

Lecture 8: From the Short to the Medium Run: The IS-LM-PC Model

Intermediate Macroeconomics, Econ 102

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Outline

- This closing lecture puts the short run and the medium run together. (or attempts to) The resulting IS-LM-PC (PC for Phillips curve) model is meant to characterize the behavior of output **both in the short run and the medium run**.
- Although it has problems and limitations, the **inflation-unemployment trade-off framework** is used by central banks around the world. (at least in their research departments)
- In 1977, Congress amended the Federal Reserve Act, directing the Board of Governors of the Federal Reserve System and the Federal Open Market Committee to “maintain long run growth of the monetary and credit aggregates commensurate with the economy’s long run potential to **increase production**, so as to promote effectively the goals of **maximum employment, stable prices** and moderate long-term interest rates.”
- The first 2 objectives are sometimes referred to as the dual mandate.

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- 1 The IS-LM-PC Model
- 2 Dynamics and the Medium Run Equilibrium
- 3 Fiscal Consolidation Revisited
- 4 The Effects of an Increase in the Price of Oil
- 5 Conclusions

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The IS-LM-PC Model

- Remember the equation for the (IS) curve:

$$Y = C(Y - T) + I(Y, r + x) + G.$$

- In the short-run, output is indeed demand determined.
- In the previous lecture, we saw that the relation between inflation and unemployment is called the Phillips curve:

$$\pi - \pi^e = -\alpha(u - u_n).$$

- This reflects that:
 - ▶ When the unemployment rate is lower than the natural rate of unemployment, inflation turns out to be higher than expected.
 - ▶ Conversely, when the unemployment rate is higher than the natural rate of unemployment, inflation turns out to be lower than expected.
- One relationship is written in terms of output, the other in terms of unemployment. How do we connect the two?

The IS-LM-PC Model

- By definition, the unemployment rate is equal to unemployment divided by the labor force:

$$u \equiv \frac{U}{L} = \frac{L - N}{L} = 1 - \frac{N}{L} \quad \Rightarrow \quad N = L(1 - u).$$

- Turning to output, we shall maintain for the moment the simplifying assumption that output is simply equal to employment, and therefore:

$$Y = N = L(1 - u).$$

- When the unemployment rate is equal to the natural rate u_n , employment is given by $N_n = L(1 - u_n)$ and output is equal to

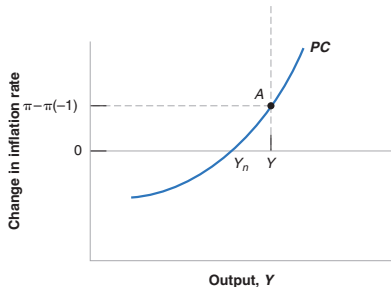
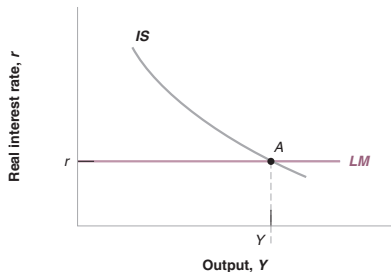
$$\boxed{Y_n = L(1 - u_n)}.$$
 This is called **potential output**.

- It follows that the deviation of employment from its natural level is:

$$N - N_n = Y - Y_n = L((1 - u) - (1 - u_n)) = -L(u - u_n).$$

- The difference between output and potential output is called the **output gap**.

The IS-LM-PC Model



- The first panel shows that a **lower policy rate** leads to a **higher output**, through the (IS) relation: a lower interest rate stimulates **investment** (and remember, probably consumption through intertemporal substitution and redistributive effects from borrowers to lenders, who have a higher MPC).
- The second panel shows that a higher output leads to a larger change in inflation.
- When monetary policy is more expansionary, output is stimulated, but inflation increases. (the economy is “overheating”)

The IS-LM-PC Model

- Thus, we have an expression for the output gap on the one hand:

$$Y - Y_n = -L(u - u_n)$$

- On the other hand, we have an expression for inflation, given by the Phillips Curve:

$$\pi - \pi^e = -\alpha(u - u_n)$$

- Replacing $u - u_n$ out gives:

$$\pi - \pi^e = \frac{\alpha}{L}(Y - Y_n)$$

- If we assume that wage setters expect inflation this year to be the same last year, then $\pi^e = \pi(-1)$:

$$\pi - \pi(-1) = \frac{\alpha}{L}(Y - Y_n).$$

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

Okun's Law

- How does the relation between output and unemployment we have derived in the text relate to the empirical relation between the two, known as Okun's law (and which Olivier Blanchard also discussed in Chapter 2)?
- The relation that we wrote in the text can be written as:

$$u - u(-1) \approx -g_Y$$

in other words: the change in the unemployment rate is approximately equal to the negative of the growth rate of output (g_Y).

