Lecture 7: The Phillips Curve, the Natural Rate of Unemployment, and Inflation

Intermediate Macroeconomics, Econ 102

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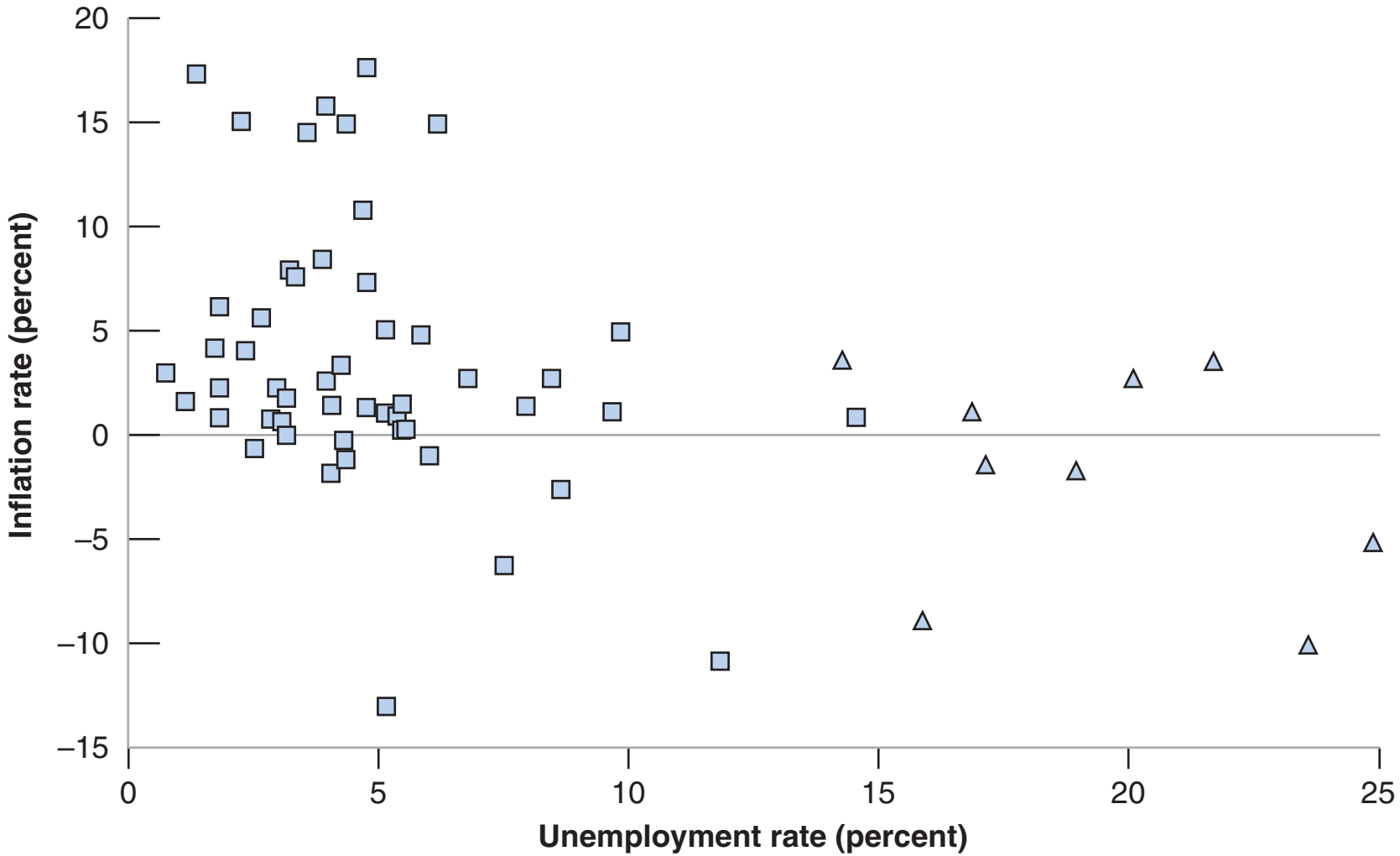
The birth of the Phillips Curve

- In 1958. A.W. Phillips uncovered a negative *association* between the rate of inflation and unemployment, in the **UK**, from 1861 to 1957. (Phillips (1958))
- Two years later, two US economists, Paul Samuelson and Robert Solow replicated the analysis for the US, using data from 1900 to 1960 (Samuelson and Solow 1960). Apart from the period 1931-1939 (triangles), they found a similar association.
- This relation was soon labeled the **Phillips curve**, and became central to macroeconomic thinking and policy (it is a central tenet of the **new-keynesian school**, which came to dominate academia in the US). However, the Phillips Curve was **not part** of Keynesian economics initially. In particular, Keynes (1936) made no mention of a trade-off between inflation and unemployment.
- Full disclosure: I am skeptical of the Phillips Curve (though i believe that output is demand-determined in the short-run). In my opinion, this lecture and the next are on shaky grounds. (see the bibliography)

Inflation versus Unemployment in the United States, 1900–1960



Outline

Inflation, Expected Inflation, and Unemployment

- Recall the wage setting equation (WS):

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

  which came from the fact that higher unemployment worsens one's barganing power, while higher unemployment benefits raises it.

