CHAPTER 14

Aggregate Supply and the Short-Run Tradeoff Between Inflation and Unemployment

Presentation Slides

Macroeconomics

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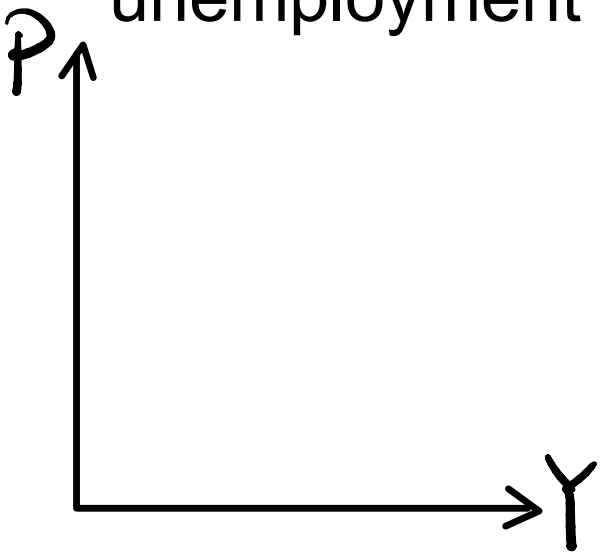
IN THIS CHAPTER, YOU WILL LEARN:

- about two models of aggregate supply in which output depends positively on the price level in the short run
- about the short-run tradeoff between inflation and unemployment known as the Phillips curve



14.1 The Basic Theory of Aggregate Supply

models of aggregate supply

- In previous chapters, we assumed the price level ***P*** was "stuck" in the short run.
  - This implies a horizontal SRAS curve.
- Now, we consider two prominent models of aggregate supply in the short run:
  - Sticky-price model
  - Imperfect-information model

Introduction

$\alpha = \frac{s}{(1-s)a}$ in sticky price model

- Both models imply:

$$Y = \bar{Y} + \alpha(P - EP)$$

- agg. output
- natural rate of output
- a positive parameter
- actual price level
- expected price level

- Other things equal, ***Y*** and ***P*** are positively related, so the SRAS curve is upward sloping.

(1) The sticky-price model

- Reasons for sticky prices:
  - long-term contracts between firms and customers
  - menu costs
  - firms not wishing to annoy customers with frequent price changes
- Assumption:
  - Firms set their own prices (*e.g.*, firms have some market power).

The sticky-price model

- An individual firm's desired price is:

$$p = P + a(Y - \bar{Y})$$

where $a > 0$.

Suppose two types of firms:

- firms with flexible prices, set prices as above
- firms with sticky prices, must set their price before they know how P and Y will turn out:

$$p = EP + a(EY - E\bar{Y})$$

The sticky-price model

$$p = EP + a(EY - E\bar{Y})$$

- Assume sticky-price firms expect that output will equal its natural rate. Then,

$$p = EP$$

- To derive the aggregate supply curve, first find an expression for the overall price level.
- s = fraction of firms with sticky prices.
  Then, we can write the overall price level as…

The sticky-price model

$$P = s[EP] + (1-s)[P + a(Y - \bar{Y})]$$

price set by sticky-price firms

price set by flexible-price firms

- Subtract $(1-s)P$ from both sides:

$$sP = s[EP] + (1-s)[a(Y - \bar{Y})]$$

- Divide both sides by s:

$$P = EP + \frac{(1-s)a}{s}(Y - \bar{Y})$$

The sticky-price model

$$P = EP + \frac{(1-s)a}{s}(Y - \bar{Y})$$

- High EP → High P
  If firms expect high prices, then firms that must set prices in advance will set them high.
  Other firms respond by setting high prices.
- High Y → High P
  When income is high, the demand for goods is high.
  Firms with flexible prices set high prices.
- The greater the fraction of flexible-price firms, the smaller is s and the bigger the effect of Y on P.

