Economics 442
Macroeconomic Policy
(11/9/2020)

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Outline

- The Phillips Curve, the Natural Rate of Unemployment, and Inflation
- From the Short to the Medium Run:

The *IS-LM-PC* Model

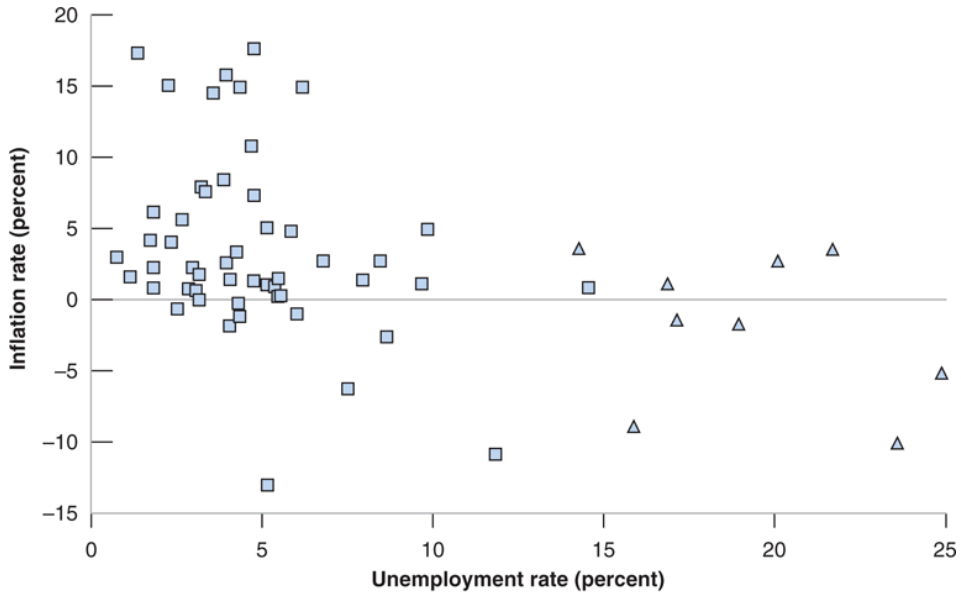
The Phillips Curve, the Natural Rate of Unemployment, and Inflation

The Phillips Curve, the Natural Rate of Unemployment, and Inflation

- In 1958. A.W. Phillips found a negative relation between inflation and unemployment.
- Two years later, Paul Samuelson and Robert Solow labeled this relation the **Phillips curve**, which became central to macroeconomic thinking and policy.

Figure 8.1 Inflation versus Unemployment in the United States, 1900–1960

During the period 1900-1960 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.



Source: Based on Historical Statistics of the United States. http://hsus.cambridge.org/HSUSWeb/index.do.

8.1 Inflation, Expected Inflation, and Unemployment (1 of 3)

- Recall the wage determination equation (7.1):

$$W = P^e F(u, z) \qquad (7.1)$$

and the price determination equation (7.3):

$$P = (1 + m)W \qquad (7.3)$$

8.1 Inflation, Expected Inflation, and Unemployment (2 of 3)

- Assume a specific form for *F*:

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

so that the *relation between the price level, the expected price level, and the unemployment rate* is:

$$P = P^{\mathrm{e}}(1 + m)(1 - \alpha u + \mathrm{z}) \qquad (8.1)$$

or in terms of inflation rate π and the expected inflation rate π^e:

$$\pi = \pi^e + (m + z) - \alpha u \qquad (8.2)$$

8.1 Inflation, Expected Inflation, and Unemployment (3 of 3)

- *An increase in π^e leads to an increase in π.*
- *Given π^e, an increase in m, or an increase in z, leads to an increase in π.*
- *Given π^e, a decrease in u leads to an increase in π.*
- Equation (8.2) with a time index *t*:

$$\pi_t = \pi_t^e + (\mathrm{m} + z) - \alpha u_t \qquad (8.3)$$

8.2 The Phillips Curve and Its Mutations (1 of 9)

- Assume $\pi_t^e = \overline{\pi}$, so that equation (8.3) becomes:

$$\pi_t = (m + z) - \alpha u_t \qquad (8.4)$$

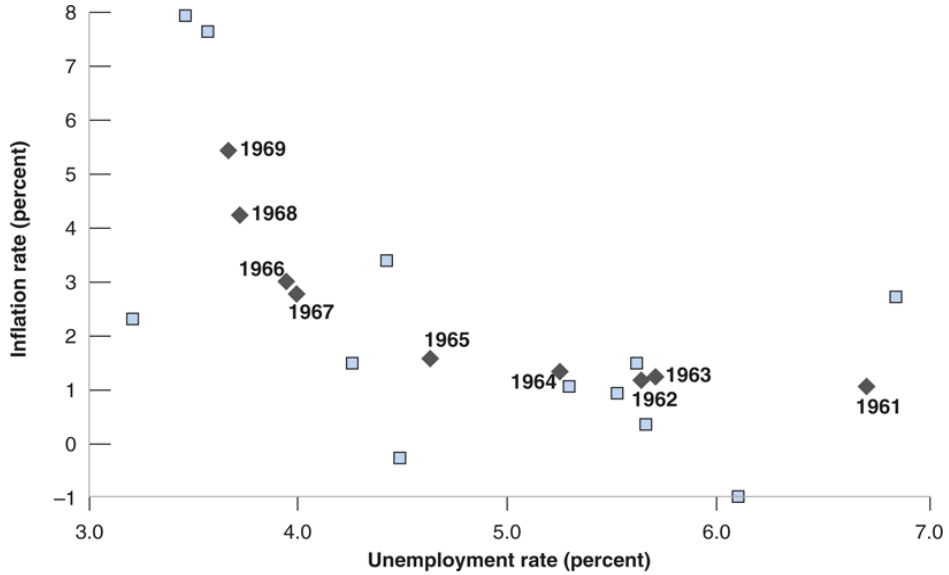
which is a negative relation between unemployment and inflation.