- Remember the price setting equation (PS):

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

- Substituting out the wage W in those two equations, this gives:

$$P = P^e(1 + m)F(u, z).$$

Inflation, Expected Inflation, and Unemployment

- Let us assume a specific linear function form for F:

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

then, replacing out in the previous equation gives the relation between the price level, the expected price level, and the unemployment rate is:

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

- After some algebra, which is shown on the next slide, one can write this expression in terms of inflation rate π and the expected inflation rate π^e:

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

Algebra 1/2

- The previous equation with time subscripts becomes:

$$P_t = P_t^e (1+m)(1-\alpha u_t + z)$$

- Dividing both sides by P_{t-1} yields:

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}} (1+m)(1-\alpha u_t + z)$$

- Rewrite $P_t/P_{t-1} = 1+\pi_t$ and do the same for the expected inflation rate $P_t^e/P_{t-1} = 1+\pi_t^e$, the previous equation becomes:

$$1+\pi_t = (1+\pi_t^e)(1+m)(1-\alpha u_t + z)$$

$$\Rightarrow \quad \frac{1+\pi_t}{(1+\pi_t^e)(1+m)} = 1-\alpha u_t + z.$$

- We need to use proposition 6 two times from Appendix 2 in Blanchard (2017) (page A-8):

$$\frac{1+x}{1+y} \approx 1+x-y$$

Algebra 2/2

- Applying Proposition 6 a first time:

$$\frac{1+\pi_t}{1+\pi_t^e} \approx 1+\pi_t-\pi_t^e$$

- Then:

$$\frac{1+\pi_t}{(1+\pi_t^e)(1+m)} \approx \frac{1+\pi_t-\pi_t^e}{1+m}$$

- Applying Proposition 6 a second time:

$$\frac{1+\pi_t-\pi_t^e}{1+m} \approx 1+\pi_t-\pi_t^e-m$$

$$\Rightarrow \quad \frac{1+\pi_t}{(1+\pi_t^e)(1+m)} \approx 1+\pi_t-\pi_t^e-m.$$

- Therefore, finally:

$$1+\pi_t-\pi_t^e-m \approx 1-\alpha u_t+z$$

$$\Rightarrow \quad \pi_t \approx \pi_t^e+(m+z)-\alpha u_t.$$

Inflation, Expected Inflation, and Unemployment

- The Phillips Curve thus writes as follows (we write it as an equality even though it is an approximation):

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

- Without the time subscript, for lighter notation:

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

- Some useful comparative statics are as follows:
  1. An increase in π^e leads to an increase in π.
  2. Given π^e , an increase in m, or an increase in z, leads to an increase in π.
  3. Given π^e , a decrease in u leads to an increase in π.

Inflation, Expected Inflation, and Unemployment

- Assume that inflation varies from year to year around some value $\pi_t^e = \bar{\pi}$, so that the previous equation becomes:

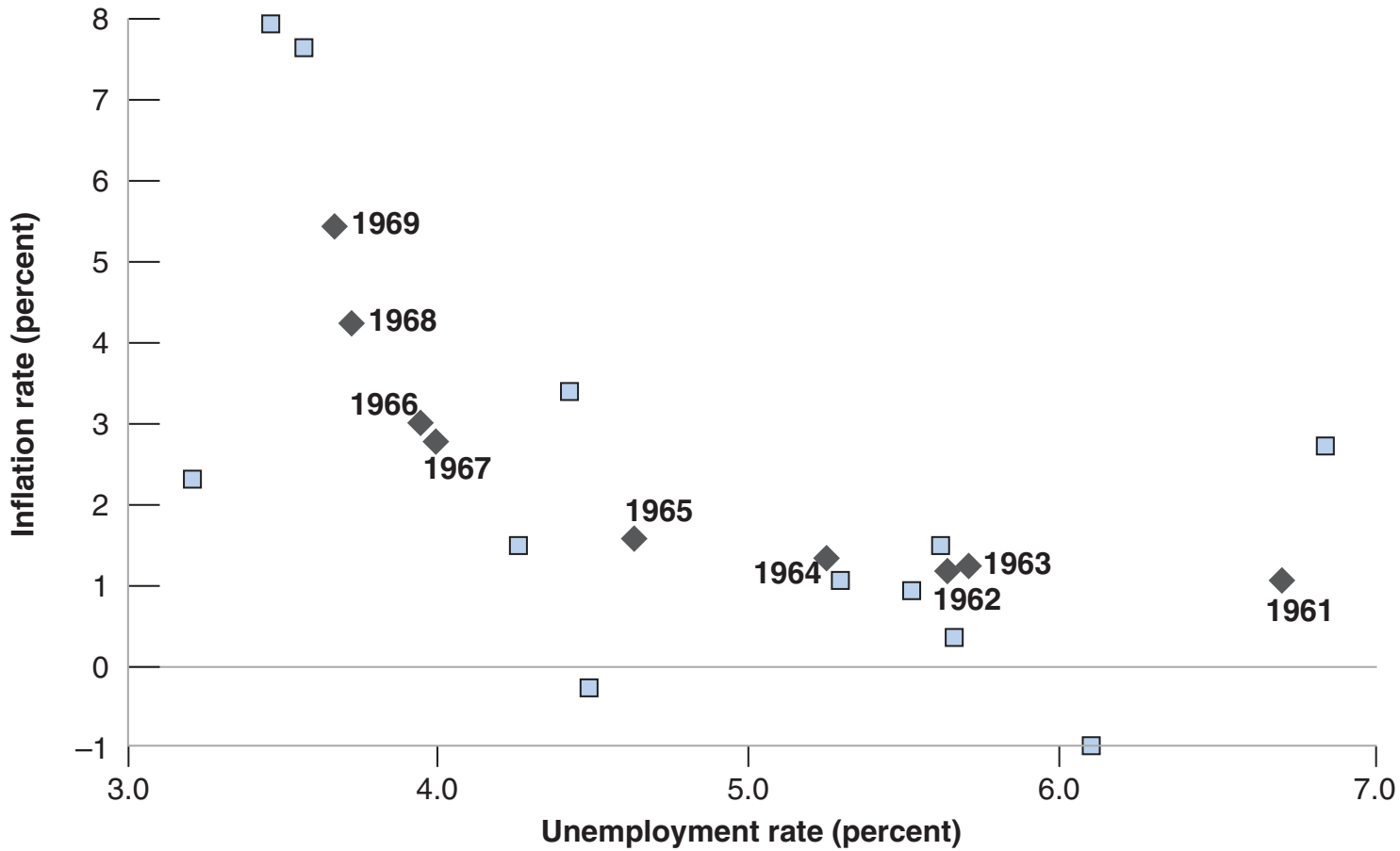
$$\pi_t = \bar{\pi} + (m + z) - \alpha u_t$$

