The Phillips Curve - Part 2

EC 313, Macroeconomics

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Book Chapter 8

Review

Review

Equation

In the last lecture, we derived **the Phillips Relation** from **the Labor Market Equilibrium**.

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

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In the last lecture, we derived **the Phillips Relation** from **the Labor Market Equilibrium**.

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

This Lecutre, we will use this Phillips Relation to explain the behavior of **inflation rate** and **unemployment rate** in the U.S. data. Specifically, we will discuss

- **the 60s and before**
- **the 70s and after**

Review

Expectation Formation

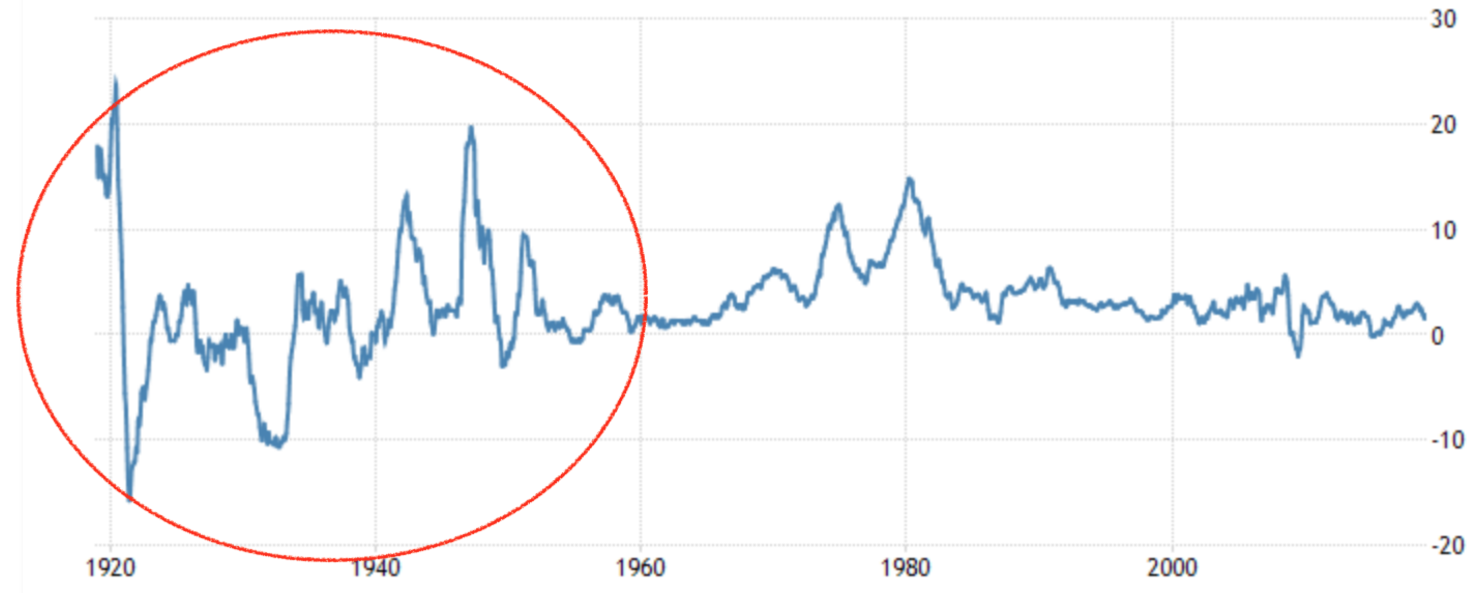
The Phillips Relation contains a term for inflation expectation. It is up to the modelers (us) to figure out how the expectation is formed. We mentioned that there are three types of expectation formations.

- **Static Expectations**
- **Adaptive Expectations**
- Rational Expectations (Not Required)

the 60s and before

the 60s and before

Inflation



- **Before 1960** inflation was positive in some years and negative in others, on average it was around zero.
- It is reasonable for people to **expect the inflation to be at the average level 0 next year**.

Inflation Expectation

Mathematically

$$\pi_t^e = 0$$

Inflation Expectation

Mathematically

$$\pi_t^e = 0$$

This can also be interpreted as:

People simply take **the expected price level** to be **last year's price level** $P_t^e = P_{t-1}$.