- This Phillips curve relation was observed in the United States in the 1960s.
- The relation vanished in the 1970s because wage setters changed the way they formed inflation expectations.

8.2 The Phillips Curve and Its Mutations (2 of 9)

Figure 8.2 Inflation versus Unemployment in the United States, 1961–1969

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

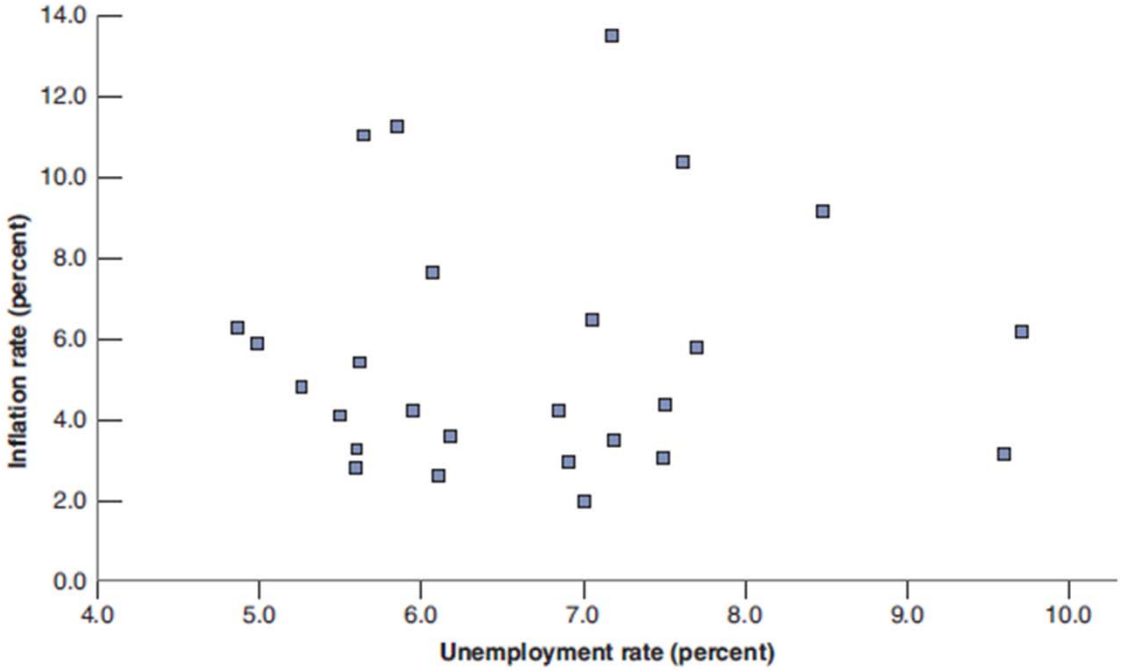


- *Source:* FRED: Series UNRATE, CPIAUSCL

8.2 The Phillips Curve and Its Mutations (3 of 9)

Figure 8.3 Inflation versus Unemployment in the United States, 1970–1995

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



Source: FRED: UNRATE, CPIAUSCL.

8.2 The Phillips Curve and Its Mutations (4 of 9)

- Suppose expected inflation this year depends on a constant value $\overline{\pi}$ with weight 1−ϑ, and partly on inflation last year with weight ϑ:

$$\pi_t^e = (1-\theta)\overline{\pi} + \theta\pi_{t-1} \qquad (8.5)$$

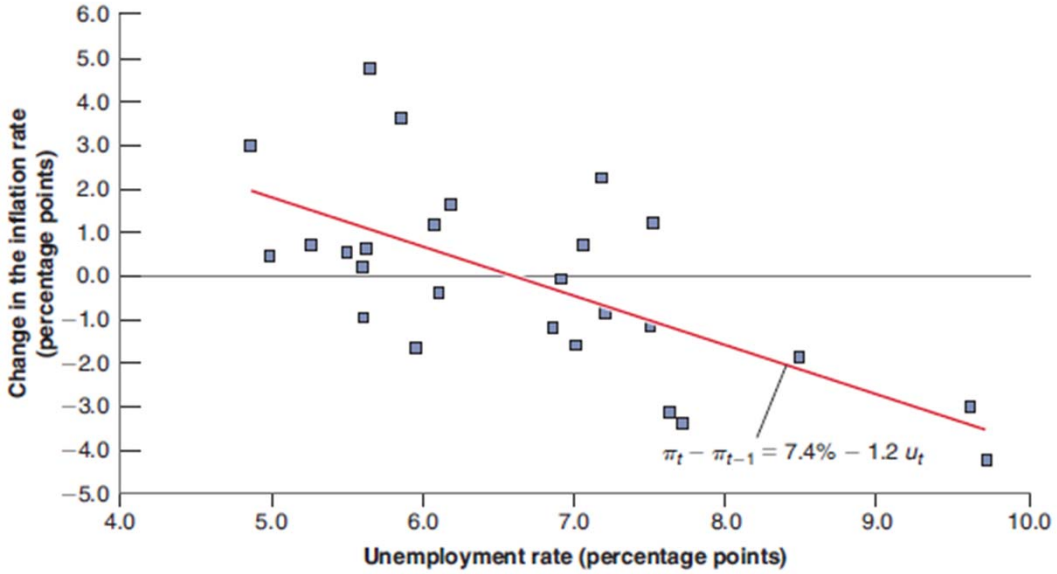
- When θ=0, $\pi_t = \overline{\pi} + (m + z) - \alpha u_t$
- When θ >0, $\pi_t = [(1 - \theta)\overline{\pi} + (m + z)] + \theta\pi_{t-1} - \alpha u_t$
- When θ =1, $\pi_t - \pi_{t-1} = (m + z) - \alpha u_t$, (8.6)

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

8.2 The Phillips Curve and Its Mutations (5 of 9)

Figure 8.4 Change in Inflation versus Unemployment in the United States, 1970–1995

From 1970 to 1995, there was a negative relation between the unemployment rate and the change in the inflation rate in the United States.