  which is a negative relation between unemployment and inflation.

- In this case, we shall observe a negative relation between unemployment and inflation:
  - This relation was observed in the United States in the 1960s, by Samuelson and Solow (1960).
  - It was also observed in the United Kingdom by Phillips (1958).

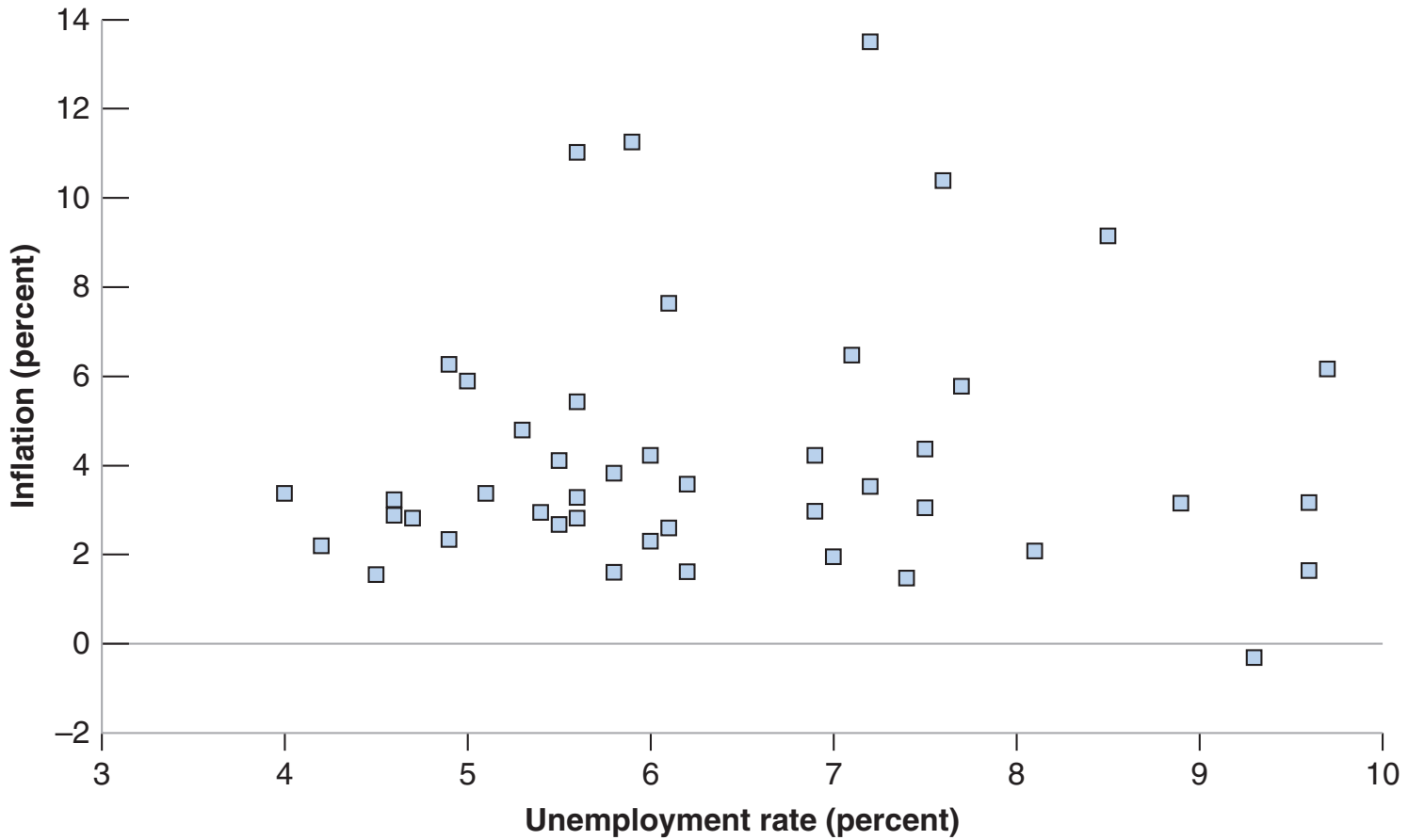
Inflation versus Unemployment in the United States, 1948–1969

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



Inflation versus Unemployment in the United States, 1970–2010

Beginning in 1970 in the United States, the relation between the unemployment rate and the inflation rate broke down. There is no longer any visible relation between the unemployment rate and the inflation rate.



