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

Intermediate Macroeconomics, Econ 102

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Where are we?

- During lectures 2 to 5, we looked at the equilibrium in the goods and financial markets, and how output is determined **in the short run**:
  - Lecture 2: The Goods Markets
  - Lecture 3: Financial Markets
  - Lecture 4: The IS-LM Model
  - Lecture 5: Financial Markets, Aggregate Demand and the Crisis
- During lectures 6 and 7, we started looking at what happens **in the medium run**:
  - Lecture 6: The Labor Market
  - Lecture 7: The Phillips Curve
- This closing lecture puts the two parts 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 its problems and limitations, the **inflation-unemployment trade-off** framework is used by central banks around the world.

Outline

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:

$$\boxed{Y = C(Y-T) + I(Y, r+x) + G}.$$

- 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:

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

- This reflects that:
    - When the unemployment rate is lower than the natural rate, inflation turns out to be higher than expected.
    - If the unemployment is higher than the natural rate, inflation turns out to be lower than expected.
- One relationship is written in terms of output, the other in terms of unemployment.

The IS-LM-PC Model

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

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

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

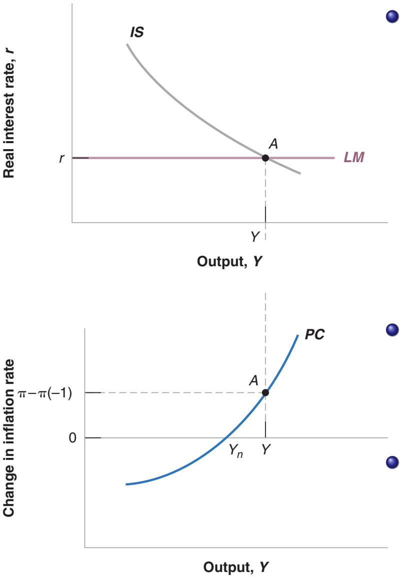
$$Y = N = L(1-u).$$

- When the unemployment rate is equal to the natural rate u_n, employment is given by $N_n = L\left(1-u_n\right)$ and output is equal to $Y_n = L\left(1-u_n\right)$. This is called **potential output**.
- It follows that we may express the deviation of employment from its natural level as:

$$Y - Y_n = L\left(\left(1-u\right) - \left(1-u_n\right)\right) = -L\left(u-u_n\right).$$

- 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 gao on the one hand:

$$Y - Y_n = -L\left(u - u_n\right)$$

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

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

.

- Replacing $u - u_n$ out gives:

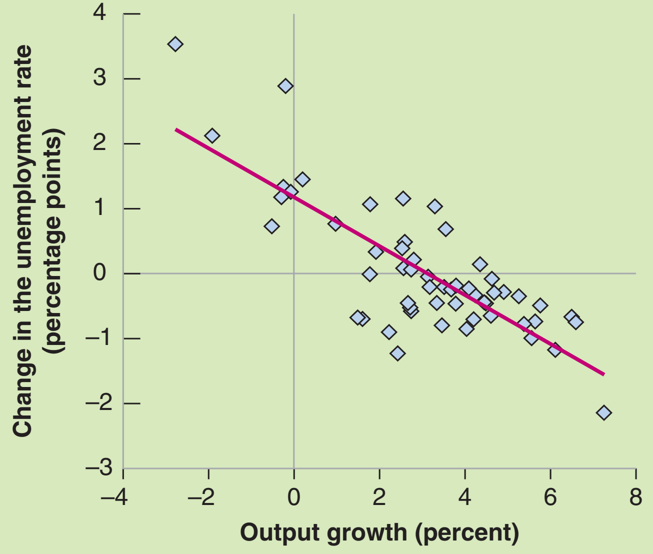
$$\pi - \pi^e = \frac{\alpha}{L}\left(Y - Y_n\right)$$

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

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

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

Okun's Law


Change in the unemployment rate (percentage points)
4
3
2
1
0
–1
–2
–3
–4
–2
0
2
4
6
8
Output growth (percent)

Okun's Law

- 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:

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

- The regression that fits the points the previous Figure is:

$$u - u(-1) = -0.4\,(g_x - 3\%)$$

- 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** due to such factors as **labor hoarding** and **discouraged workers.**
- The coefficient (0.4) is called the **Okun coefficient**.

