips Curve

Mutations

Figure 3

Inflation versus Unemployment in the United States Since 1970

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



The Phillips Curve

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.

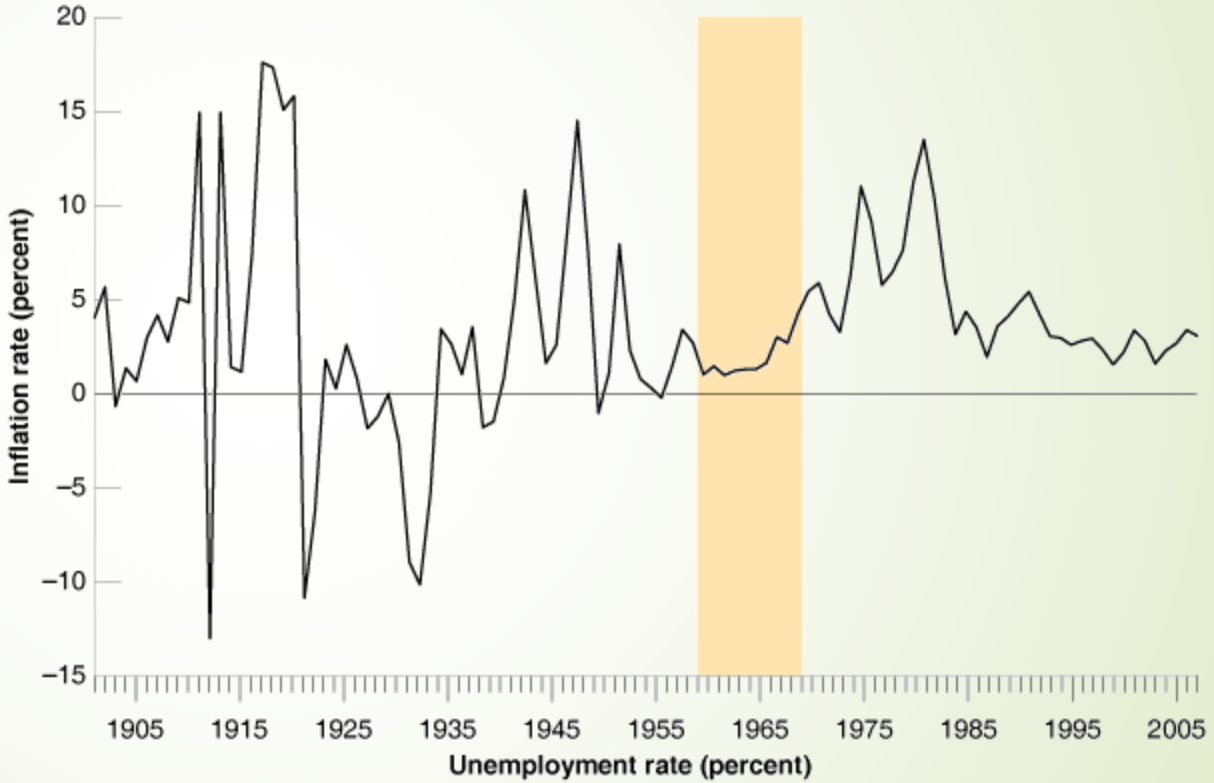
The Phillips Curve

Mutations

Figure 4

U.S. Inflation since 1900

Since the 1960s, the U.S. inflation rate has been consistently positive. Inflation has also become more persistent: A high inflation rate this year is more likely to be followed by a high inflation rate next year.



The Phillips Curve

Mutations

Suppose expectations of inflation are formed according to

$$\pi_t^e = \theta \pi_{t-1}$$

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.

The Phillips Curve

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.

The Phillips Curve

Mutations

$$\pi_t = \overbrace{\theta\pi_{t-1}}^{\pi_t^e} + (\mu + z) - au_t$$

- When θ equals zero, we get the original Phillips curve, a relation between the inflation rate and the unemployment rate:

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

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

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

The Phillips Curve

Mutations

- When θ equals 1, the relation becomes (moving last year's inflation rate to the left side of the equation)

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

When θ=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.