The Phillips Curve and Its Mutations

- What happened? The usual story is that **wage setters changed the way they formed their expectations about inflation**.
- Suppose expected inflation this year depends on a constant value $\bar{\pi}$ with weight $1-\theta$, and partly on inflation last year with weight θ:

$$\pi_t^e = (1-\theta)\bar{\pi} + \theta\pi_{t-1}.$$

- When the weight on last year's inflation is $\theta = 0$, then we observe a stable Phillips curve:

$$\pi_t = \bar{\pi} + (m+z) - \alpha u_t.$$

- When $\theta > 0$:

$$\pi_t = [(1-\theta)\,\bar{\pi} + (m+z)] + \theta\pi_{t-1} - \alpha u_t.$$

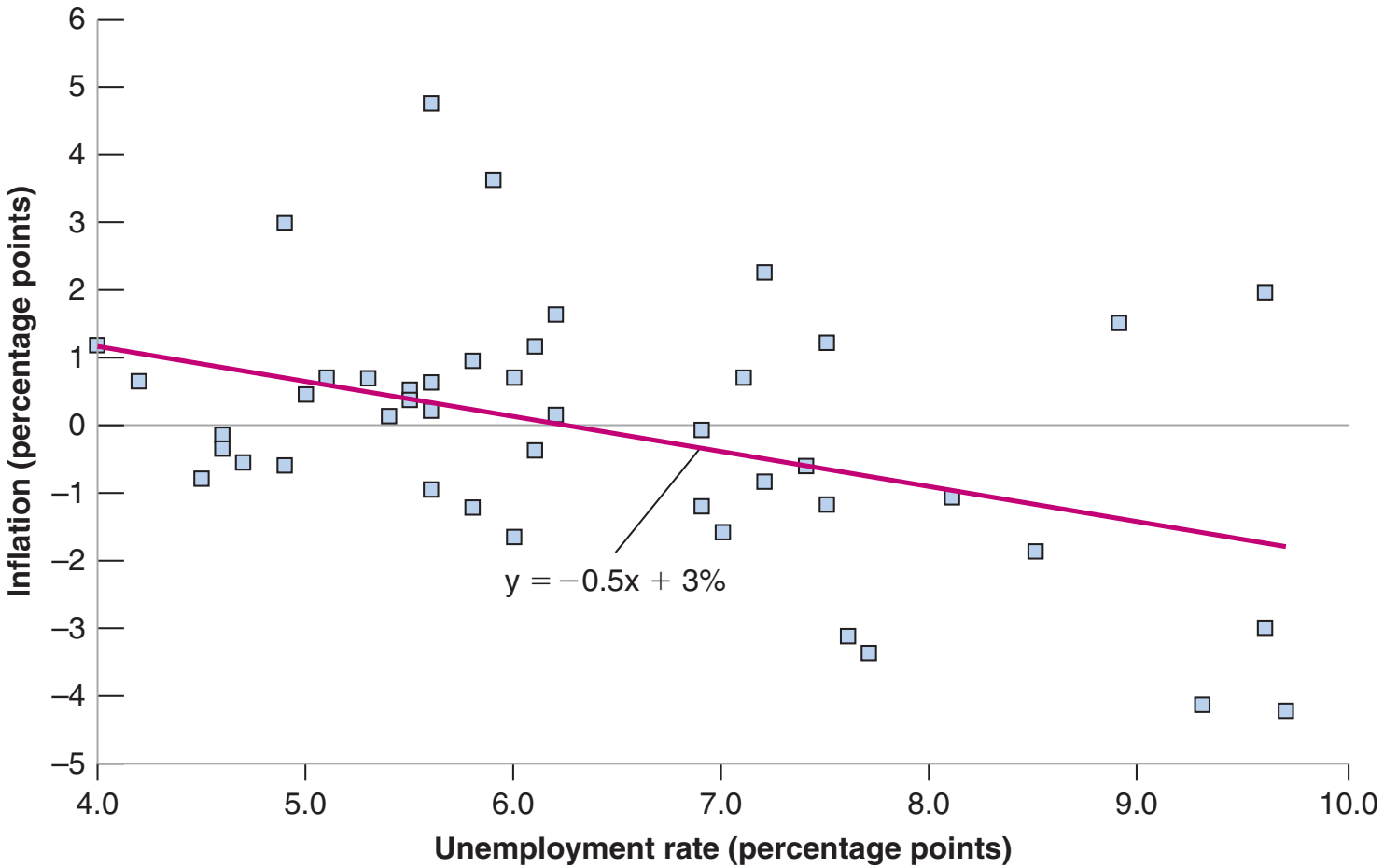
- When $\theta = 1$:

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

so the unemployment rate affects not the inflation rate, but rather the change in the inflation rate.

Change in Inflation versus Unemployment in the United States, 1974–2014

And indeed: since 1970, there has been a **negative relation between the unemployment rate and the change in the inflation rate** in the US.
(note that the y-axis should say "change in inflation")



The Phillips Curve and Its Mutations

- The line that best fits the scatter of points in the previous figure is:

$$\pi_t - \pi_{t-1} = 3.0\% - 0.5u_t$$

  which is called the **modified Phillips curve**, or the **expectations-augmented Phillips curve**, or the **accelerationist Phillips curve**:
  - "expectations-augmented" points to the fact that expected inflation, here π_{t-1}, enters in the equation.
  - "accelerationist" indicates that a low unemployment rate leads to an increase in the inflation rate and thus an ***acceleration*** of the price level.

- We shall simply call this equation the *Phillips curve*, as opposed to *the original Phillips curve*.