The sticky-price model

$$P = EP + \frac{(1-s)a}{s}(Y - \bar{Y})$$

- Finally, derive *AS* equation by solving for Y:

$$Y = \bar{Y} + \alpha(P - EP),$$

where $\alpha = \dfrac{s}{(1-s)a} > 0$

(2) The imperfect-information model

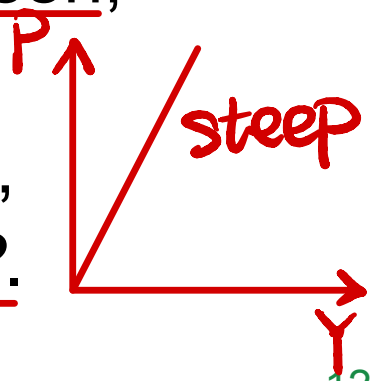
Assumptions:

- All wages and prices are perfectly flexible, all markets are clear.
- Each supplier produces one good, consumes many goods.
- Each supplier knows the nominal price of the good she produces, but does not know the overall price level.

$Y = \bar{Y} + \alpha(P - EP)$

The imperfect-information model

- Supply of each good depends on its relative price: the nominal price of the good divided by the overall price level.
- Supplier does not know price level at the time she makes her production decision, so uses EP.
- Suppose P rises but EP does not.
  - Supplier thinks her relative price has risen, so she produces more.
  - With many producers thinking this way, Y will rise whenever P rises above EP.