$$\pi_t^e = \frac{P_t^e - P_{t-1}}{P_{t-1}} = \frac{0}{P_{t-1}} = 0$$

Early Incarnation

Combining $\pi_t^e = 0$ with the **Phillips Relation**,

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

we get

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

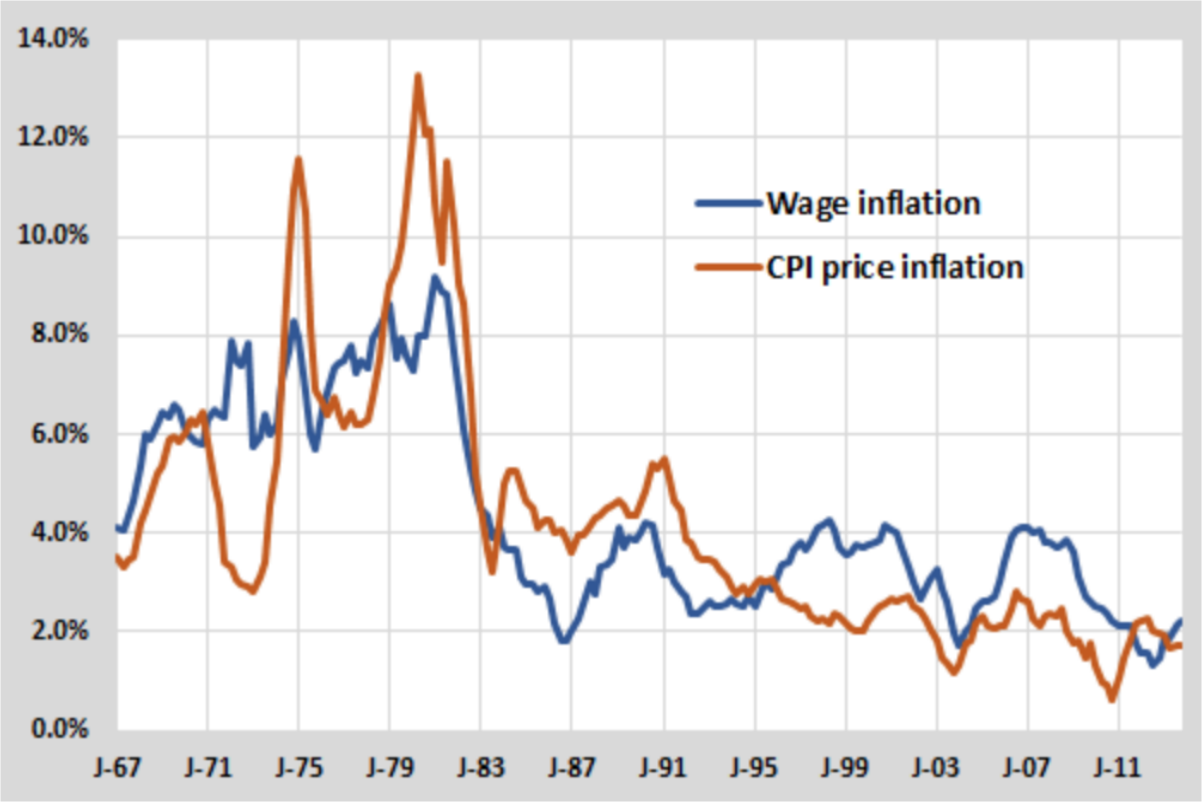
This equation above is called **the Early Incarnation of Phillips Curve**. It is also called **wage-price spiral**.

Wage-price Spiral

1. Low unemployment leads to **a higher nominal wage**.
2. In response to the higher nominal wage, **firms increase their prices**. The price level increases.
3. In response to the higher price level, **workers ask for a higher nominal wage** the next time the wage is set.
4. The higher nominal wage leads **firms to further increase their prices**. **Goes back to 2.**