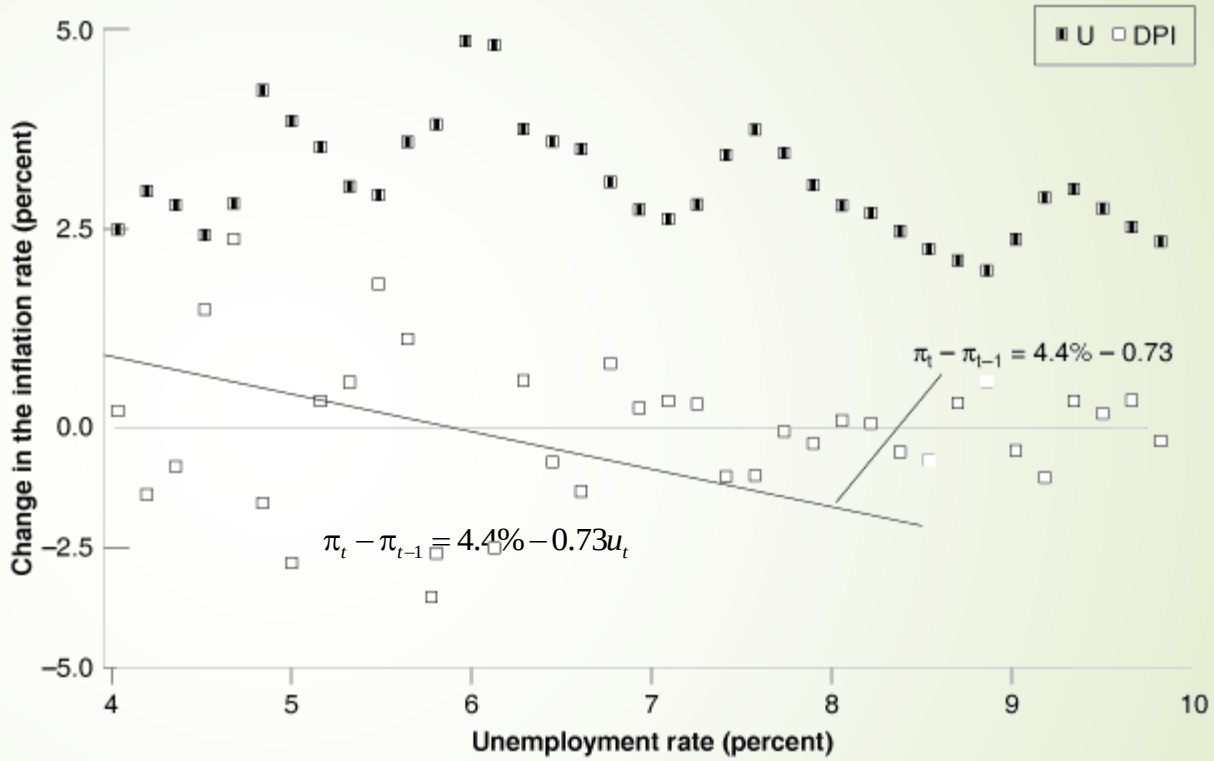
The Phillips Curve

Mutations

Figure 5

Change in Inflation Versus Unemployment in the United States Since 1970

Since 1970, there has been a negative relation between the unemployment rate and the change in the inflation rate in the United States.



The line that best fits the scatter of points for the period 1970-2006 is:

The Phillips Curve

Mutations

The original Phillips curve is:

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

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

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

The Phillips Curve

Back to the Natural Rate of Unemployment

Friedman and Phelps questioned the trade-off between unemployment and inflation. They argued that the unemployment rate could not be sustained below a certain level, a level they called 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.

$$0 = (\mu + z) - \alpha u_n$$

then,

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

The Phillips Curve

Back to the Natural Rate of Unemployment

$$\pi_t - \pi_t^e = -a\left(u_t - \frac{\mu + z}{a}\right)$$

Then,

$$\pi_t - \pi_t^e = -a(u_t - u_n)$$

Finally, assuming that π^e_t 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.

The Phillips Curve

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 in the United States today 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.

Theory ahead of Facts: Milton Friedman and Edmund Phelps

Economists are usually not very good at predicting major changes before they happen. Here is an exception.

In the late 1960s—precisely as the original Phillips curve relation was working like a charm—two economists, Milton Friedman and Edmund Phelps, argued that the appearance of a trade-off between inflation and unemployment was an illusion.

Friedman could not have been more right. A few years later, the original Phillips curve started to disappear, in exactly the way Friedman had predicted.

A Summary and Many Warnings

Variations in the Natural Rate 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.

A Summary and Many Warnings

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.

What Explains European Unemployment?