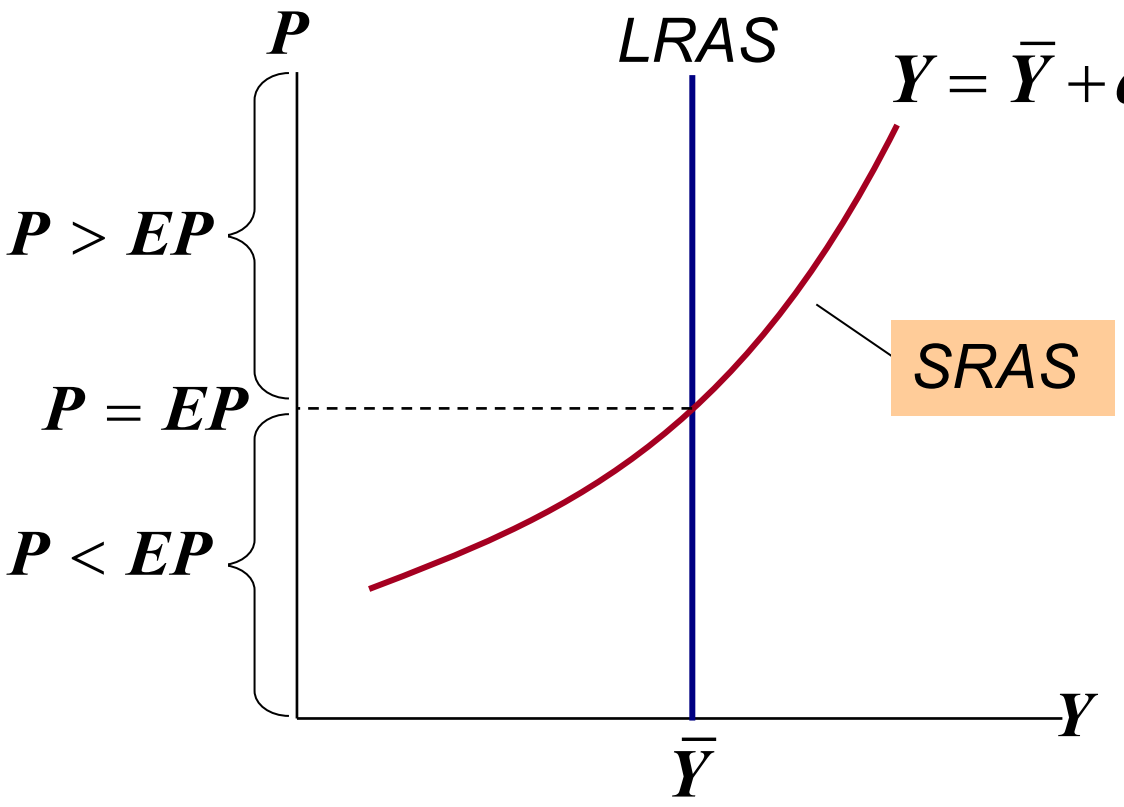


Case Study: International difference in the aggregate supply curve

- Lucas's imperfect-information model: the slope of the aggregate supply curve should depend on the volatility of aggregate demand; in countries where aggregate demand fluctuates widely, the SRAS curve should be relatively steep.

- Sticky-price model: the average rate of inflation should influence the slope of the SRAS curve; a high rate of inflation should make the short-run aggregate supply curve steeper.
- International data support all these predictions.

Summary & implications



Both models of agg. supply imply the relationship summarized by the *SRAS* curve & equation.