- Note however that this relationship is far from tight. Lately, the accelerationist version of the Phillips Curve has not been working very well. The Phillips Curve may be broken for good?

The Phillips Curve and the Natural Rate of Unemployment

- The history of the Phillips curve is closely related to the concept of the Natural Rate of Unemployment.
- With the original Phillips curve, there was **no such a thing as a natural unemployment rate**: with a higher inflation rate, one could forever maintain low unemployment.
- 1960s: pretty much right. However, Milton Friedman and Edmund Phelps argued that the trade-off between inflation and unemployment in the late 1960s was an illusion. (Friedman (1968), Phelps (1968))
- According to them, the Phillips curve **is a temporary, rather than a permanent, trade-off between inflation and unemployment** that comes not from inflation per se, but from a rise rate of inflation, which results in unanticipated inflation.
- The usual story is that the failure of the Phillips curve at the beginning of the 1970s proved them right.

Theory ahead of facts? (Friedman (1968))

"Implicitly, Phillips wrote his article for a world in which everyone anticipated that nominal prices would be stable and in which this anticipation remained unshaken and immutable whatever happened to actual prices and wages. Suppose, by contrast, that everyone anticipates that prices will rise at a rate of more than 75% a year—as, for example, Brazilians did a few years ago. Then, wages must rise at that rate simply to keep real wages unchanged. An excess supply of labor will be reflected in a less rapid rise in nominal wages than in anticipated prices, not in an absolute decline in wages."

"To state [my] conclusion differently, **there is always a temporary trade-off between inflation and unemployment; there is no permanent trade-off. The temporary trade-off comes not from inflation per se, but from a rising rate of inflation.**"

The Phillips Curve and the Natural Rate of Unemployment

- By definition, the natural rate of unemployment is the unemployment rate at which the actual price level is equal to the expected price level.
- More conveniently here, the natural rate of unemployment is the unemployment rate such that the actual inflation rate is equal to the expected inflation rate. Thus, the natural rate of unemployment u_n is such that $\pi = \pi^e$ and therefore:

$$0 = (m + z) - \alpha u_n \quad \Rightarrow \quad \boxed{u_n = \frac{m + z}{\alpha}}.$$

- The higher the markup m, the higher the factors that affect wage setting z, the higher the natural rate of unemployment. Now, rewriting the previous equation:

$$\pi_t - \pi_{t-1} = (m + z) - \alpha u_t \quad \Rightarrow \quad \pi_t - \pi_t^e = -\alpha \left(u_t - \frac{m + z}{\alpha} \right)$$

so it can be rewritten as:

$$\boxed{\pi_t - \pi_t^e = -\alpha \left(u_t - u_n \right)}.$$

The Phillips Curve and the Natural Rate of Unemployment

- If π^e is well approximated by π_{t-1}, then:

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

and therefore:

$$\begin{aligned} u_t < u_n \quad &\Rightarrow \quad \pi > \pi_{t-1} \\ u_t > u_n \quad &\Rightarrow \quad \pi < \pi_{t-1} \end{aligned}$$

- The change in the inflation rate depends on the difference between the actual and the natural unemployment rates.
- The natural rate of unemployment is the rate of unemployment required to keep the inflation rate constant.
- This is why the natural rate is also called the **Non-Accelerating Inflation Rate of Unemployment (NAIRU)**.

A Summary and Many Warnings

- The relation between unemployment and inflation in the United States today 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. (disclaimer however: this is probably less true in recent years !)
- When the unemployment rate is above (below) the natural rate of unemployment, the inflation rate typically decreases (increases).
- Even if one accepts this theory of the Phillips Curve, it is hardly a universal "law of physics".
- In particular, the natural rate of unemployment differs across countries due to, e.g., **labor-market rigidities**, and also over time. More generally, there are many facts that this theory leaves unexplained.

Variations in the Natural Rate across Countries

- The natural rate of unemployment is given by:

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

- Therefore, it depends on:
  - The factors affecting wage setting, summarized by the catchall variable z.
  - The markup set by firms, m.
  - The response of inflation to unemployment, α. (the slope of the Phillips Curve)

- These factors **vary across countries**. For example, the unemployment rate in the Euro area has averaged about 9% since 1990. A high average unemployment rate for 25 years, with no sustained decrease in inflation most likely reflects a high natural rate of unemployment – at least according to the last theory.

- For some, the problem of Europe lies in **labor market rigidities**.