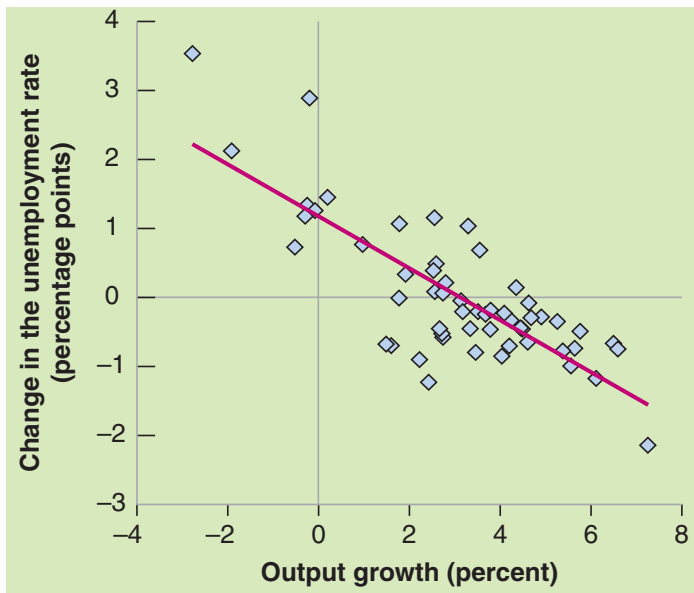
- How do we get that expression? We have that:

$$g_N = \frac{N - N(-1)}{N(-1)} = -\frac{L}{N(-1)} (u - u(-1))$$

- Therefore, approximating the ratio of the labor force to employment by one, we have:

$$\frac{L}{N(-1)} \approx 1 \quad \Rightarrow \quad g_Y = g_N \approx -(u - u(-1)).$$

Okun's Law



Okun's Law

- Compare the theoretical relation:

$$u - u(-1) \approx -g_Y$$

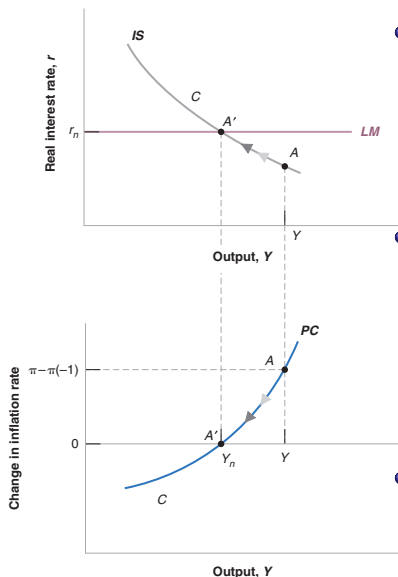
with the regression line that fits the points the previous Figure, whose equation is:

$$u - u(-1) = -0.4(g_Y - 3\%)$$

- 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. Why the discrepancy between the theory and empirics?
 - ▶ labor hoarding.
 - ▶ discouraged workers.
- The coefficient (0.4) is called the **Okun coefficient**.

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Medium-Run Output and Inflation



- Previously the interest rate was “too low”, with $Y > Y_n$ and $\pi - \pi(-1) > 0$. The economy was said to be “overheating”, putting pressure on inflation. This is the short run.
- 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.

The Role of Expectations Revisited

- Instead of assuming that expected inflation is equal to last year's inflation, $\pi(-1)$, let us assume instead that people think that inflation will be equal to some constant, $\bar{\pi}$, irrespective of what inflation was last year.

- The Phillips Curve is then given by:

$$\pi - \bar{\pi} = -\alpha(u - u_n).$$

- When the output gap is still:

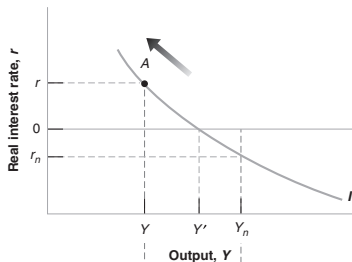
$$Y - Y_n = -L(u - u_n).$$

- Then the previous equation becomes:

$$\pi - \bar{\pi} = \frac{\alpha}{L}(Y - Y_n).$$

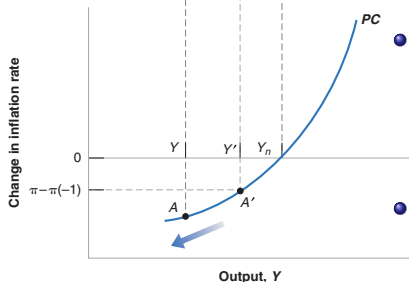
- A positive output gap generates a **higher level of inflation**, rather than an **increase in inflation**. So long as inflation **expectations** remain **anchored**, the central bank does not need to compensate for the initial boom by a recession later.