- *Source:* FRED: CPIAUCSL, UNRATE

8.2 The Phillips Curve and Its Mutations (6 of 9)

- The line that best fits the scatter of points in Figure 8.4 is:

$$\pi_t - \pi_{t-1} = 7.4\% - 1.2u_t \qquad (8.7)$$

which became known as the **accelerationist Phillips curve**.

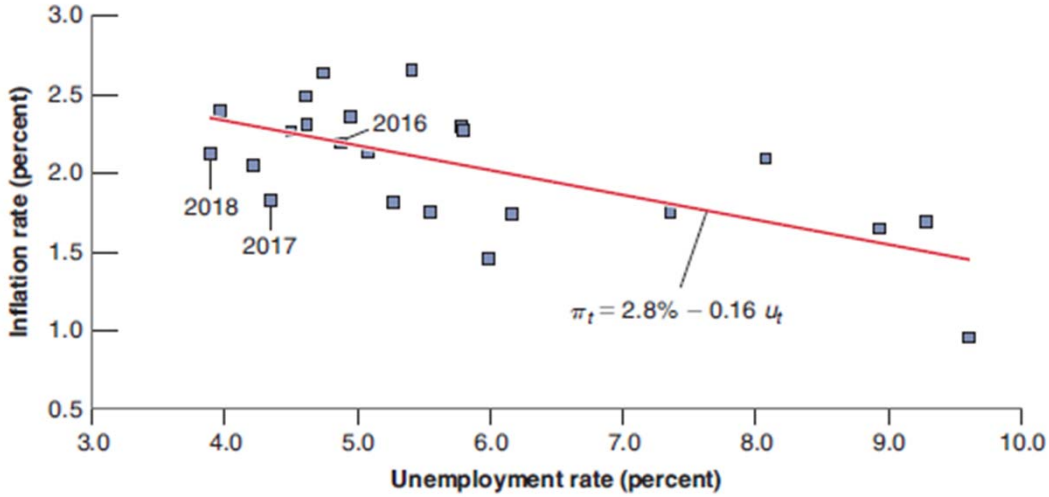
The Re-anchoring of Expectations (7 of 9)

- By the mid-1990s the Fed had largely achieved its goal of keeping inflation around 2%.
- Stable inflation changed the way people formed expectations yet again.
- Expectations of inflation that became de-anchored during the 1970s and 1980s became re-anchored in the mid-1990s.

8.2 The Phillips Curve and Its Mutations (8 of 9)

Figure 8.5 Inflation versus Unemployment in the United States, 1996–2018

Since the mid-1990s, the Phillips curve has taken the form of a relation between the inflation rate and the unemployment rate.



- *Source:* FRED: CPIAUCSL, UNRATE

8.2 The Phillips Curve and Its Mutations (9 of 9)

- The figure also plots the line that best fits the scatter of points for the period 1996–2018 and is given by:

$$\pi_t = 2.8\% - 0.16u_t \qquad (8.8)$$

8.3 The Phillips Curve and the Natural Rate of Unemployment (1 of 2)

- Suppose $\pi = \pi^e$ and solve for u_n in equation (8.3):

$$u_n = \frac{m + z}{\alpha} \qquad (8.9)$$

- Rewrite equation (8.3) as

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

so equation (8.9) can be rewritten as

$$\pi_t - \pi_t^e = -\alpha(u_t - u_n) \qquad (8.10)$$

8.3 The Phillips Curve and the Natural Rate of Unemployment (2 of 2)

Using equation (8.8) and putting p*t* = 2% gives:

$$2\% = 2.8\% - 0.16u_n \Rightarrow u_n = \frac{0.8}{0.16} = 5.0\%$$

FOCUS: Theory ahead of Facts: Milton Friedman and Edmund Phelps

- Milton Friedman and Edmund Phelps argued that the trade-off between inflation and unemployment in the late 1960s was an illusion.
- Accordingly, 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 rising rate of inflation, which results in unanticipated inflation.

8.4 A Summary and Many Warnings (1 of 5)

- 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.
- When the unemployment rate is above (below) the natural rate of unemployment, the inflation rate typically decreases (increases).
- The natural rate of unemployment differ across counties due to, e.g., **labor-market rigidities**, and also over time.

8.4 A Summary and Many Warnings (2 of 5)

- When the inflation rate becomes high, the terms of wage agreements tend to change with the level of inflation.
- **Wage indexation** is a provision that automatically increases wages in line with inflation.
- Suppose λ a proportion of labor contracts that is indexed, so nominal wages move one-for-one with changes in the actual price level, equation (8.10) becomes

$$\pi_t = [\lambda\pi_t + (1 - \lambda)\pi_{t-1}] - \alpha(u_t - u_{\mathrm{n}}) \qquad (8.11)$$

8.4 A Summary and Many Warnings (3 of 5)

- When λ=0, equation (8.11) becomes equations (8.10).
- When λ>0, equation (8.11) becomes:

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

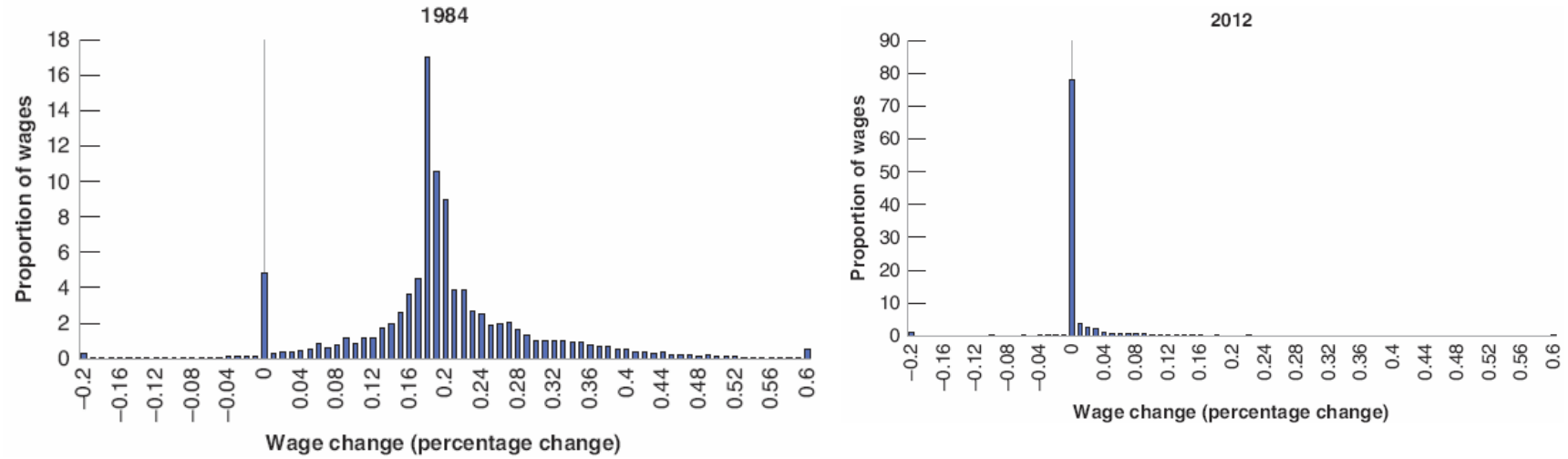
- *Wage indexation increases the effect of unemployment on inflation.*
- Without wage indexation, lower unemployment increases wages, which in turn increases prices.

8.4 A Summary and Many Warnings (4 of 5)

- When low inflation or deflation occurs, the Phillips curve relation breaks down.
- One possible reason is the reluctance of workers to accept cuts in nominal wages.

8.4 A Summary and Many Warnings (5 of 5)

Figure 8.6 Distribution of wage changes in Portugal, in times of high and low inflation



- 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.

Source: Pedro Portugal, based on Portuguese household survey.

APPENDIX: Derivation of the Relation Between Inflation, Expected Inflation, and Unemployment

- Equation (8.1) with time subscripts becomes:

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

- Divide both sides by $P_{t\text{-}1}$:

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}}(1+m)(1-\alpha u_t + z) \qquad (8A.1)$$

- Rewrite $P_t/P_{t\text{-}1}$ as $1+\pi_t$ and do the same for the expected inflation rate, equation (8A.1) becomes:

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

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

- If the left side is not large, it becomes $1 + \pi_t - \pi_t^e - m$ and so:

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

From the Short to the Medium Run: The *IS-LM-PC* Model

Chapter 9 Outline

From the Short to the Medium Run: The *IS-LM-PC* Model

From the Short to the Medium Run: The *IS-LM-PC* Model

- In Chapters 3 through 6, we looked at equilibrium in the goods and financial markets, and how output is determined in the short run.
- In Chapters 7 and 8, we looked at equilibrium in the labor market.
- We now put the two parts together and use this IS-LM-PC (PC for Phillips curve) model to characterize the behavior of output both in the short run and the medium runs.

9.1 The IS-LM-PC Model (1 of 3)

- In Chapter 6, output in the short run is determined by demand (IS curve):

$$Y = C(Y - T) + I(Y, r + x) + G \qquad (9.1)$$

$$r_t \approx i_t - \pi^e_{t+1} \qquad (6.4)$$

- In Chapter 8, the relation between inflation and unemployment is called the Phillips curve:

$$\pi - \pi^{\mathrm{e}} = -\alpha(u - u_{\mathrm{n}}) \qquad (9.2)$$

- When $u = u_n$, natural employment is $Nn = L(1- u_n)$
- When $u = u_n$, **potential output** is $Y_n = L(1- u_n)$
- Output gap: $Y - Y_n = L((1- u)-(1- u_n) = -L(u - u_n)$

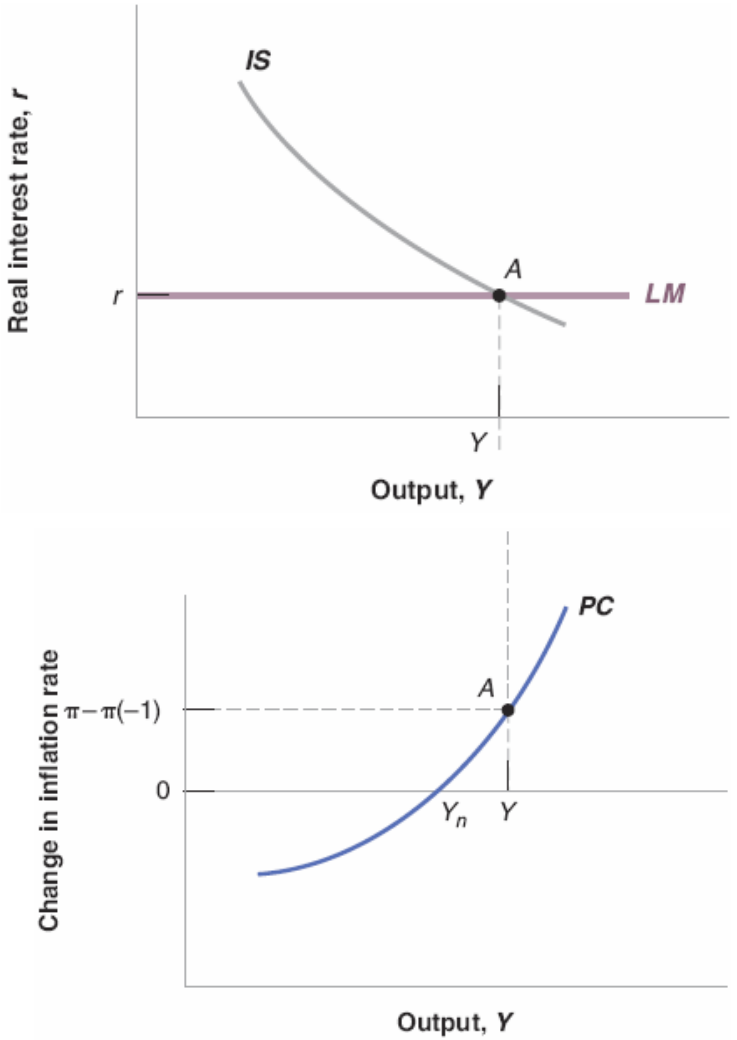
9.1 The IS-LM-PC Model (2 of 3)

Figure 9.1 The IS-LM-PC Model: Output and Inflation

Short-run equilibrium

Top graph: A low policy rate leads to higher output.