Summary & implications

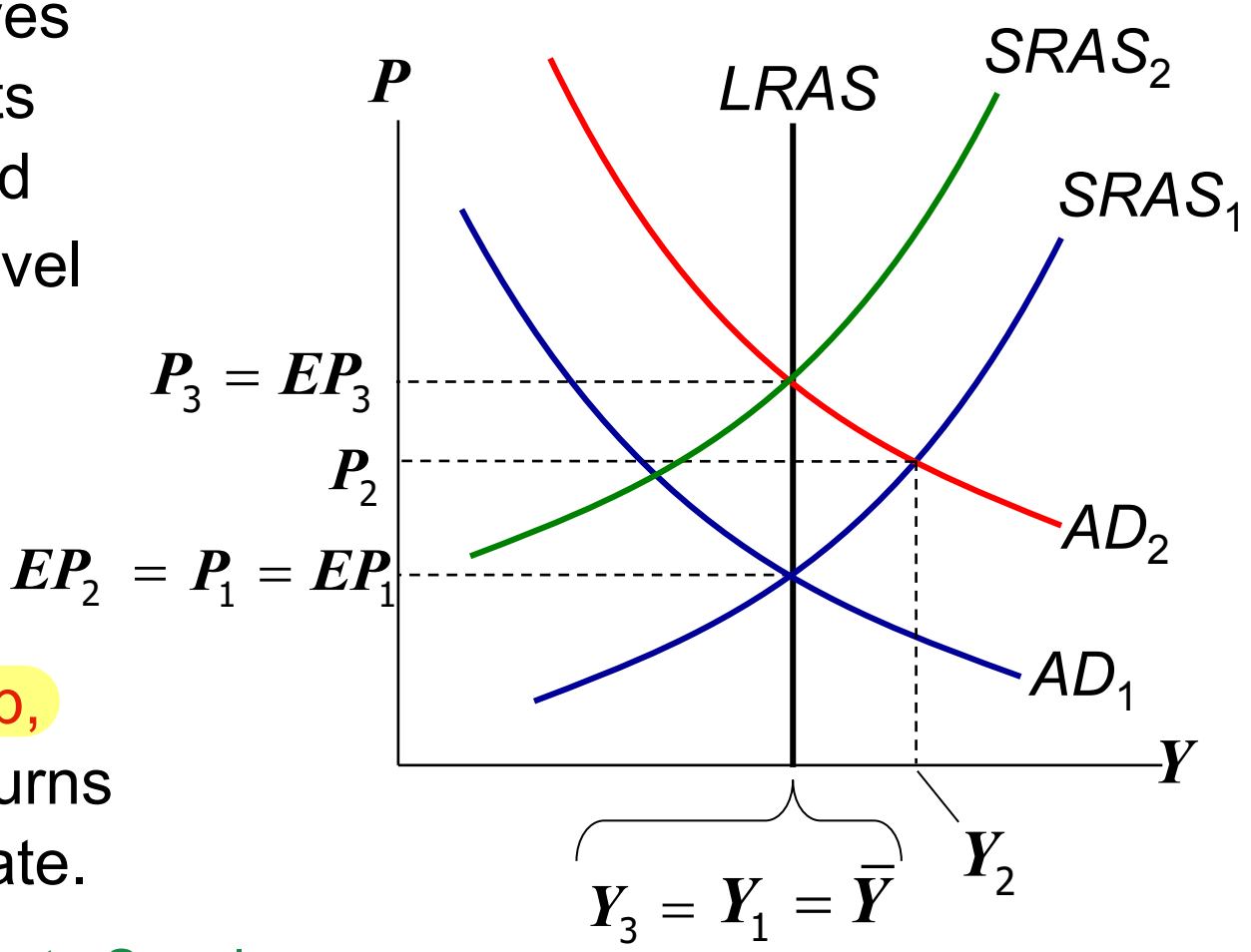
P-Y curve

EP↑ SRAS↑

SRAS equation: $Y = \bar{Y} + \alpha(P - EP)$

Suppose a positive *AD* shock moves output above its natural rate and P above the level people had expected.

Over time, EP rises, *SRAS* shifts up, and output returns to its natural rate.



14.2 Inflation, Unemployment, and the Phillips Curve

The Phillips curve

The **Phillips curve** states that π depends on

- expected inflation, $E\pi$
- **cyclical unemployment**: the deviation of the actual rate of unemployment from the natural rate
- supply shocks, v

$$\pi = E\pi - \beta(u - u^n) + v$$

where $\beta > 0$ is an exogenous constant.

Deriving the Phillips curve from *SRAS*

(1) $Y = \bar{Y} + \alpha(P - EP)$

(2) $P = EP + (1/\alpha)(Y - \bar{Y})$

(3) $P = EP + (1/\alpha)(Y - \bar{Y}) + v$

(4) $(P - P_{-1}) = (EP - P_{-1}) + (1/\alpha)(Y - \bar{Y}) + v$

(5) $\pi = E\pi + (1/\alpha)(Y - \bar{Y}) + v$

(6) $(1/\alpha)(Y - \bar{Y}) = -\beta(u - u^n)$ Okun's law

(7) $\pi = E\pi - \beta(u - u^n) + v$

Comparing *SRAS* and the Phillips curve

SRAS: $Y = \bar{Y} + \alpha(P - EP)$

Phillips curve: $\pi = E\pi - \beta(u - u^n) + \nu$

- *SRAS* curve:
  Output is related to
  unexpected movements in the price level.

P → Y

- Phillips curve:
  Unemployment is related to
  unexpected movements in the inflation rate.

π → u

The History of the Modern Phillips Curve

- The original PC is about the negative relationship between u and the rate of ~~wage inflation~~.
- The modern PC differs in three ways from its original form:

--- substituting price inflation for wage inflation;

--- including expected inflation;

--- including supply shocks.

Adaptive expectations

- **Adaptive expectations**: an approach that assumes people form their expectations of future inflation based on recently observed inflation.
- A simple version:
  Expected inflation = last year's actual inflation

$$E\pi = \pi_{-1}$$

- Then, Phillips curve eq'n becomes

$$\pi = \pi_{-1} - \beta(u - u^n) + \nu$$

NAIRU: non-accelerating inflation rate of unemployment

Inflation inertia

$$\pi = \pi_{-1} - \beta(u - u^n) + \nu$$

In this form, the Phillips curve implies that inflation has inertia:

- In the absence of supply shocks or cyclical unemployment, inflation will continue indefinitely at its current rate.
- Past inflation influences expectations of current inflation, which in turn influences the wages & prices that people set.