The Deflation Spiral



- Imagine that we are at point A : the economy is in a recession. At the current policy rate r , output is equal to Y , which is far below Y_n .

- The zero lower bound constraint may make it impossible to achieve a negative real policy rate.



- Deflation spiral or deflation trap** occurs at Y' when output is still below potential, and thus inflation is still decreasing.
- Lower output leads to more deflation, and more deflation leads to a higher real interest rate and lower output.

Deflation in the Great Depression

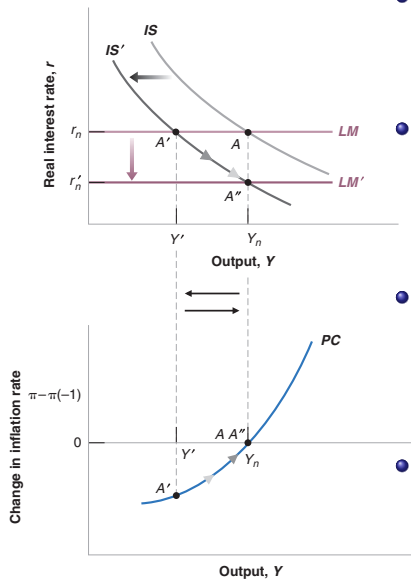
- Deflation is not just a theoretical concern. The US economy was in a deflation trap between 1929 and 1933.
- Monetary policy decreased the nominal interest rate from 5.3% to 2.3% in 1933, but with negative inflation rates, the real rate reached 12.3% in 1931 and 7.8% in 1933.
- Starting in 1934, however, inflation came back. Why, despite a high unemployment rate, the U.S. economy was able to avoid further deflation remains a hotly debated issue.

Table 1 The Nominal Interest Rate, Inflation, and the Real Interest Rate, 1929–1933

| 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 |

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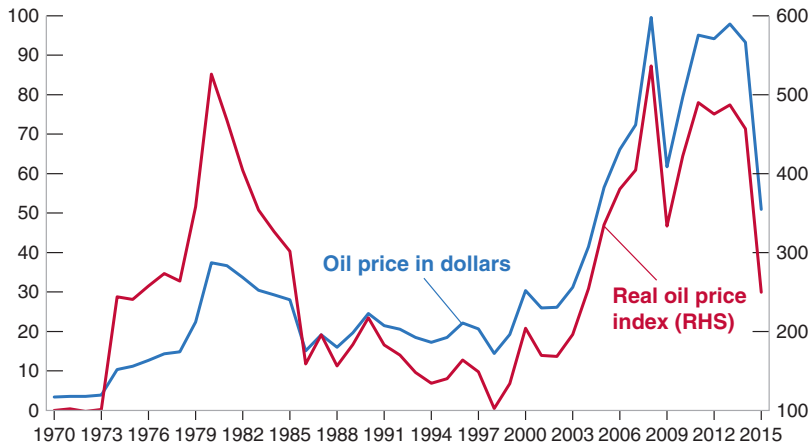
Fiscal Consolidation Revisited



- Now we can look not only at the short-run effects of a fiscal consolidation but also at its medium-run effects.
- Start with an economy at potential at point A . The first panel shows that a fiscal consolidation leads to a decrease in output in the short run.
- As output is too low, and inflation is decreasing, the central bank is likely to react and decrease the policy rate until output is back to potential.
- In the medium run, output returns to potential, and the policy rate needed to maintain output at potential is now $r'_n < r_n$.