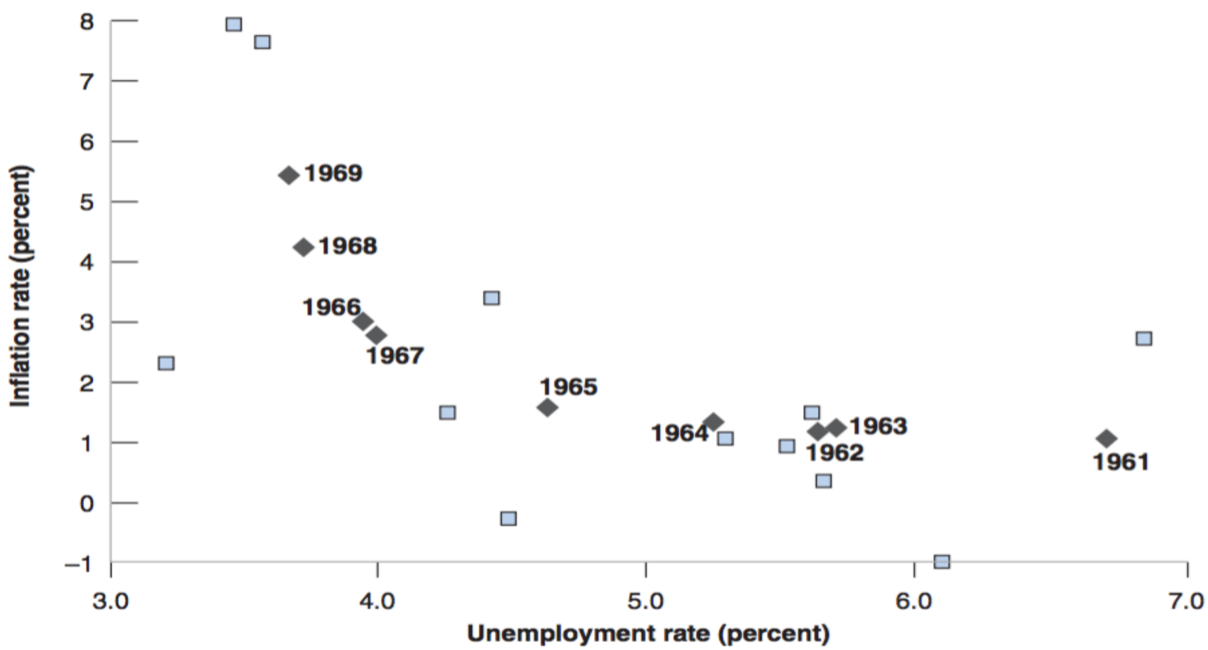
Wage-price Spiral

From the data, **Wage Inflation and CPI Price Inflation** are roughly aligned.



Theory Matches Data

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

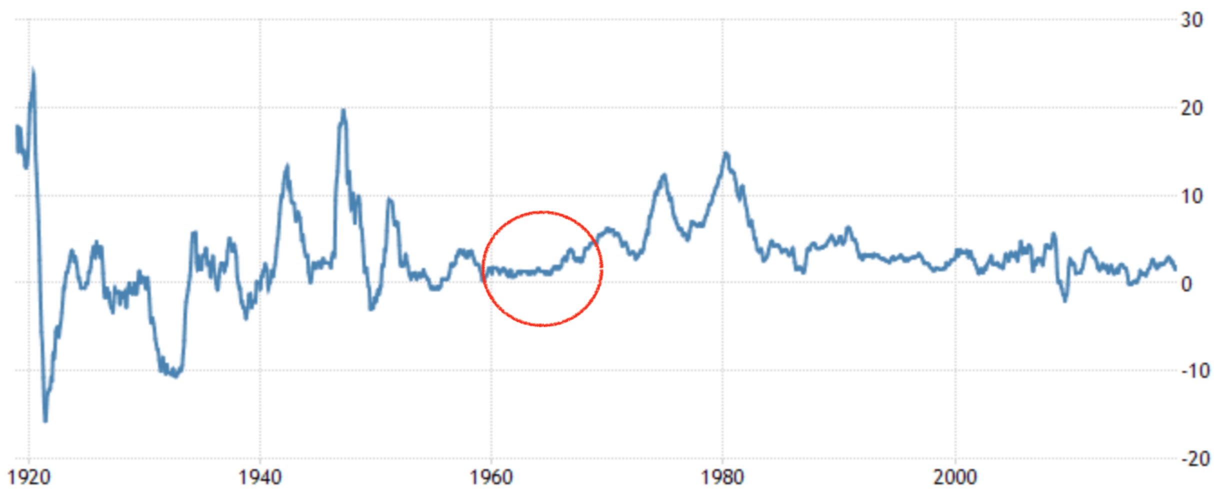


Static Expectation Revisited

Let's revisit our assumption about how expectation is formed:

$$\pi_t^e = 0$$

It says people expect the inflation rate to be zero. However, in the 60s, **the inflation rate was maintained above zero**.



Static Expectation Revisited

Q: **Would the static expectation formation still be a good assumption?**

A: **No!**

What are the alternatives?

1. $\pi_t^e = c$ and $c > 0$
2. $\pi_t^e = \theta\pi_{t-1}$

Alternative I

$$\pi_t^e = c, \text{where } c > 0$$

Combined with the **Phillips Relation**,

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

We would get

$$\pi_t = (c + m + z) - \alpha u_t$$

The **wage-price spiral** would still exist.

the 60s and before

Alternative II

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

Combined with the **Phillips Relation**,

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

We would get

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

We get a new negative relation between **the change in inflation rate** and **unemployment rate**.

Alternative II - Three Cases

We can study the second alternative in three different cases:

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

where

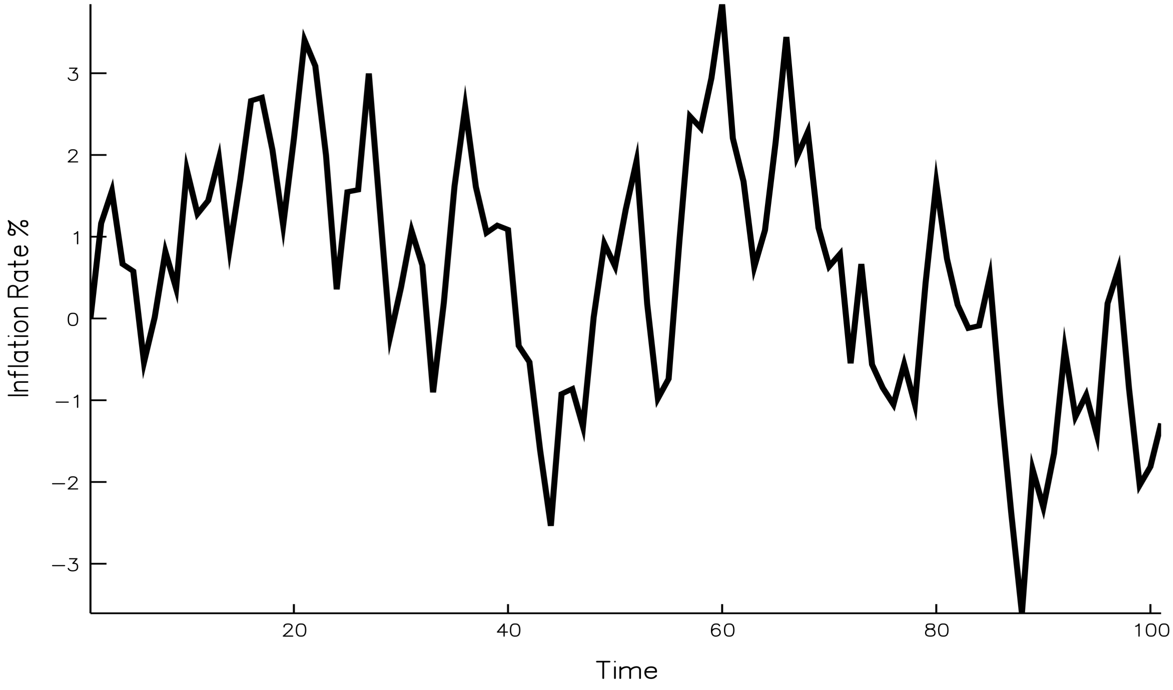
- $0 < \theta < 1$
- $\theta = 1$
- $\theta > 1$

The model-predicted inflation rates are drastically different depending on which case we are looking at.

Alternative II Case 1: $0 < \theta < 1$

Simulation with $0 < \theta < 1$ for

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

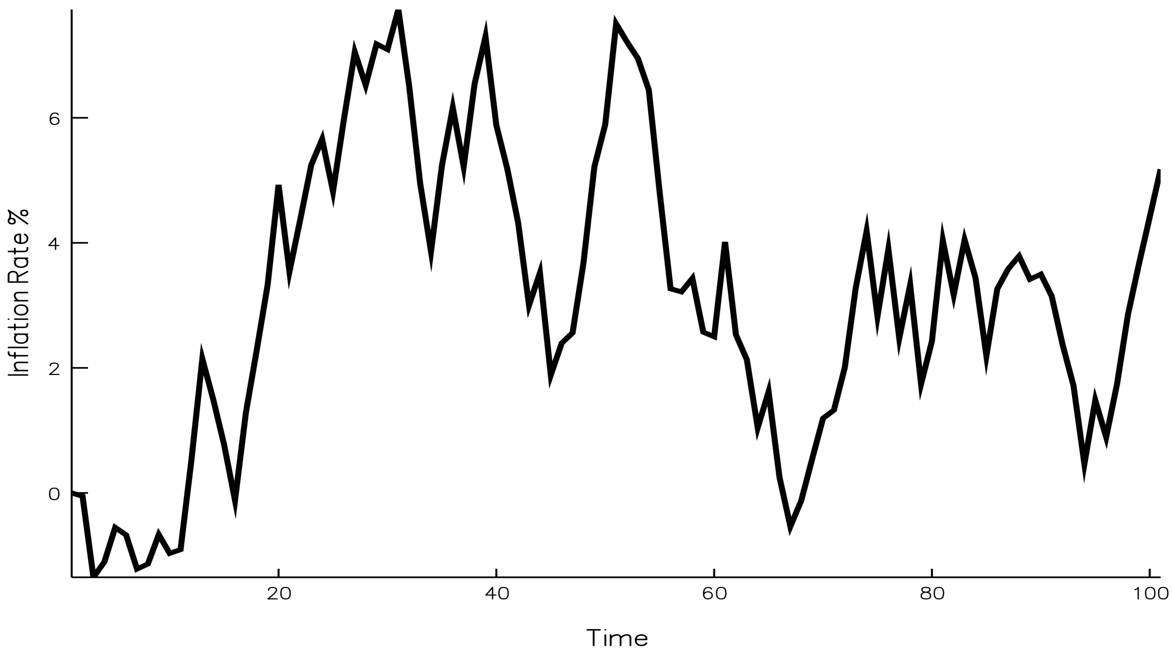


Alternative II Case 2: $\theta = 1$

This seems to be the case for the United States after the 60s!!