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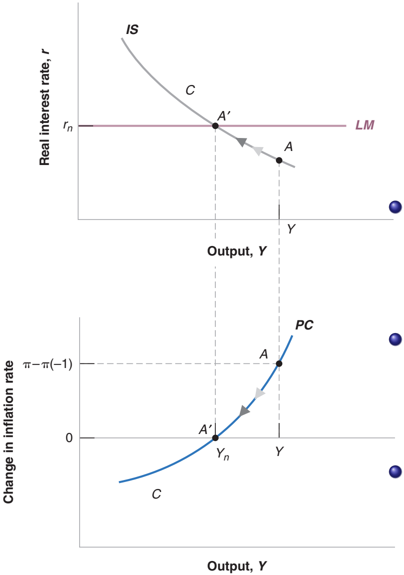
Medium-Run Output and Inflation



- 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.

Dynamics and the Medium Run Equilibrium

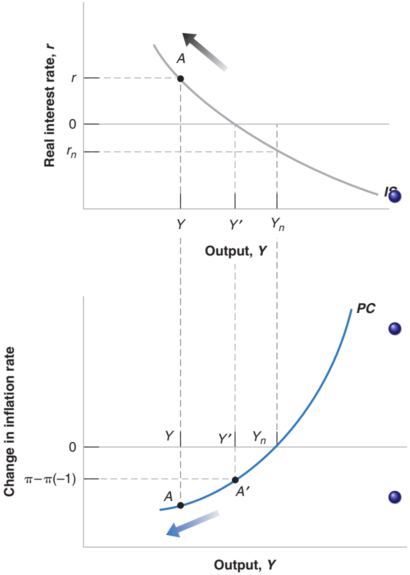
- Assume instead that the expected inflation rate is a constant, then the previous equation becomes:

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

- 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


Real interest rate, r
r
0
r_n
A
IS
Y
Y′
Y_n
Output, Y
Change in inflation rate
PC
0
π−π(−1)
Y
Y′
Y_n
A′
A
Output, Y

- 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

- 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.

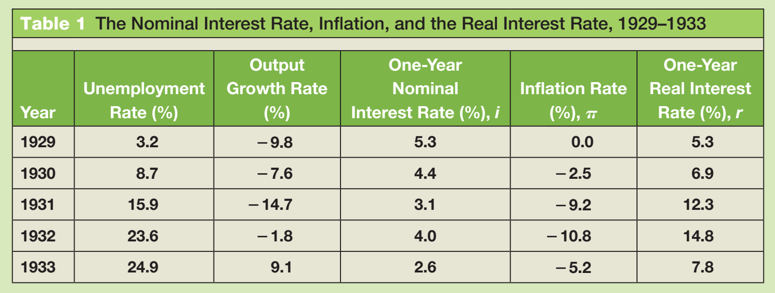


Table 1 The Nominal Interest Rate, Inflation, and the Real Interest Rate, 1929–1933

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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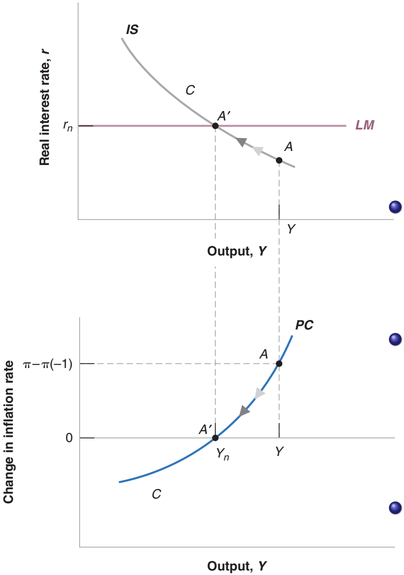
Fiscal Consolidation Revisited



- 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 however, output returns to potential, and the interest rate is lower.