Bottom graph: A higher output leads to a larger change in inflation.



9.1 The IS-LM-PC Model (3 of 3)

- Output gap: $Y - Y_n = L((1 - u) - (1 - u_n) = - L(u - u_n)$
- Replacing $u - u_n$ in equation (9.2) gives:

$$\pi - \pi^e = (\alpha/L)(Y - Y_n) \qquad (9.3)$$

- Assume wage setters expect inflation this year to be the same last year:

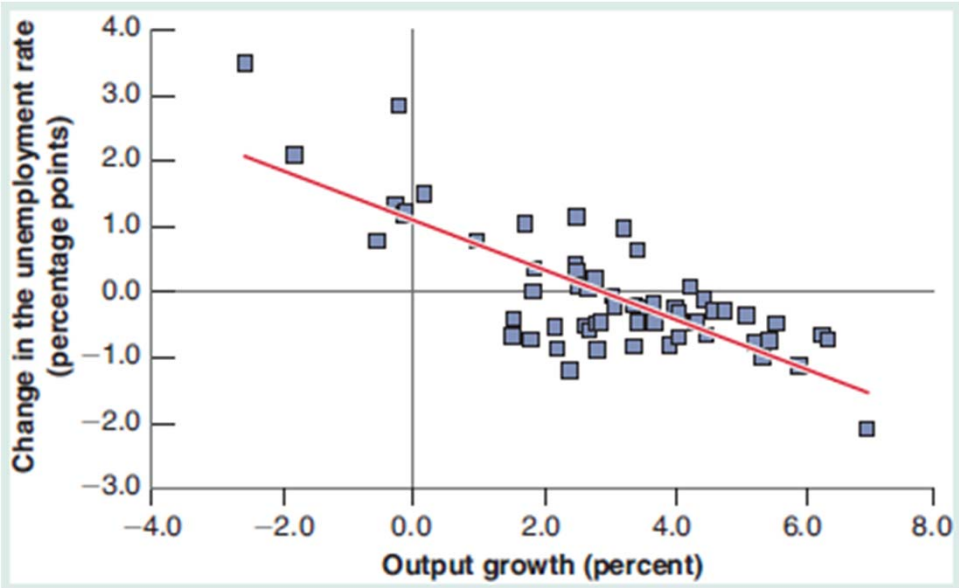
$$\pi - \pi(-1) = (\alpha/L)(Y - Y_n) \qquad (9.4)$$

- When output is above potential (positive output gap), inflation increases, and vice versa.

FOCUS: Okun's Law across Time and Countries (1 of 2)

Figure 1 Changes in the Unemployment Rate versus Output Growth in the United States, 1960–2018

High output growth is associated with a reduction in the unemployment rate; low growth is associated with an increase in the unemployment rate.



Source: FRED: *Series* GDPCA, UNRATE

FOCUS: Okun's Law across Time and Countries (2 of 2)

- Okun's law can be written as the change in the unemployment that is approximately equal to the negative of the growth rate of output:

$$u - u(-1) \approx -g_y \qquad (9\,\text{B}.1)$$

- The regression that fits the points in Figure 1 is:

$$u - u(-1) = -0.4\left(g_y - 3\%\right) \qquad (9\,\text{B}.2)$$

- Annual output growth has to be at least 3% to prevent the unemployment rate from rising.
- Output growth 1% above normal leads only to a 0.4% reduction in the unemployment rate due to such factors as labor hoarding and discouraged workers.
- The coefficient (0.4) is called the **Okun coefficient**.

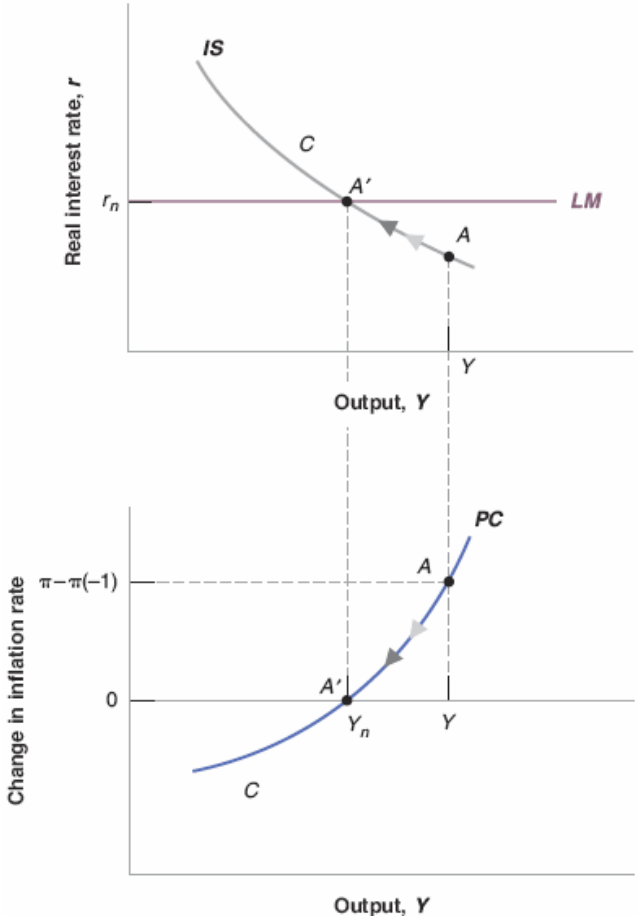
9.2 From the Short to the Medium Run (1 of 2)

Figure 9.2 Medium-Run Output and Inflation

Over the medium run, the economy converges to the natural level of output and stable inflation.