Simulation with $\theta = 1$ for

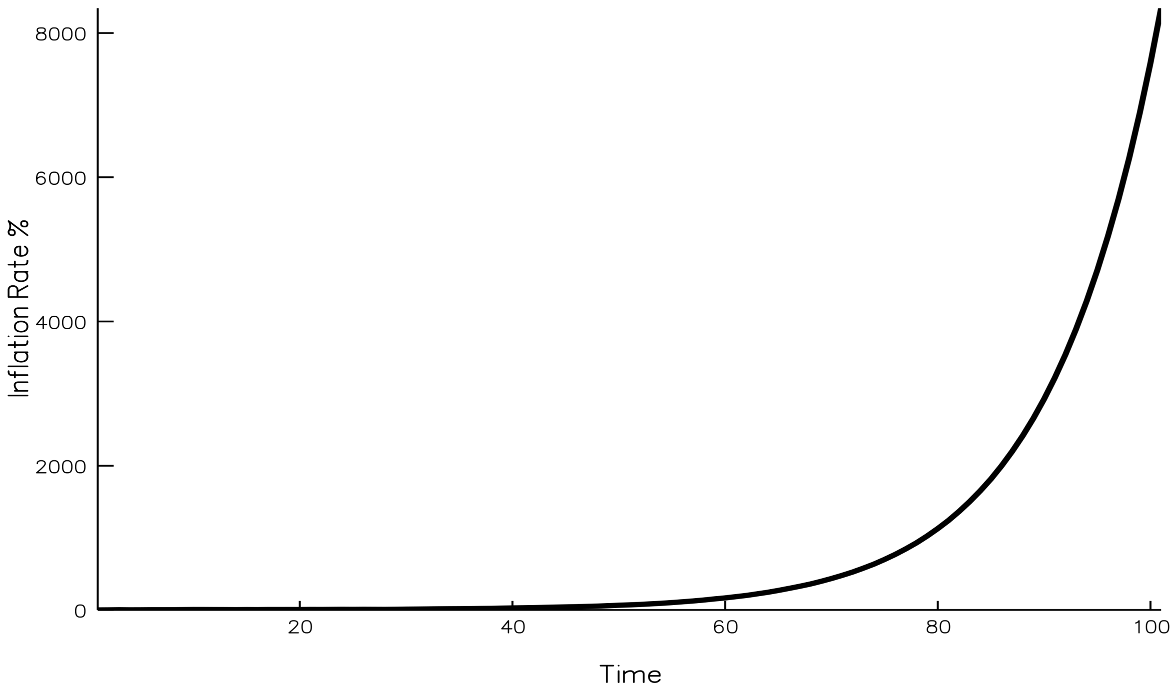
$$\pi_t = \theta\pi_{t-1} + (m + z) - \alpha u_t$$



Alternative II Case 3: $\theta > 1$

Simulation with $\theta > 1$ for

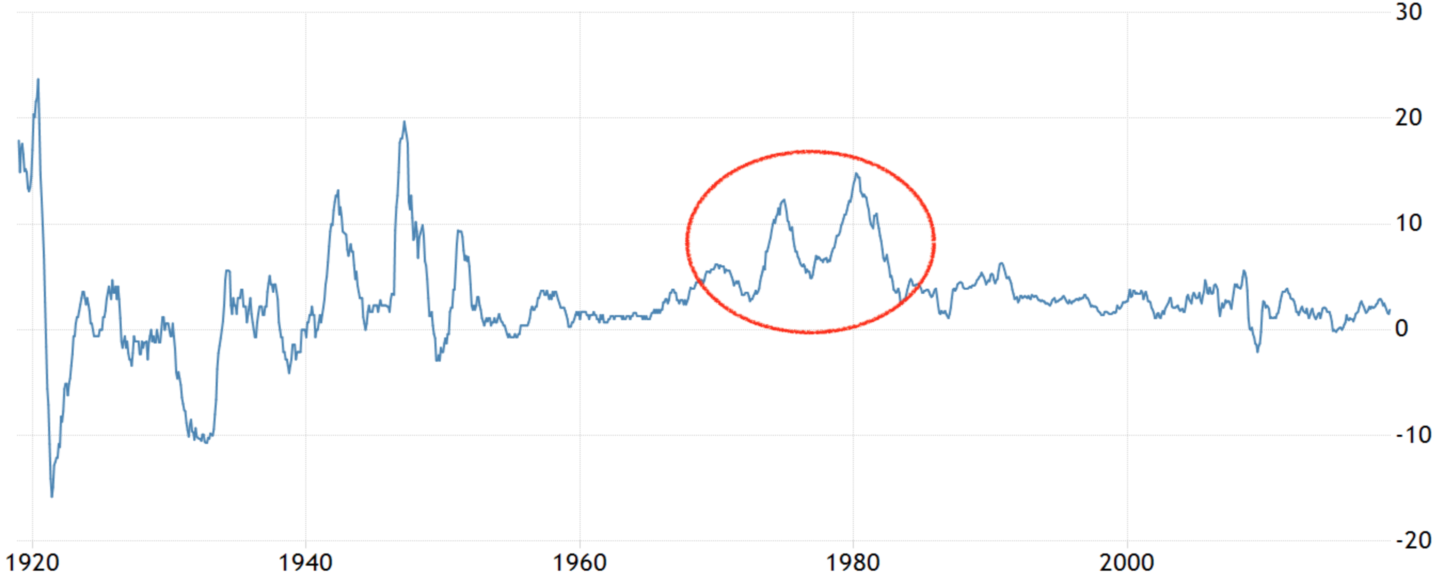
$$\pi_t = \theta\pi_{t-1} + (m + z) - \alpha u_t$$