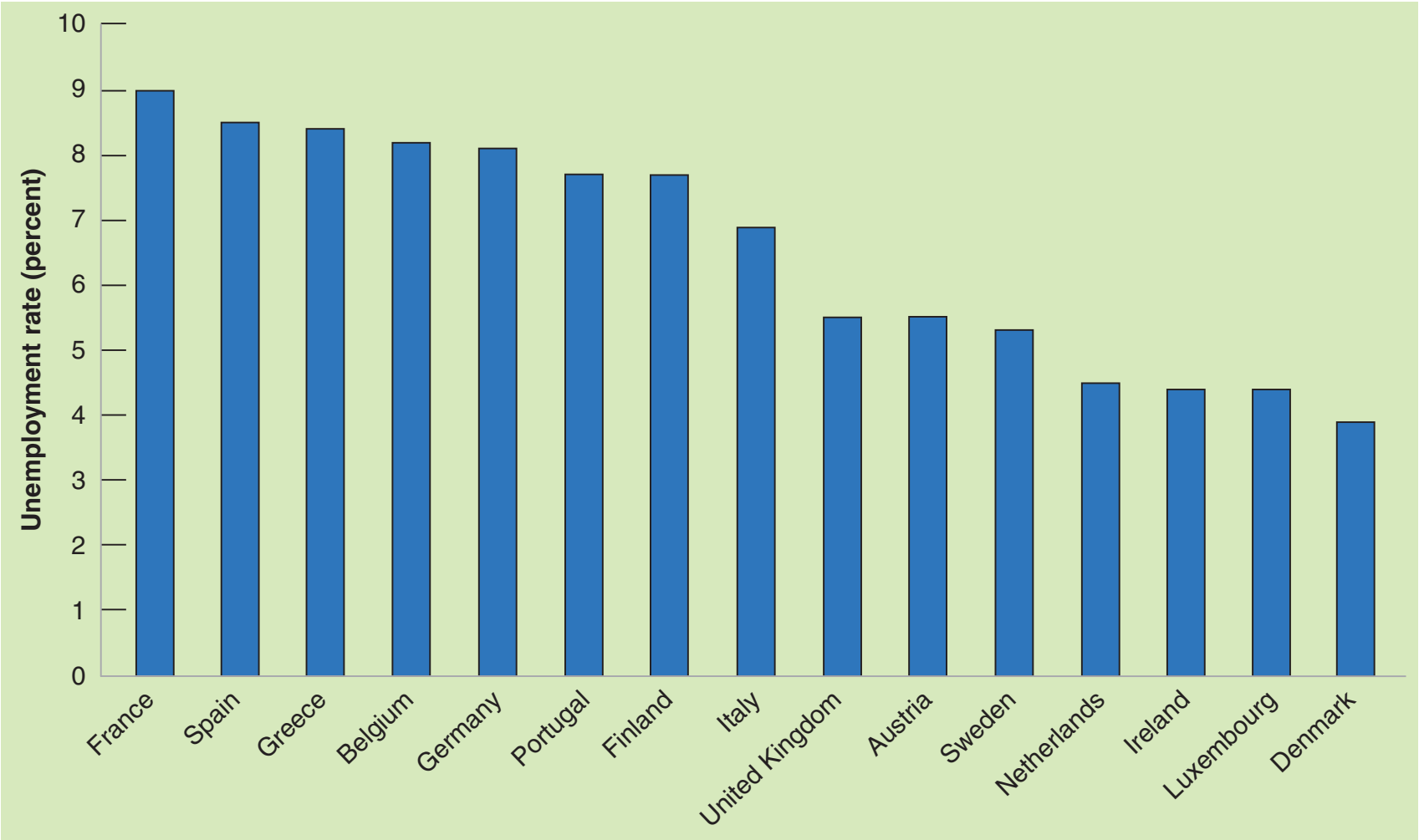
What Explains European Unemployment? (1/2)

- Europe is a particularly interesting laboratory to understand what matters for unemployment, given how relatively high it is there.
- Economists studying Europe often blame the higher u_n on "labor market rigidities". What are these potential rigidities?:
  - A **generous system of unemployment insurance**, which decreases the incentives of the unemployed to search for jobs, as well as raises z:
    - ★ the replacement rate – the ratio of unemployment benefits to the after-tax wage – is quite high.
    - ★ the duration of benefits – the period of time for which the unemployed are entitled to receive benefits – often runs in years.
  - A **high degree of employment protection**: their purpose is to decrease layoffs and protect workers. However, it may increase the cost of labor for firms, and discourage firms from hiring in the first place.
  - **High minimum wages**, which raise z.
  - **Favorable bargaining rules**, such as extension agreements: a contract agreed to by a subset of firms may be automatically extended to other sectors.

What Explains European Unemployment? (2/2)

- Do these labor-market institutions really explain high unemployment in Europe? Not quite. Indeed, two facts are hard to reconcile with this simplistic theory:
  1. Unemployment was not always high in Europe. In the 1960s, the unemployment rate in the 4 major European countries was lower than the US, around 2 to 3%. US economists would cross the Atlantic and study the "European unemployment miracle!" Natural rate today is 8 to 9%. However, institutions did not change that much. The problem thus seems to be the **interaction between institutions and shocks**. (Blanchard, Olivier and Wolfers (2001)) Employment protection for example, may be good in tranquil times, but had in agitated times (from the oil price shocks of the 1970s).
  2. Before the crisis, in 2006, European countries had different experiences with respect to unemployment. (see the next slide) True, Ireland, and the United Kingdom, have "anglo-saxon" like institutions. But Sweden, the Netherlands, Denmark do not.
- The conclusion is that the devil is in the detail. For example, unemployment benefits may be generous if the unemployed are forced to take jobs if such jobs are available.

Unemployment Rates in 15 European Countries, 2006



Changes in the U.S. Natural Rate of Unemployment since 1990

- The **natural rate of unemployment** appears to have d**ecreased in the US** from around 7 to 8% in the 1980s to close to 5% today. Researchers have offered a number of explanations:
  - Increased globalization and stronger competition between U.S. and foreign firms may have led to a decrease in monoploly power and to a decrease in the markup. Also, the threat of outsourcing has certainly **decreased workers' bargaining power**.
  - Increases in employment by temporary help agencies, from 0.5% in 1980 to more than 2% today. Internet based recruiting and professional platforms such as Linked in have also certainly made the matching of jobs and workers easier.