At the medium-run equilibrium (point *A*'), r_n is called the **natural**, **neutral**, or **Wicksellian rate of interest**.

If the central bank wants to achieve a constant level of inflation, then the initial boom must be followed by a recession.



9.2 From the Short to the Medium Run (2 of 2)

- In the medium run, the real variables are independent of monetary policy.
- Monetary policy determines the rate of inflation and the nominal rate of interest.
- The fact that monetary policy does not affect real variables in the medium run is referred to as the **neutrality of money**.

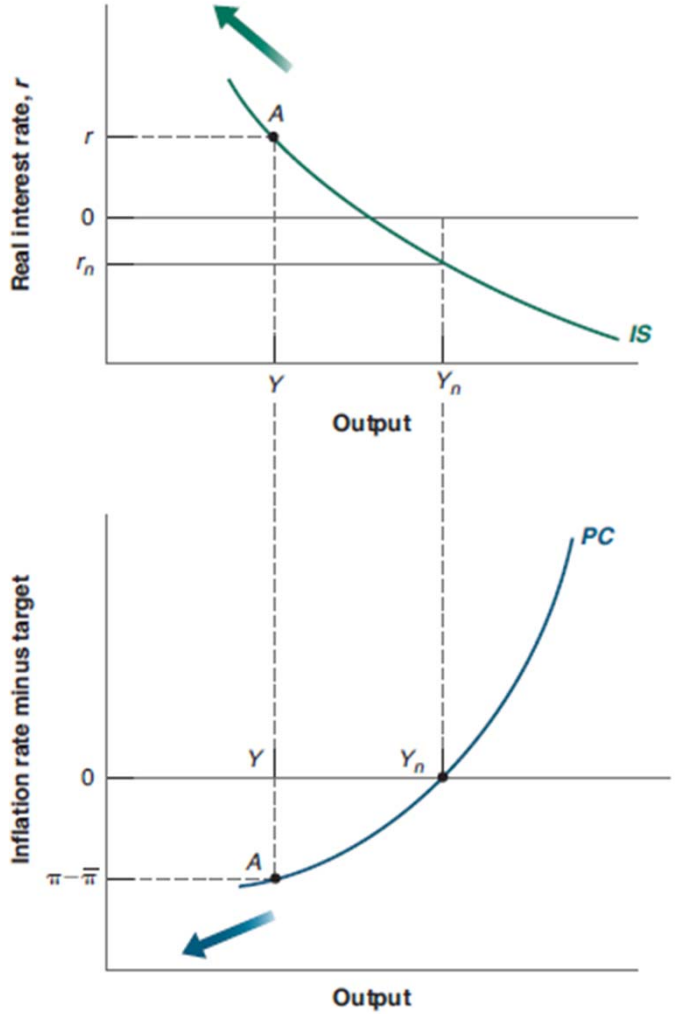
9.3 Complications and How Things Can Go Wrong (1 of 3)

- The adjustment to the medium-run equilibrium in Section 9-2 seemed smooth and easy.
- While this process looks easy to do in Figure 9-2, reality is more complicated for two reasons;
  1. It is difficult for the central bank to know where potential output is exactly and thus how far output is from potential.
  2. It takes time for the economy to respond.

9.3 Complications and How Things Can Go Wrong (2 of 3)

Figure 9.3 The Deflation Spiral

- If the zero lower bound prevents monetary policy from increasing output back to potential, the result may be a deflation spiral. More deflation leads to a higher real rate, which in turn leads to lower output and more deflation.



9.3 Complications and How Things Can Go Wrong (3 of 3)

- One issue that can occur is known as a deflation spiral.
- A **deflation spiral** or **deflation trap** results when deflation pushes real interest rates higher, lowers output, and leads to larger and larger deflation.
- This scenario played out during the Great Depression.
- The recent Great Recession gave rise to similar concerns.

FOCUS: Deflation in the Great Depression

- The economy seemed to be in a deflation trap between 1929 and 1933.
- Monetary policy decreased the nominal interest rate from 5.3% to 2.3% in 1933, but with negative inflation rates, the real rate reached 12.3% in 1931 and 7.8% in 1933.

Table 1 The Nominal Interest Rate, Inflation, and the Real Interest Rate, 1929–2033

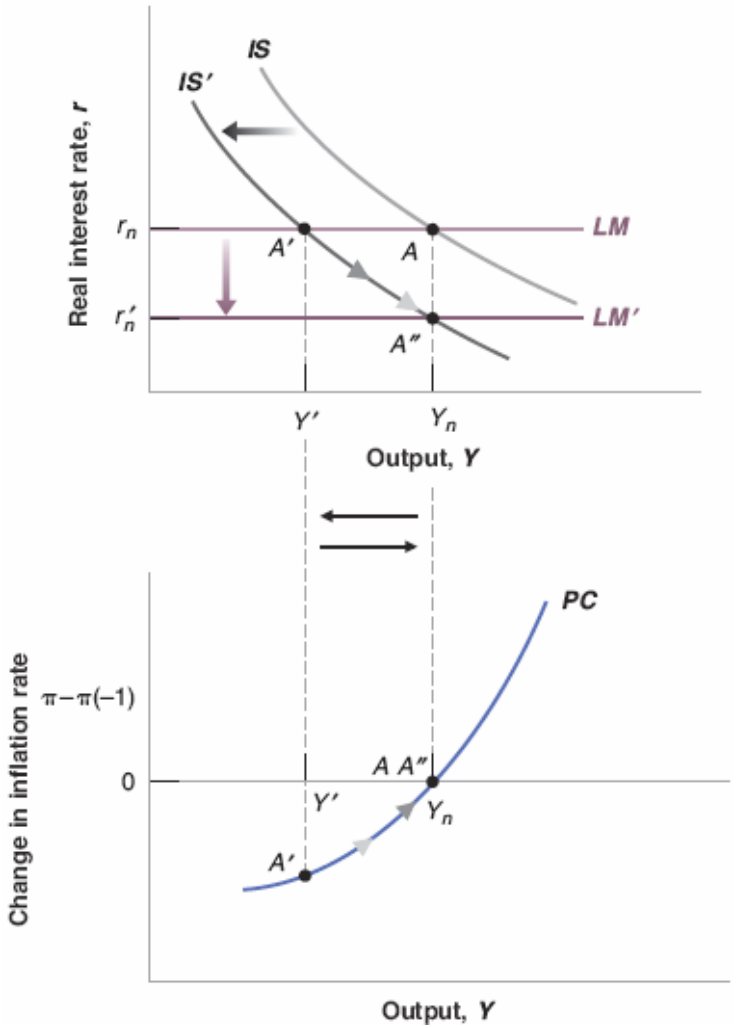
Year	Unemployment Rate (%)	Output Growth Rate (%)	One-Year Nominal Interest Rate (%), *i*	Inflation Rate (%), π	One-Year Real Interest Rate (%), *r*
1929	3.2	−9.8	5.3	0.0	5.3
1930	8.7	−7.6	4.4	−2.5	6.9
1931	15.9	−14.7	3.1	−9.2	12.3
1932	23.6	−1.8	4.0	−10.8	14.8
1933	24.9	9.1	2.6	−5.2	7.8