the 70s and after

the 70s and after

Inflation



- Hit twice in the 1970s by **a large increase in the price of oil**.
- **Higher nonlabor costs** forced firms to increase their prices relative to the wages they were paying. **Or mark-up m increased**.

Inflation Expectation

Note that in the 60s, the inflation rate was maintained above zero. The **static expectation**

$$\pi_t^e = 0$$

can't hold any more. People would be making **persistent mistakes** using this expectation formaiton in the 60s. It is reasonable to think they changed the way they form expectations after the 60s.

Inflation Expectation

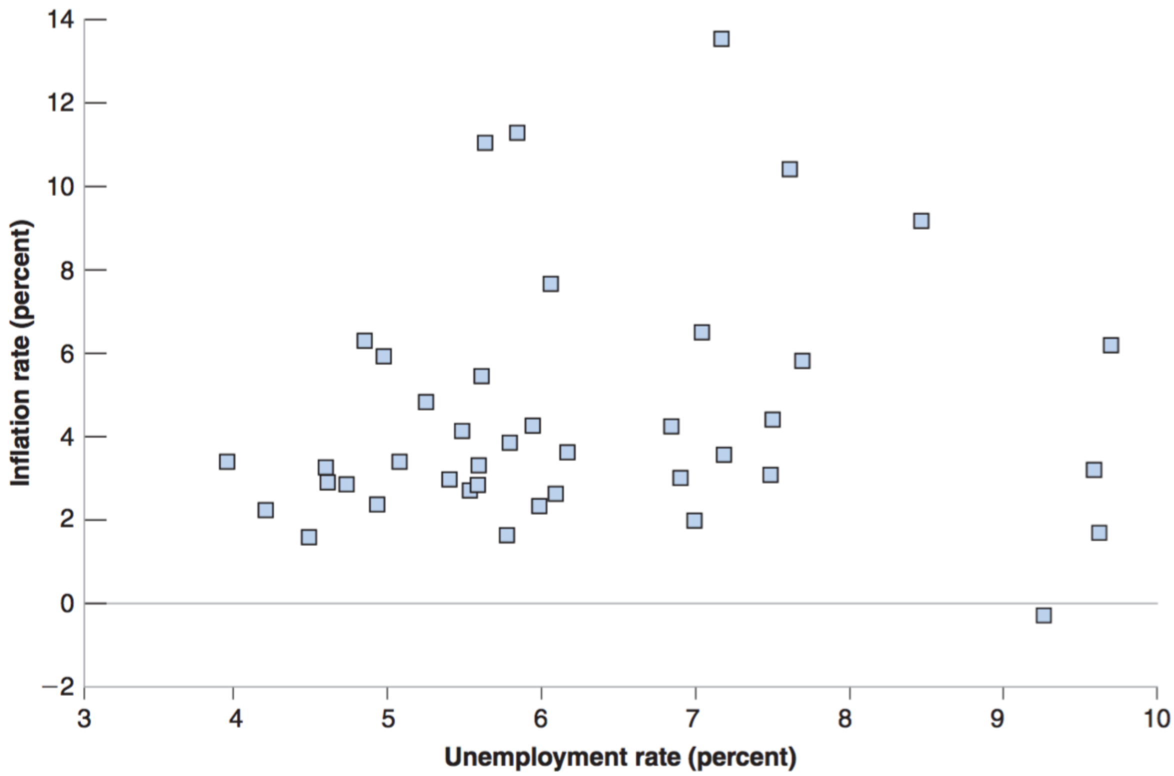
From the previous discussion, there are two possible alternatives:

1. $\pi_t^e = c, \text{where } c > 0$
2. $\pi_t^e = \pi_{t-1}$

Both would work in terms of matching the positive persistent inflation observed in the data. But which one makes more sense?

Inflation - Unemployment

There is **no correlation between the inflation rate and unemployment rate** from 1970 to 2010.