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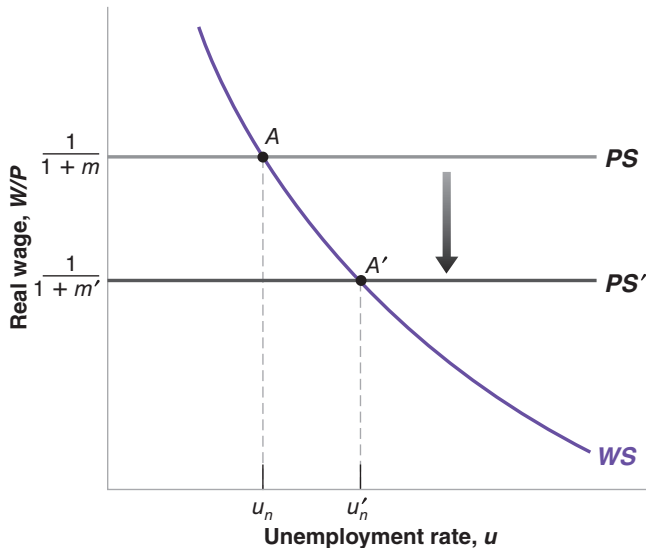
The Nominal and the Real Price of Oil, 1970–2015



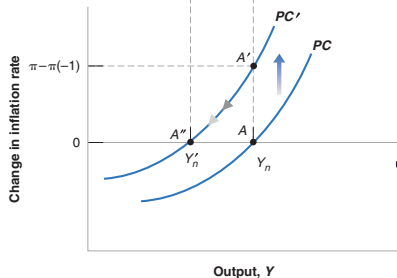
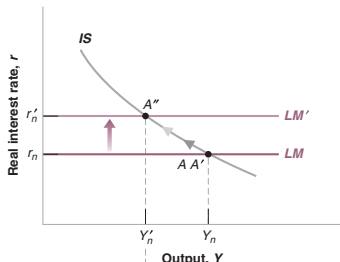
The Effects of an Increase in the Price of Oil

- There are large variations in the price of oil over time (nominal and real).
- 4 episodes are particularly salient:
 - ① **1970s:** OPEC (the Organization of Petroleum Exporting Countries) acted as a monopoly and increased oil prices.
 - ② **2000s:** The fast growth of emerging economies led to a rapid increase in world oil demand, and thus a steady increase in real oil prices.
 - ③ **2008:** A large recession led to a sudden decrease in the demand for oil, and thus falling oil prices.
 - ④ **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.
- An increase in the price of oil will be modelled as an increase in m : given wages, an increase in the price of oil increases the cost of production, forcing firms to increase prices to maintain the same profit rate. This changes the natural rate of unemployment which increases: $u'_n > u_n$.

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



The Effects of an Increase in the Price of Oil



- An oil shock thus moves the (PC) curve instead of the (IS) curve.
- An increase in the price of oil leads to a decrease in potential output: for a given change in inflation, there is now a lower $Y'_n < Y_n$.
- If A' is the short-run equilibrium, then if the central bank increases the policy rate to stabilize inflation, then the economy moves to its medium-run equilibrium at point A''.
- Note that along the way, lower output is associated with higher inflation, a combination that economists call **stagflation**.

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Conclusions

- One key message of this lecture was that 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.
- In general, these first 8 lectures gave you a general way of thinking about output fluctuations. Economic fluctuations are typically the results of shocks and of the propagation mechanism, which determine their dynamic effects. These shocks had different sources:
 - ▶ 1970s : increases in the price of oil.
 - ▶ early 1980s: sharp contraction in money.
 - ▶ early 1990s: sudden decline in consumer confidence.
 - ▶ 2001: sharp drop in investment spending.
 - ▶ Recent crisis: problems in the housing market.
- The Phillips Curve is under scrutiny. Yet the basic IS-LM logic and the idea that **in the short and medium run, output is demand determined**, remains useful to think about the most salient macroeconomic events.

Suggested Readings / Exercises

👉 Chapter 9, *Macroeconomics*, 7th Edition, Olivier Blanchard.

☆☆ Exercise 3, 4 Chapter 9, pages 194-195, *Macroeconomics*, 7th Edition, Olivier Blanchard.

☆ Exercise 7, 9, Chapter 9, pages 195-196, *Macroeconomics*, 7th Edition, Olivier Blanchard.

Chapter 24, *Macroeconomics*, 7th Edition, Olivier Blanchard.

How to Teach Intermediate Macroeconomics after the Crisis?, Olivier Blanchard, June 2, 2016. [Link](#)

📖 Krugman, Paul. “Good Enough for Government Work? Macroeconomics since the Crisis.” *Oxford Review of Economic Policy* 34, no. 1–2 (January 5, 2018): 156–68. [Link](#)

📖 Blanchard, Olivier, Eugenio Cerutti, and Lawrence Summers. “Inflation and Activity – Two Explorations and Their Monetary Policy Implications.” Working Paper. National Bureau of Economic Research, November 2015. [Link](#)

Larry Summers: Advanced economies are so sick we need a new way to think about them, *The Washington Post*, November 3, 2015. [Link](#)