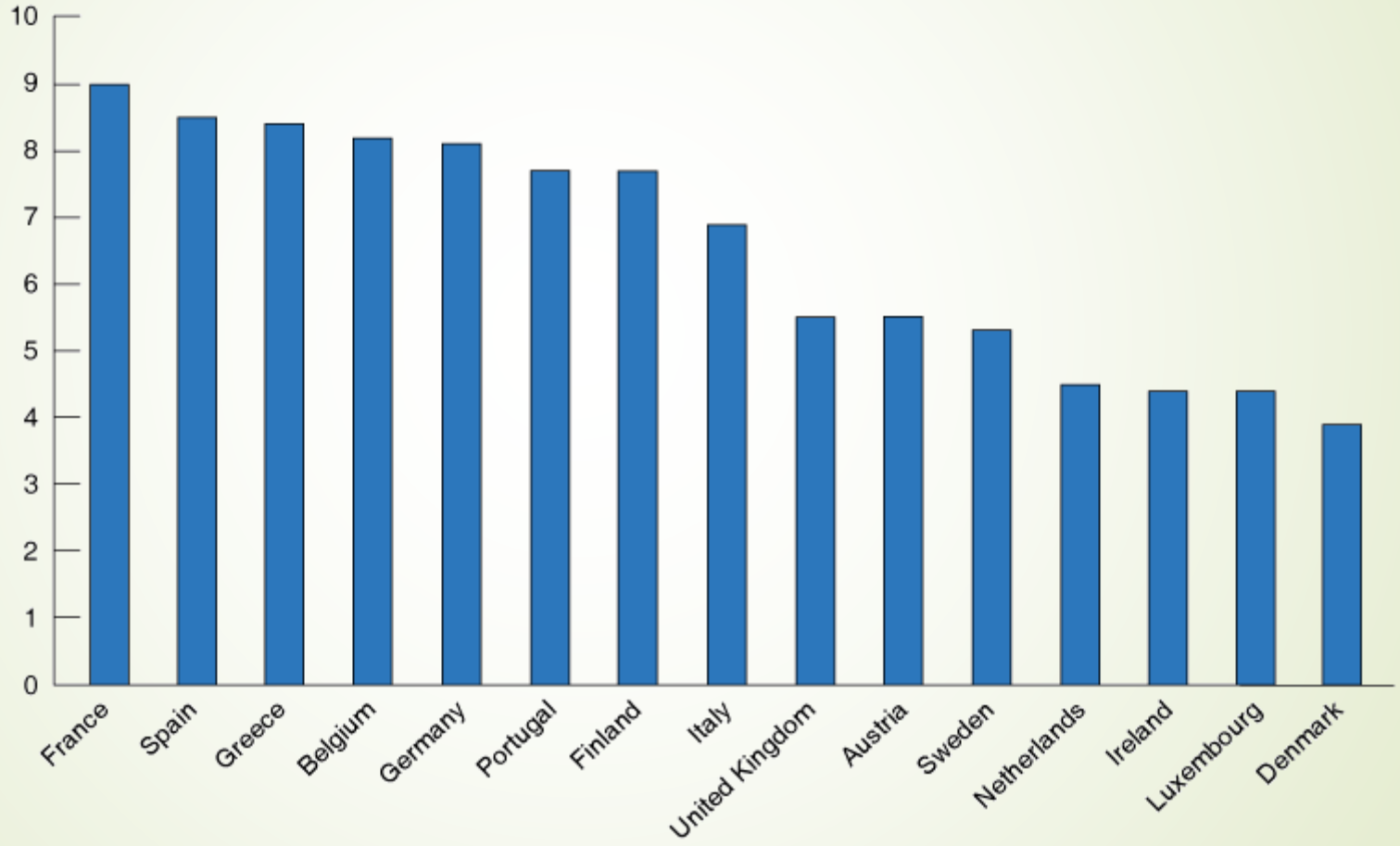


Figure 1 *Unemployment Rates in 15 European Countries, 2006*

Has the U.S. Natural Rate of Unemployment Fallen since the Early 1990s and, If So, Why?

