The IS-LM-PC model: Introduction

EC 235 | Fall 2023

Materials

Required readings:

- Blanchard, ch. 9.

Prologue

Prologue

The IS-LM model provided a comprehensive analysis of equilibrium in *goods* and *financial* markets, as well as the effects of *monetary* and *fiscal* policies to interest rates and aggregate income.

Then, moving on to the *labor market* and *inflation* lectures, we were able to study how the *state of unemployment* may affect the *price level*, through the *Phillips curve*.

That said, we can move on to a model where these components are put together: the IS-LM-PC model.

But first, we need some basic (re-)definitions.

Inflation

Inflation

When the inflation rate is *not* stable over time, how economic agents form their *expectations* becomes a *crucial* factor in wage- and price-setting behavior.

Recall:

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

- What is expected inflation when $\theta = 0$?
- What is expected inflation when $\theta = 1$?

Inflation

In either case, the *natural rate of unemployment* (u_n) is the unemployment rate such that actual inflation is equal to expected inflation.

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

$$0 = (m + z) - \alpha u_t$$

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

Inflation

From the previous expression, we can re-write the Phillips curve:

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

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

Inflation

And since $u_n = \dfrac{(m+z)}{\alpha}$,

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

- The above version of the Phillips curve states that, whenever actual unemployment is *below* its natural level, inflation will be *higher* than expected.

- Similarly, if actual unemployment is *at its natural level*, inflation will be *equal* to its expected rate.

The IS relation

The IS relation

When studying the IS-LM model, we defined the equilibrium condition in the goods market as:

$$Y = Z = C(Y_D) + I(Y, i) + G$$

And now, since we have already incorporated (expected) inflation into our analysis, we may think about interest rates in *real* terms.

We can define the *real interest rate*, *r*, as:

$$r \approx i - \pi_{t+1}^e$$

The IS relation

Again:

$$r \approx i - \pi_{t+1}^{e}$$

In words, the *real interest rate* is (approximately) equal to the *nominal interest rate minus expected inflation*.

A few implications:

- When expected inflation equals *zero*, the nominal and the real interest rates are *equal*;
- Because expected inflation is typically *positive*, the real interest rate is typically *lower* than the nominal interest rate;
- For a given nominal interest rate, the *higher* the expected rate of inflation, the *lower* the real interest rate.

The IS relation

That said, we may re-write the equilibrium condition in the goods market as:

$$Y = Z = C(Y_D) + I(Y, r) + G$$

$$Y = Z = C(Y_D) + I(Y, i - \pi^e_{t+1}) + G$$

The PC curve

The PC curve

The IS-LM model took place in a *(Y, i)* two-dimensional space.

If we wish to incorporate the Phillips curve into the analysis, at least one of the axes must match with the IS-LM model's.

Therefore, let us try to express the Phillips curve in terms of *inflation* (π) and *output* (Y).

The PC curve

First, by definition, the unemployment rate (u) is equal to unemployment (U) divided by the labor force (L):

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

where N is the number of employed individuals.

Solving for N:

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

The PC curve

Still assuming an aggregate production function $Y = A \cdot N$, with $A = 1$, we may write:

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

And if we consider the *natural rate of unemployment*, u_n, we may write an expression for the *natural level of output* (i.e., *potential output*), Y_n:

$$Y_n = N = L(1 - u_n)$$

The PC curve

We are now able to write an expression for the *output gap*:

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

Using our latest Phillips curve (and dropping time indexes):

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

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

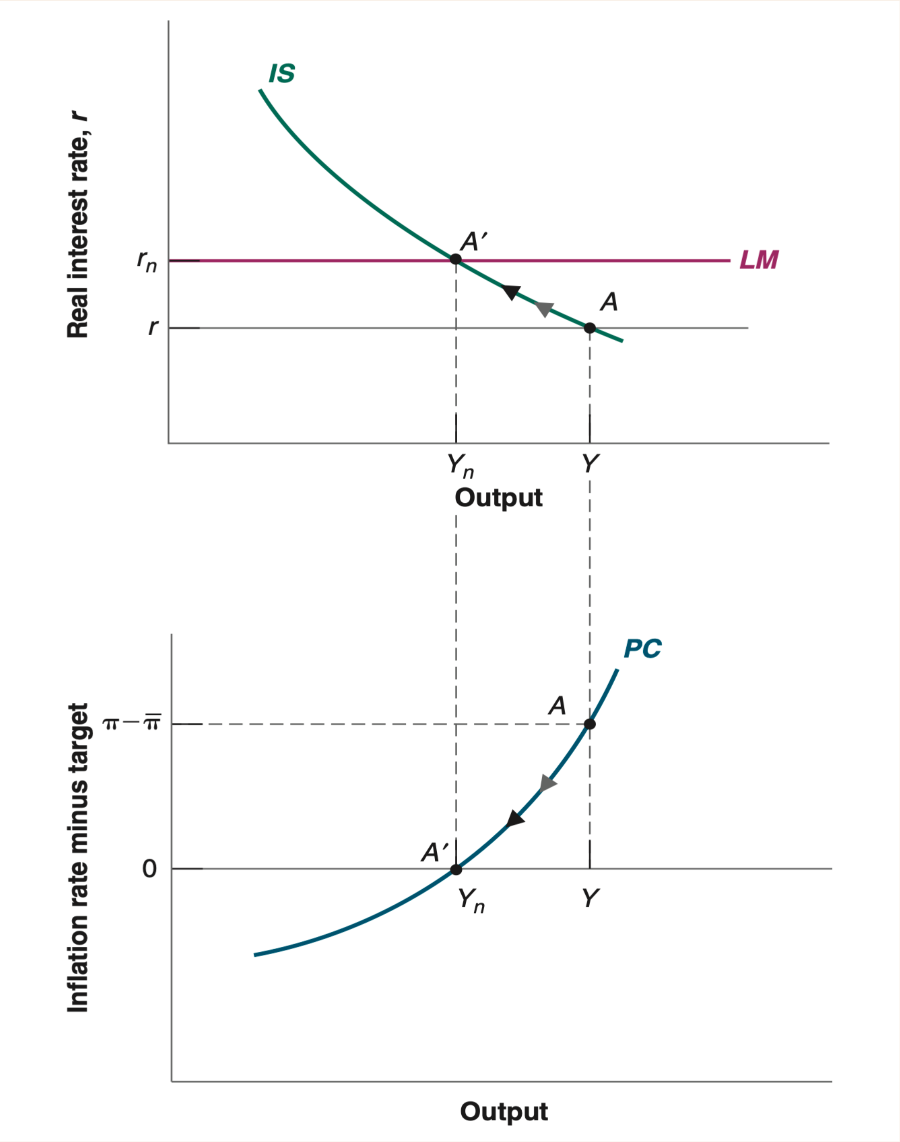
The PC curve

And if expectations are well-anchored, expected inflation will be equal to the target set by the monetary authority (e.g., 2% in the United States):

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

And here we have an equation relating *inflation* and *output*.

The PC curve


IS
LM
A′
A
r_n
r
Real interest rate, r
Y_n
Y
Output
PC
A
A′
$\pi - \overline{\pi}$
0
Y_n
Y
Inflation rate minus target
Output