9.4 Fiscal Consolidation Revisited

Figure 9.4 Fiscal Consolidation in the Short and the Medium Run

Fiscal consolidation leads to a decrease in output in the short run.

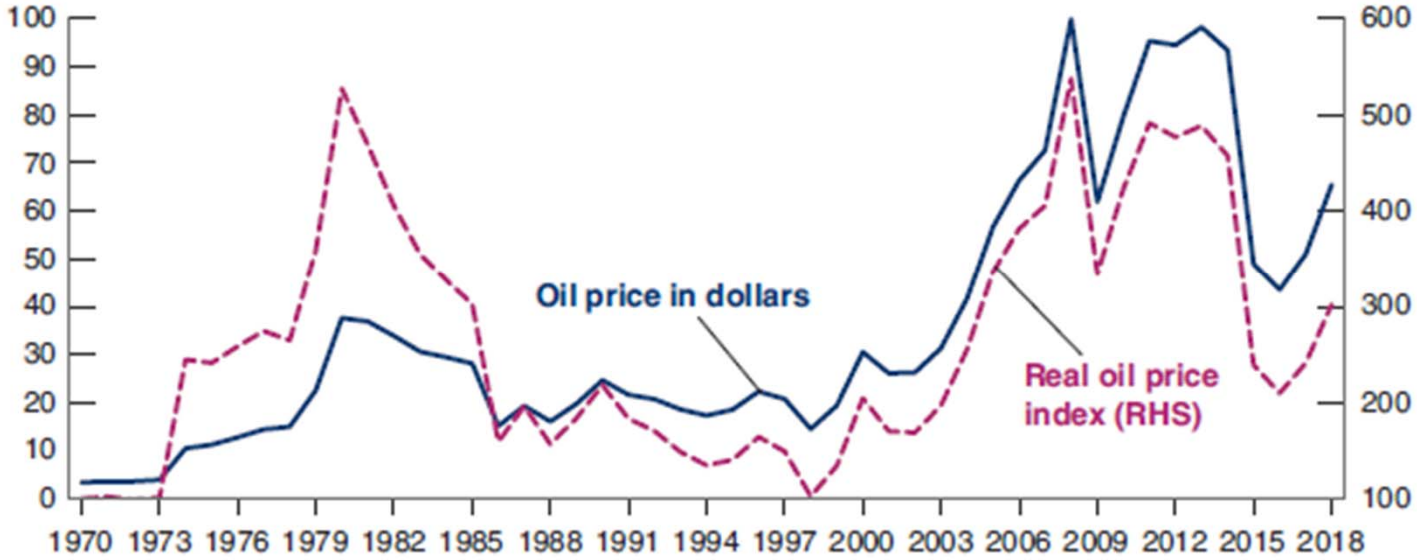
In the medium run, output returns to potential, and the interest rate is lower.



9.5 The Effects of an Increase in the Price of Oil (1 of 4)

Figure 9.5 The Nominal and the Real Price of Oil, 1970–2018

Over the last 40 years, there have been two sharp increases in the real price of oil, the first in the 1970s and the second in the 2000s.



- *Source:* FRED: OILPRICE, CPIAUSCL. Left vertical axis: nominal price of oil, dollars per

9.5 The Effects of an Increase in the Price of Oil (2 of 4)

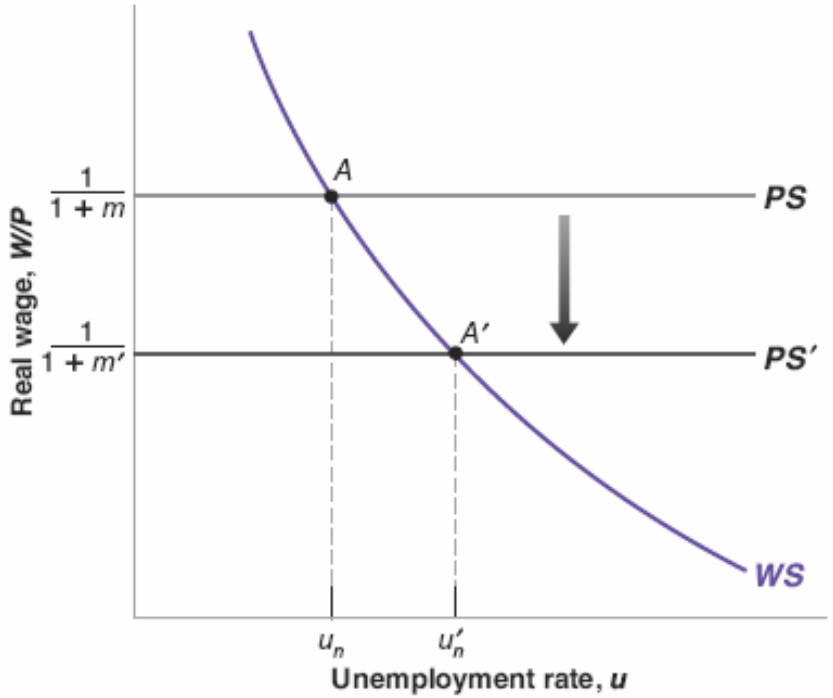
- 1970s: OPEC (the Organization of Petroleum Exporting Countries) act as a monopoly and increased oil prices.
- 2000s: The fast growth of emerging economies led a rapid increase in world oil demand, and thus a steady increase in real oil prices.
- 2008: A large recession led to a sudden decrease in the demand for oil, and thus falling oil prices.
- 2014 and after: A combination of increased supply due to the increase in U.S. shale oil production and the partial breakdown of OPEC led to sudden drop in oil prices.