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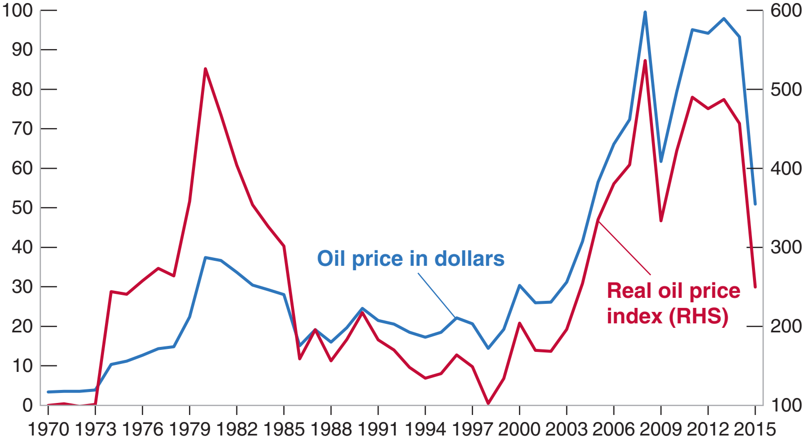
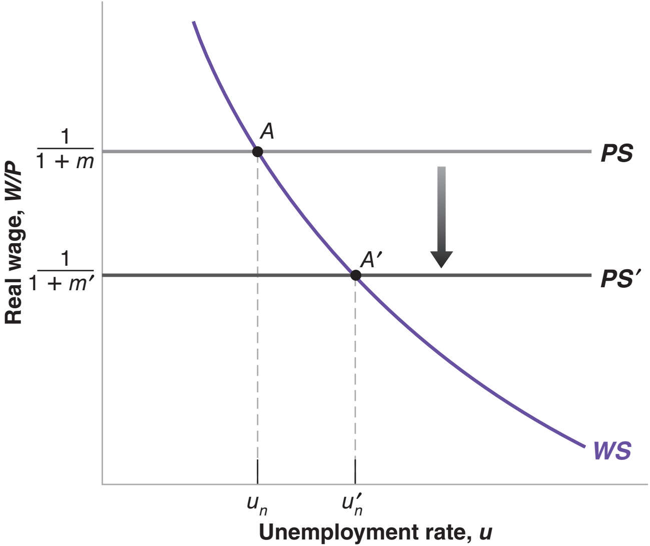
The Nominal and the Real Price of Oil, 1970–2015



The Effects of an Increase in the Price of Oil

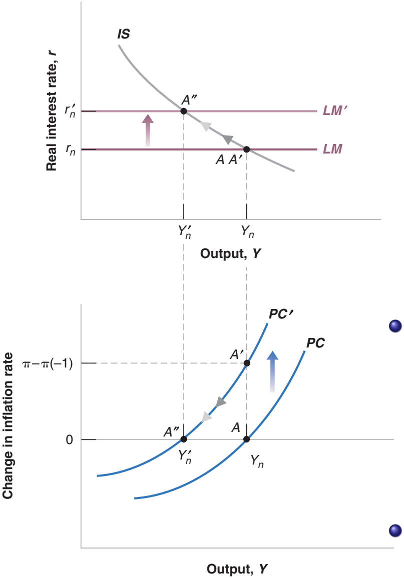
- **1970s**: OPEC (the Organization of Petroleum Exporting Countries) act as a monopoly and increased oil prices.
- **2000s**: The fast growth of emerging economies led a rapid increase in world oil demand, and thus a steady increase in real oil prices.
- **2008**: A large recession led to a sudden decrease 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.

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



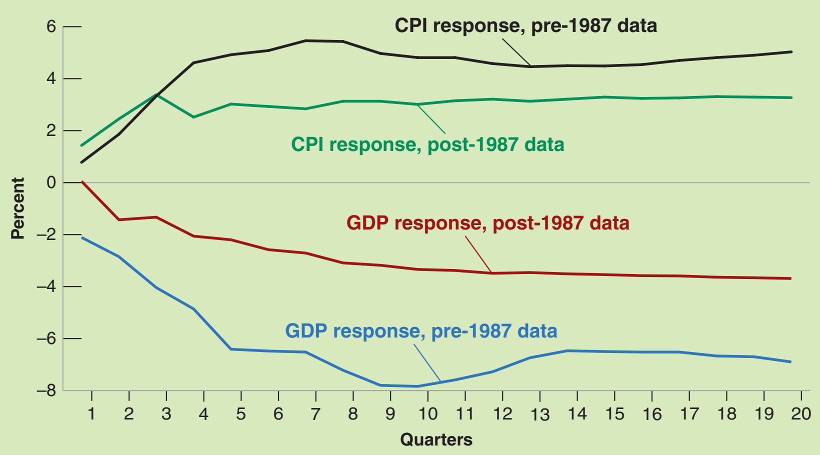
Real wage, W/P
$\frac{1}{1+m}$
$\frac{1}{1+m'}$
A
A'
PS
PS'
WS
u_n
u'_n
Unemployment rate, u

The Effects of an Increase in the Price of Oil



- 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''.
- **Stagflation** (lower output and higher inflation) occurs along the way.

The Effects of a 100% Permanent Increase in the Price of Oil on the CPI and on GDP



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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**.