Two causes of rising & falling inflation

$$\pi = \pi_{-1} - \beta(u - u^n) + \nu$$

- **cost-push inflation**:
  inflation resulting from supply shocks

  Adverse supply shocks typically raise production costs and induce firms to raise prices, *pushing* inflation up.

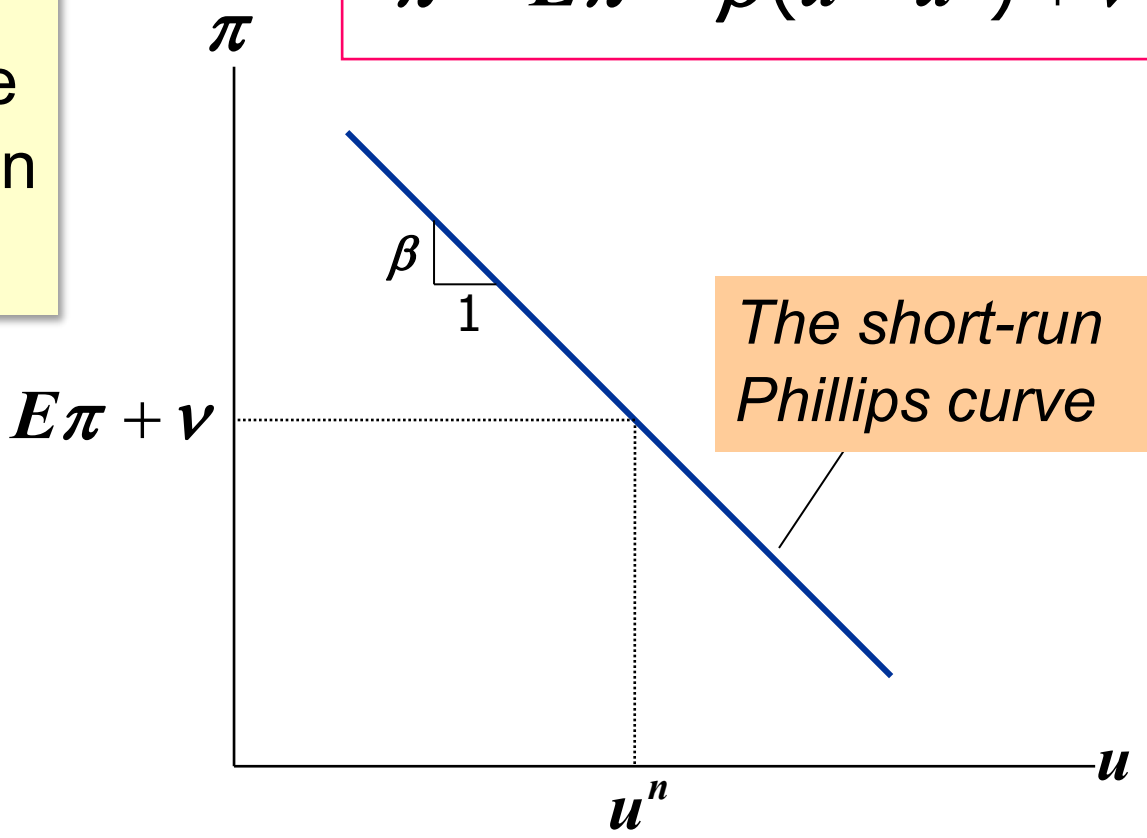
- **demand-pull inflation**:
  inflation resulting from demand shocks

  Positive shocks to aggregate demand cause unemployment to fall below its natural rate, which *pulls* the inflation rate up.