9.5 The Effects of an Increase in the Price of Oil (3 of 4)

Figure 9.6 The Effects of an Increase in the Price of Oil on the Natural Rate of Unemployment

An increase in the price of oil is equivalent to an *increase in the markup*.

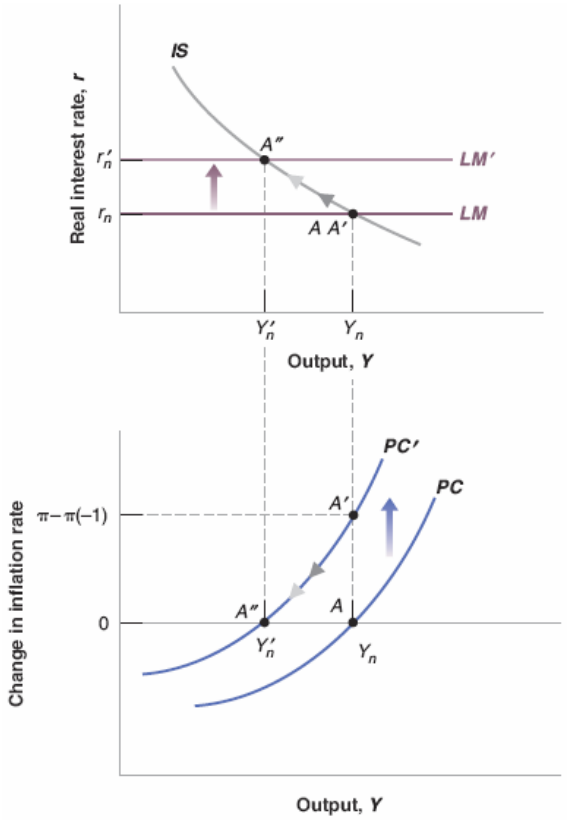
It leads to lower real wages and a higher natural rate of unemployment.



9.5 The Effects of an Increase in the Price of Oil (4 of 4)

Figure 9.7 Short- and Medium-Run Effects of an Increase in the Price of Oil

- In the short run, an increase in the price of oil leads to higher inflation. If the price increase is permanent, it leads to lower output in the medium run.
- **Stagflation** (lower output and higher inflation) occurs along the way.

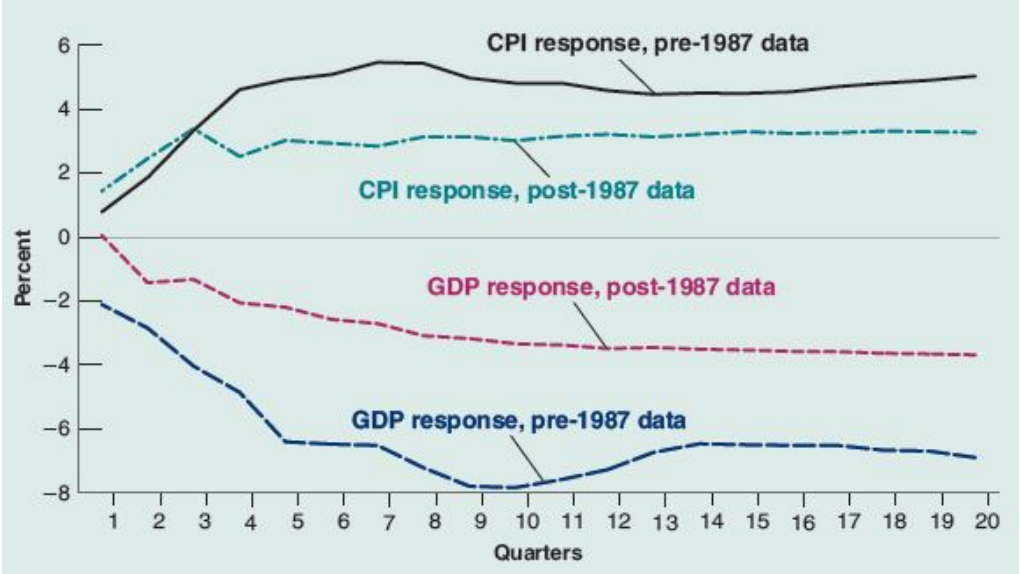


FOCUS: Oil Price Increases: Why Were the 2000s So Different from the 1970s?

Figure 1 The Effects of a 100% Permanent Increase in the Price of Oil on the C PI and on GDP

The effects of an increase in the price of oil on output and the price level are smaller than they used to be.

Plausible explanations include U.S. workers' lower bargaining power, and inflation that was more anchored by monetary policy.



9.6 Conclusions

- Shocks or changes in policy typically have different effects in the short run and in the medium run.
- Disagreements about the effects of various policies depend on how fast you think the economy adjusts to shocks.
- Movements in output around its trend are called **output fluctuations** (**business cycles**).
- **Economic fluctuations** are the results of shocks and their dynamic effects, called the **propagation mechanism**.