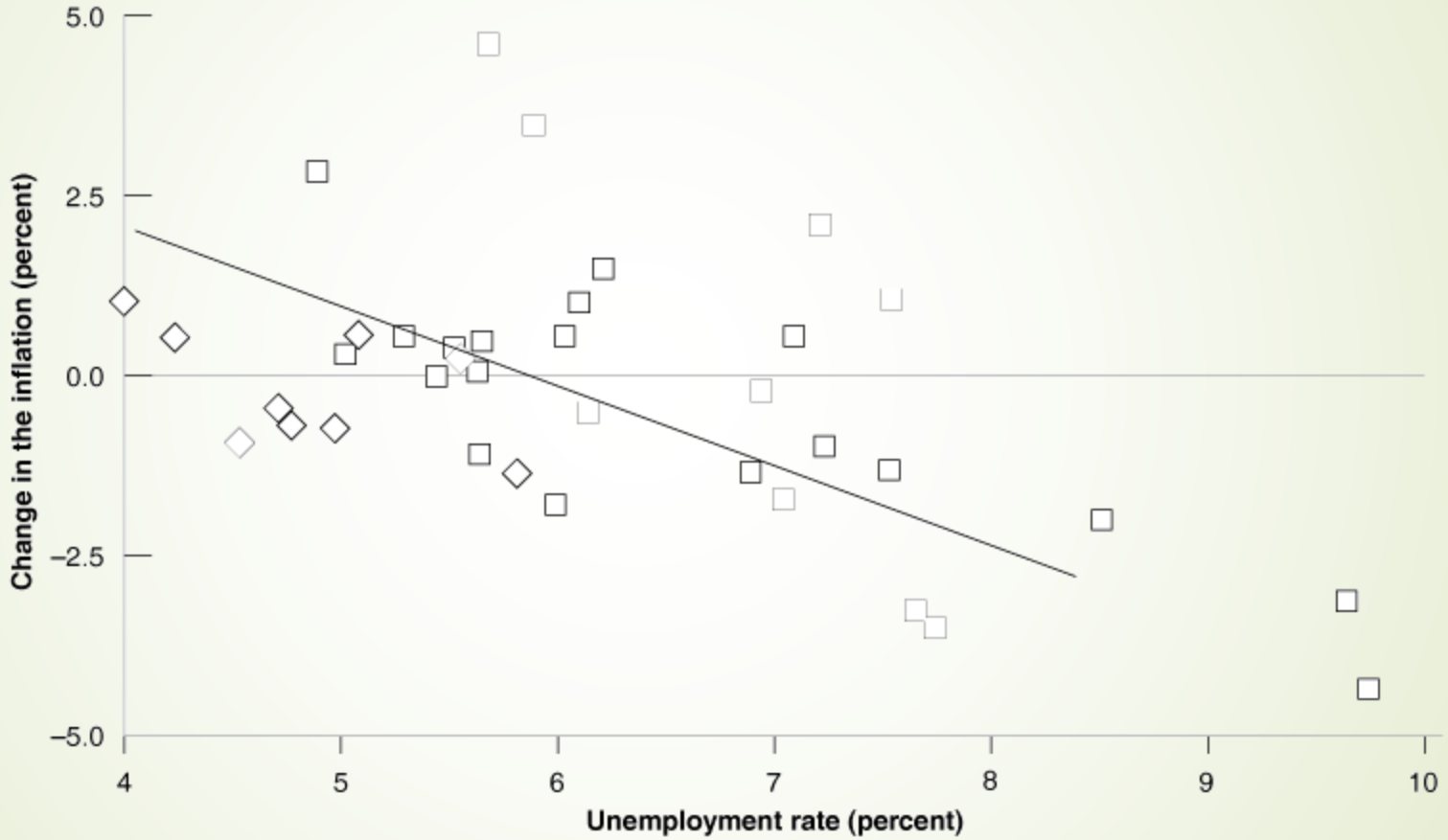


Figure 1 *Change in Inflation versus Unemployment in the United States since 1997*

Has the U.S. Natural Rate of Unemployment Fallen since the Early 1990s and, If So, Why?

Part of the decrease, however, seems attributable to other factors. Among them:

- The aging of the U.S. population.
- The increase in the prison population.
- The increase in the number of workers on disability.
- The increase in temporary help employment.
- The unexpectedly high rate of productivity growth since the end of the 1990s.

A Summary and Many Warnings

High Inflation and the Phillips Curve Relation

The relation between unemployment and inflation is likely to change with the level and the persistence of inflation.

When inflation is high, it is also more variable.

The form of wage agreements also changes with the level of inflation. Wage indexation, a rule that automatically increases wages in line with inflation, becomes more prevalent when inflation is high.

A Summary and Many Warnings

High Inflation and the Phillips Curve Relation

Let λ denote the proportion of labor contracts that is indexed, and (1– λ) the proportion that is not indexed.

Then:

$$\pi_t - \pi^e{}_t = -\alpha(u_t - u_n)$$

$$\pi_t = [\lambda\pi_t + (1-\lambda)\pi^e{}_t] - \alpha(u_t - u_n)$$

The proportion of contracts that is indexed responds to π_t, while the proportion that is not responds to $\pi^e{}_t$.

When λ =0, all wages are set on the basis of expected inflation (equal to last year's inflation), then:

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

A Summary and Many Warnings

High Inflation and the Phillips Curve Relation

When λ is positive,

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

According to this equation, the higher the proportion of wage contracts that is indexed—the higher λ--the larger the effect of the unemployment rate on the change in inflation.

When λ is closer to 1, small changes in unemployment can lead to very large changes in inflation.

A Summary and Many Warnings

Deflation and the Phillips Curve Relation

Given the very high rate of unemployment during the Great Depression, we would have expected a large rate of deflation, but deflation was limited and inflation was actually positive.

The reason for this may be that the Phillips curve relation may disappear or at least become weaker when the economy is close to zero inflation.

Thank YOU for attention

End