Graphing the Phillips curve

In the short run, policymakers face a tradeoff between π and u.

$$\pi = E\pi - \beta(u - u^n) + \nu$$

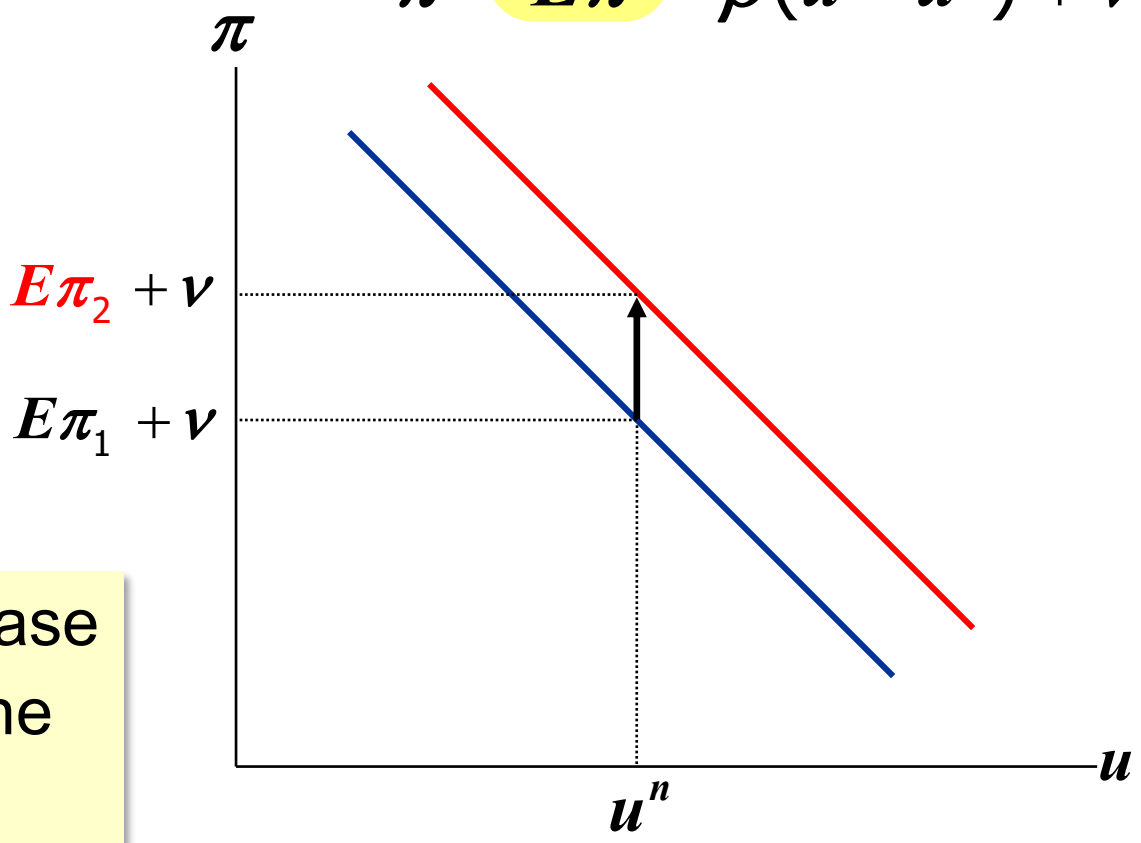


Shifting the Phillips curve

People adjust their expectations over time, so the tradeoff only holds in the short run.

E.g., an increase in $E\pi$ shifts the short-run P.C. upward.

$$\pi = E\pi - \beta(u - u^n) + \nu$$



How Precise Are Estimates of the Natural Rate of Unemployment?

- Estimates of the natural rate of unemployment, or NAIRU, are far from precise.
- One problem is supply shocks..
- A second problem is that the natural rate changes over time.
- Policymakers may want to keep unemployment close to its natural rate, but their ability to do so is limited by the fact that they cannot be sure what that natural rate is.

The sacrifice ratio

- To reduce inflation, policymakers can contract agg. demand, causing unemployment to rise above the natural rate.
- The **sacrifice ratio** measures the percentage of a year's real GDP that must be forgone to reduce inflation by 1 percentage point.
- A typical estimate of the ratio is 5.