Changes in the U.S. Natural Rate of Unemployment since 1990

- Some explanations may surprise you:
  - The aging of the U.S. population. The proportion of young workers fell from 24% in the 1980s to 14% today. Young workers typically have a higher unemployment rate.
  - An increase in the incarceration rate. Many low-skilled people, the more likely to be unemployed, are incarcerated in the US (in 1980, 0.3% of the working age population was in prison – nowadays, this number stands at 1%)
  - The increase in the number of workers on disability. Eligibility criteria were related in 1984: from 2.2% of the working age population in 1984 to 4.3% today.

- The natural rate of unemployment is persistent. Indeed, there exists some hysteresis:
  - Workers who have been unemployed may lose their skills.
  - They may (more importantly) lose their morale, or even their "work ethic."

High inflation and the Phillips Curve relation

- When the inflation rate becomes high, the terms of wage agreements tend to change with the level of inflation.
- The terms of wage agreements change with the level of inflation. Nominal wages are set for shorter periods of time, down from a year to a month or even less. **Wage indexation**, which is a provision that automatically increases wages in line with inflation, becomes more prevalent.
- In turn, these changes lead to a stronger response of inflation to unemployment.
- Suppose λ is the proportion of labor contracts that is indexed, so nominal wages move one-for-one with changes in the actual price level, the previous equation $\pi_t = \pi_{t-1} - \alpha(u_t - u_n)$ becomes:

$$\pi_t = [\lambda\pi_t + (1-\lambda)\pi_{t-1}] - \alpha(u_t - u_n).$$

High inflation and the Phillips Curve relation

- When $\lambda = 0$, this means that:

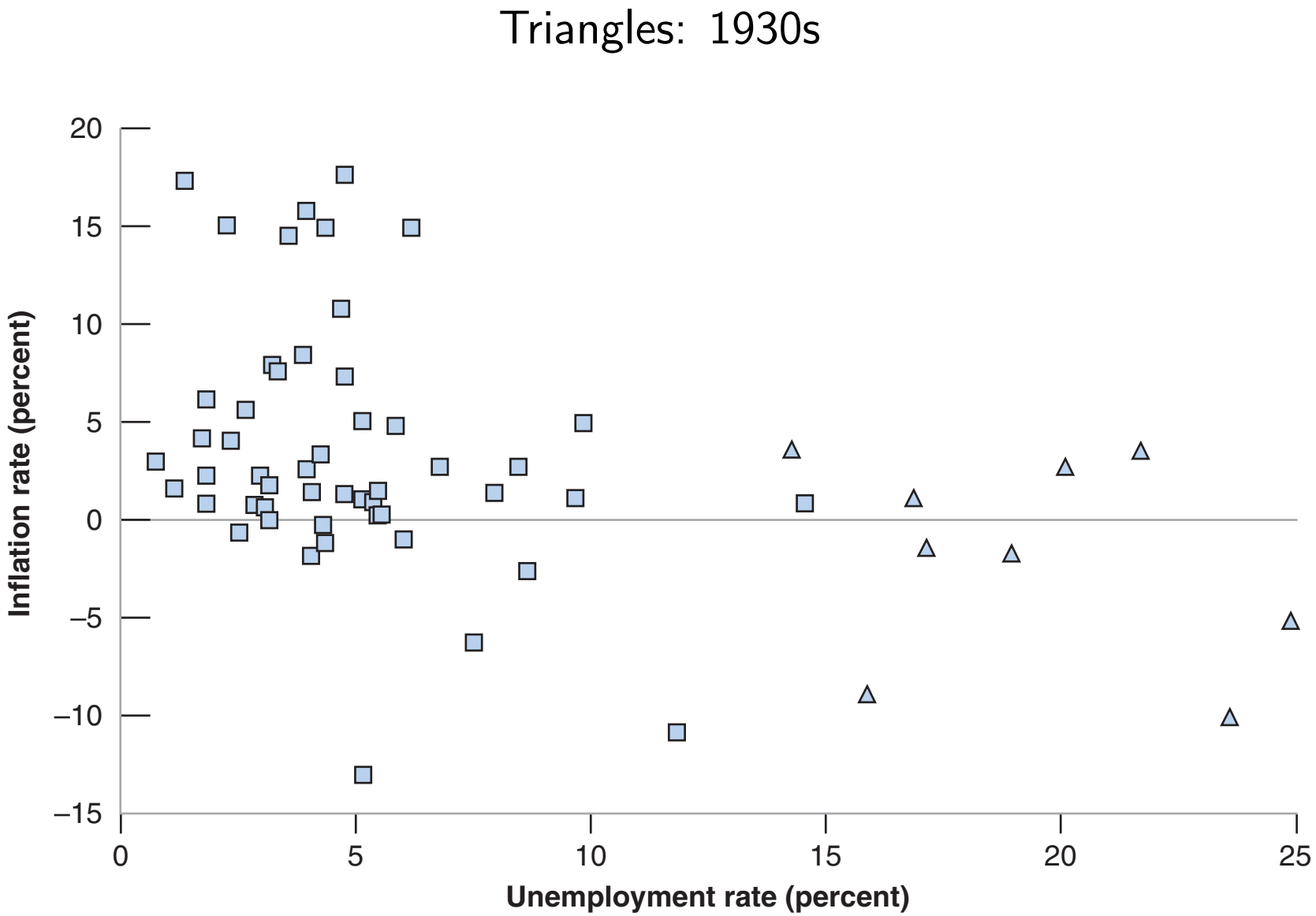
$$\pi_t - \pi_{t-1} = -\alpha (u_t - u_n).$$

- When $\lambda > 0$, the previous equation can be rewritten:

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

- Therefore, because $\alpha/(1-\lambda) > \alpha$, wage indexation increases the effect of unemployment on inflation.
- The intuition is as follows:
  - Without wage indexation: lower unemployment increases wages, which in turn increases prices. But because wages do not respond to prices right away, there is no further increase in prices within the year.
  - With wage indexation: an increase in prices leads to a further increase in wages within the year, which leads to a further increase in prices, and so on, so that the effect of unemployment on inflation within the year is higher.