Alternative I

Alternative I $\pi_t^e = c$ would **still predicit that there is correlation between the inflation rate and unemployment rate** from 1970 to 2010:

Combine $\pi_t^e = c$ with the Phillips Relation

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

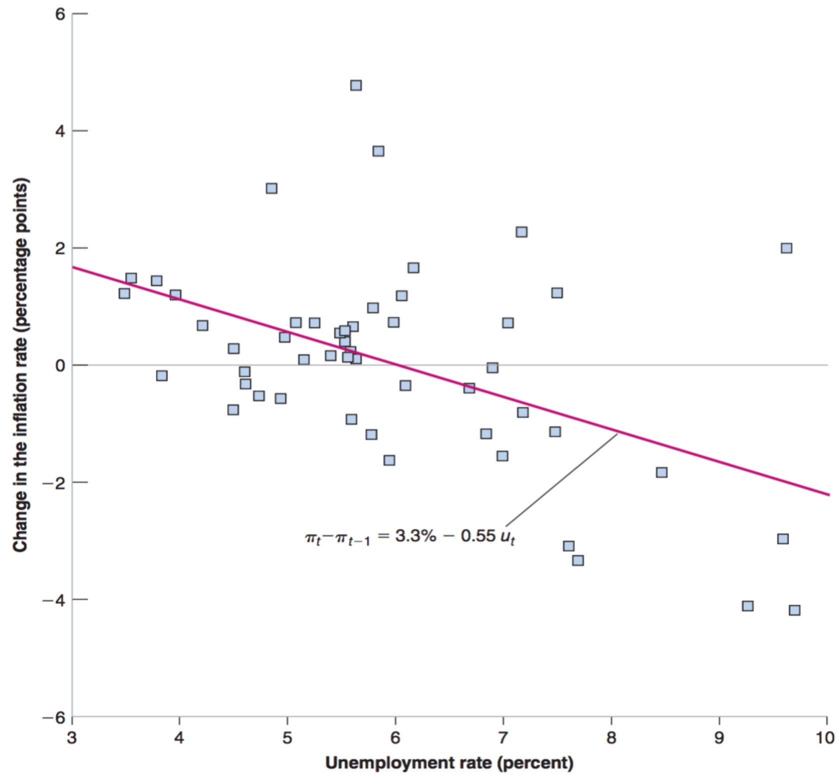
, we would get

$$\pi_t = (c + m + z) - \alpha u_t$$

Note that π_t and u_t would still be negatively correlated. Alternative I $\pi_t^e = c$ doesn't match the data.

Change in Inflation - Unemployment

There is correlation between **the change in inflation rate** and unemployment rate from 1970 to 2010.



Alternative II

Alternative II (case 2) $\pi_t^e = \pi_{t-1}$ would match this correlation between **the change in inflation rate** and unemployment rate from 1970 to 2010.

Combine $\pi_t^e = \pi_{t-1}$ with the Phillips Relation

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

, we would get

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

Note that **change in inflation**, $\pi_t - \pi_{t-1}$ and u_t would be negatively correlated. Alternative II $\pi_t^e = \pi_{t-1}$ matches the data.

Accelerationist Phillips Curve

Using a regression line to estimate the model implied by Alternative II, we get

$$\pi_t - \pi_{t-1} = \mathbf{3.3\% - 0.55}u_t$$

This Relation is also called **Accelerationist Phillips Curve**

Accelerationist Phillips Curve

One of the reasons why we want to figure out the Phillips Curve is because we can use it to predict inflation rate. Suppose the Accelerationist Phillips Curve holds in an economy:

$$\pi_t - \pi_{t-1} = 3.3\% - 0.55u_t$$

Let $\pi_{2017} = 2$, and unemployment rate for 2017 and 2018 are $u_{2018} = 4\%$ and $u_{2019} = 6\%$. What is the inflation rate in 2019 π_{2019}?

the 70s and after

Contractionary Policies

Contractionary policies notably occurred in the early 1980s when the then-Federal Reserve chairman Paul Volcker finally **ended the soaring inflation of the 1970s**.

- Higher Tax and Lower Government Spending
- Less money supply (higher interest rate)

These two policies can be analyzed in the framework of ADAS model. The result is **lower output, higher unemployment rate, negative change in the inflation rate** (cool down the economy).