The sacrifice ratio

- Example: To reduce inflation from 6 to 2 percent, must sacrifice 20 percent of one year's GDP:

$$\text{GDP loss} = (\text{inflation reduction}) \times (\text{sacrifice ratio})$$
$$= \quad 4 \quad \times \quad 5$$

- This loss could be incurred in one year or spread over several, *e.g.*, 5% loss for each of four years.
- The cost of disinflation is lost GDP.
  One could use Okun's law to translate this cost into unemployment.

Rational expectations

Ways of modeling the formation of expectations:

- **adaptive expectations**:
  People base their expectations of future inflation on recently observed inflation.

- **rational expectations**:
  People base their expectations on all available information, including information about current and prospective future policies.

Painless disinflation?

- Proponents of rational expectations believe that the sacrifice ratio may be very small:
- Suppose $u = u^n$ and $\pi = E\pi = 6\%$, and suppose the Fed announces that it will do whatever is necessary to reduce inflation from 6 to 2 percent as soon as possible.
- If the announcement is **credible**, then $E\pi$ will fall, perhaps by the full 4 points.
- Then, π can fall without an increase in u.

Calculating the sacrifice ratio for the Volcker disinflation

- 1981: $\pi = 9.3\%$
  1985: $\pi = 3.2\%$
  } Total disinflation = 6.1%

year	u	u^n	$u - u^n$
1982	9.7%	6.0%	3.7%
1983	9.6	6.0	3.6
1984	7.5	6.0	1.5
1985	7.2	6.0	1.2
		Total	10%

Calculating the sacrifice ratio for the Volcker disinflation

- From previous slide: Inflation fell by 6.1%, total cyclical unemployment was 10%.
- Okun's law:
  1% of unemployment = 2% of lost output.
- Thus, 10% cyclical unemployment
  = 20% of a year's real GDP.
- **Sacrifice ratio** = (lost GDP)/(total disinflation)
  = 20/6.1 = 3.3 percentage points of GDP were lost for each 1 percentage point reduction in inflation.

The natural-rate hypothesis

Our analysis of the costs of disinflation, and of economic fluctuations in the preceding chapters, is based on the **natural-rate hypothesis**:

> Changes in aggregate demand affect output and employment only in the short run.
>
> In the long run, the economy returns to the levels of output, employment, and unemployment described by the classical model (Chaps. 3–9).

An alternative hypothesis: Hysteresis

滞后作用

- **Hysteresis**: the long-lasting influence of history on variables such as the natural rate of unemployment.
- Negative shocks may increase u^n, so economy may not fully recover.

Europe after 2008

Hysteresis: Why negative shocks may increase the natural rate

- The skills of cyclically unemployed workers may deteriorate while unemployed, and they may not find a job when the recession ends.
- Cyclically unemployed workers may lose their influence on wage setting; then, insiders (employed workers) may bargain for higher wages for themselves.
- Result: The cyclically unemployed "outsiders" may become structurally unemployed when the recession ends.

CHAPTER SUMMARY

1. Two models of aggregate supply in the short run:
   - sticky-price model
   - imperfect-information model

   Both models imply that output rises above its natural rate when the price level rises above the expected price level.

$$Y = \bar{Y} + \alpha(P - EP)$$

CHAPTER SUMMARY

2. Phillips curve
   - derived from the *SRAS* curve
   - states that inflation depends on
     - expected inflation
     - cyclical unemployment
     - supply shocks
   - presents policymakers with a short-run tradeoff between inflation and unemployment

CHAPTER SUMMARY

3. How people form expectations of inflation
   - adaptive expectations
     - based on recently observed inflation
     - implies "inertia"
   - rational expectations
     - based on all available information
     - implies that disinflation may be painless

CHAPTER SUMMARY

4. The natural rate hypothesis and hysteresis
   - the natural rate hypotheses
     - states that changes in aggregate demand can affect output and employment only in the short run
   - hysteresis
     - states that aggregate demand can have permanent effects on output and employment