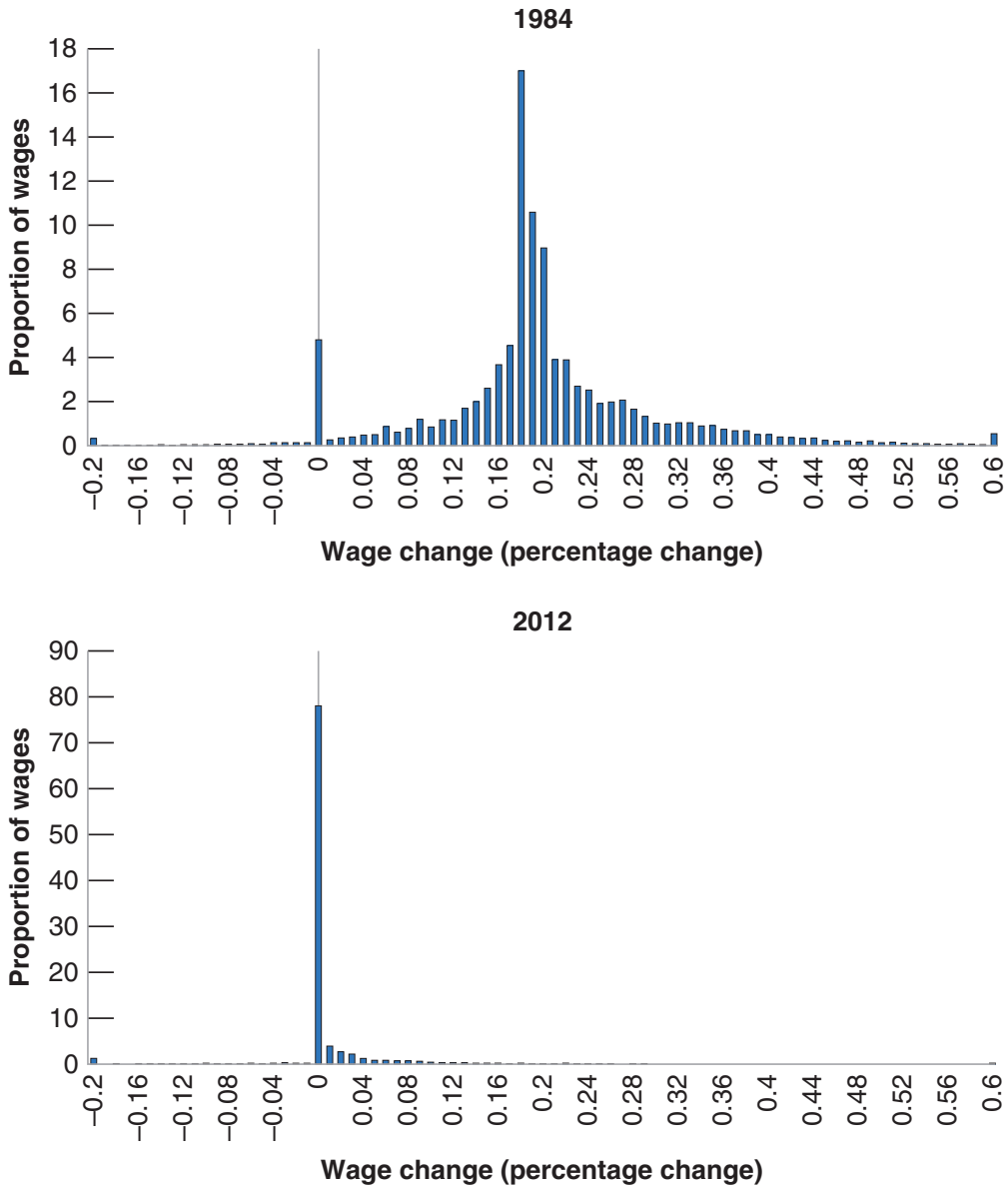
Inflation VS Unemployment in the US, 1900–1960



Deflation and the Phillips Curve relation

- How about when inflation is actually "too low"? For example, in 1930s, given the high unemployment rate, the inflation rate was surprisingly high. We would have expected a large rate of deflation.
- From **1934-1937**, despite still high unemployment, **inflation actually turned positive**.
- One explanation: reluctance of workers to accept decreases in their nominal wages.
- Another example, closer from our times, which allows us to access more data – Portugal in 1984 versus 2012:
  - In 1984, the inflation rate was 27%, and the distribution of wage wages was roughly symmetric.
  - In 2012, the inflation rate was just 2.1%, and the distribution of wages was bunched at zero with nearly no negative wage changes.
- Explanation for the "missing deflation" during the last crisis? The discussion is still ongoing. Central banking and monetary policy face tough questions.

Unemployment Rates in 15 EU Countries, 2006



Readings

☞ Chapter 8, *Macroeconomics*, 7th Edition, Olivier Blanchard.

✎ Phillips, A. W. "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957." Economica 25, no. 100 (November 1, 1958): 283–99. Link

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Phillips Curve Doesn't Help Forecast Inflation, Fed Study Finds, *Bloomberg Markets*, August 24, 2017. Link

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The Phillips hydraulic machine. Link

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