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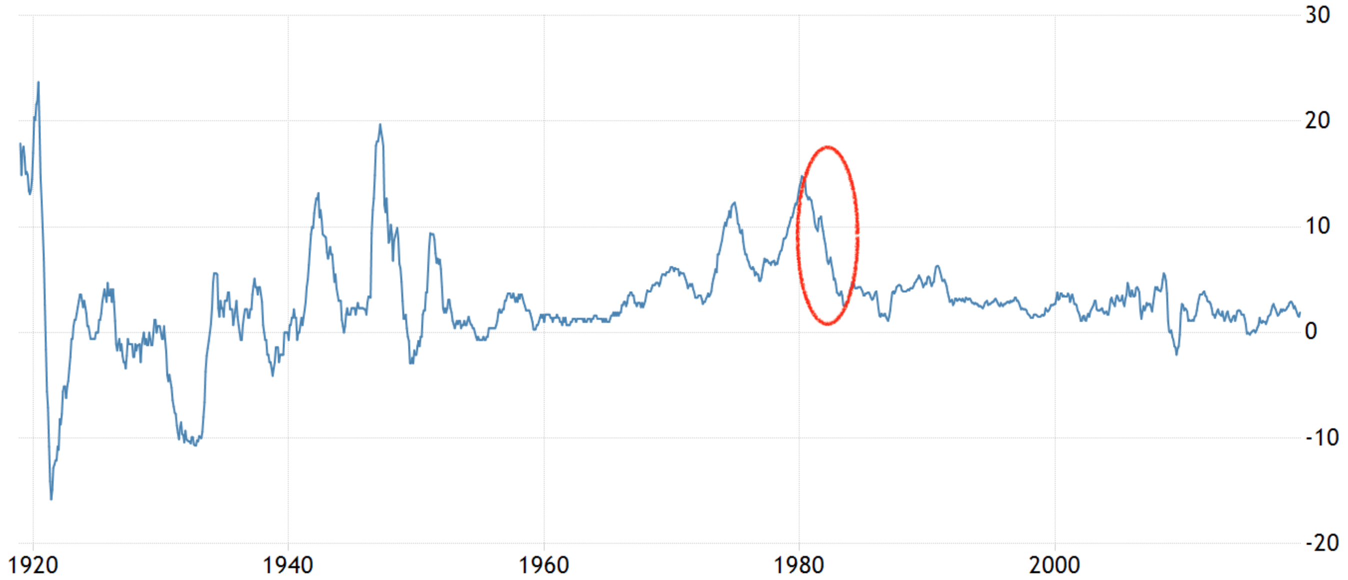

Natural Rate of Unemployment

Derive the Natural Rate of Unemployment

Recall that the natural rate of unemployment is the **Equilibrium Unemployment Rate from the Labor Market Model**.

The Labor Market Equilibrium can be written as

$$\begin{aligned} \mathrm{WS}: W &= P^e F(u, z) \\ \mathrm{PS}: P &= (1+m)W \\ F(u, z) &= 1 - \alpha u + z \end{aligned}$$

Or

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

Derive the Natural Rate of Unemployment

Let $P^e = P$, we have

$$1 = (1+m)(1-\alpha u_n + z) \approx 1 + m - \alpha u_n + z$$

We get

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

Rewrite the Phillips Relation

It is useful to rewrite the Phillips Relation in terms of the natural rate of unemployment.

$$\begin{aligned}
\pi_t &= \pi_t^e + (m+z) - \alpha u_t \\
\pi_t &= \pi_t^e + \alpha \frac{(m+z)}{\alpha} - \alpha u_t \\
\pi_t &= \pi_t^e + \alpha u_n - \alpha u_t \\
\pi_t &= \pi_t^e - \alpha(u_t - u_n) \\
\pi_t - \pi_t^e &= -\alpha(u_t - u_n)
\end{aligned}$$

Natural Rate of Unemployment

Rewrite the Phillips Relation

Static Expectation with $\pi_t^e = 0$:

$$\pi_t = -\alpha(u_t - u_n)$$

Adaptive Expectation with $\pi_t^e = \pi_{t-1}$:

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

Natural Rate of Unemployment

Change Since the 80s

The natural rate of unemployment

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

It appeared that the natural rate was around 5%, so roughly 2% lower than it had been in the 1980s.

Questions

Suppose the natural rate of unemployment is 5%. This year the unemployment rate is 6%. The last year the inflation rate is 2%. $F(u, z) = 1 - \alpha u + z$ where $\alpha = -0.5$.

Q1: If the expectation formation is $\pi_t^e = 0$, what is this year's inflation rate?

Q2: If the expectation formation is $\pi_t^e = \pi_{t-1}$, what is this year's inflation rate?

Natural Rate of Unemployment

Questions

Q1: If the expectation formation is $\pi_t^e = 0$, what is this year's inflation rate?

A1: If the expectation formation is $\pi_t^e = 0$, the Phillips Relation can be written in terms of the natural rate of unemployment.

$$\pi_t = -\alpha(u_t - u_n) = -0.5(6\% - 5\%) = -0.5\%$$

Natural Rate of Unemployment

Questions

Q2: If the expectation formation is $\pi_t^e = \pi_{t-1}$, what is this year's inflation rate?

A1: If the expectation formation is $\pi_t^e = \pi_{t-1}$, the Phillips Relation can be written in terms of the natural rate of unemployment.

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n) = -0.5(6\% - 5\%) = -0.5\%$$

and

$$\pi_{t-1} = 2\%$$

then

$$\pi_t = 2\% - 0.5\% = 1.5\%$$

The Great Depression

Let's use the Static Expectation Formation for Great Depression (1930s), the Phillips Curve can be written as

$$\pi_t = -\alpha(u_t - u_n)$$

Question: During the great depression, we see a very high u_t, but also we see a large deflation $\pi_t < 0$. How do we explain this?