Macroeconomics Lecture 9

SGPE Summer School

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Introduction

Plan

- In the IS-LM model, we assumed that prices were given in the short run
- But prices are not constant. We need a theory for how wages and prices adjust in the short run
- In the long run, production and employment should go back to the equilibrium levels found in Lectures 2 and 6
- Analysis of wage and price adjustment ties the short and the long run together

Questions

- What factors determine short run wage and price adjustment?
- Is there a choice between low inflation and low unemployment?

Phillips Curve

Wage Adjustment

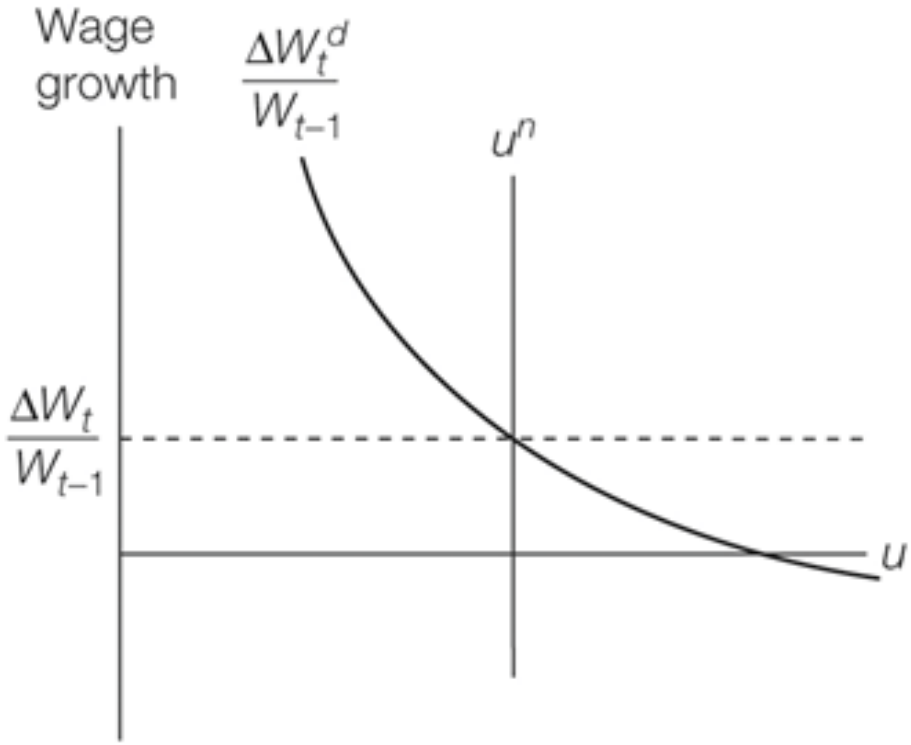
The wage-setting equation:

$$\frac{\Delta W^d}{W_{t-1}} = \frac{\Delta W_t}{W_{t-1}} - b(u_t - u^n)$$

If unemployment is lower (higher) than the equilibrium level, companies want to raise wages more (less) than the average rate of wage growth

Wage setting

Fig. 9.1 *The wage-setting rule*



Wage setting

Wage-setting in the short run:

- Share $1 - \lambda$ of companies set wages W^r at the end of the previous year
- Share λ of companies that have flexible wages:W^x
- Average rate of wage increase in the economy:

$$\frac{\Delta W_t}{W_{t-1}} = \lambda \frac{W_t^x}{W_{t-1}} + (1 - \lambda) \frac{\Delta W_t^r}{W_{t-1}}$$

Wage setting

• Wage-setting in companies that can adjust wages (these firms set their desired wages):

$$\frac{\Delta W_t^x}{W_{t-1}} = \frac{\Delta W_t}{W_{t-1}} - b(u_t - u^n)$$

• Wage-setting in companies that cannot adjust wages (these firms set wages based on their expectations about average wage development):

$$\frac{\Delta W_t^r}{W_{t-1}} = \frac{\Delta W_t^e}{W_{t-1}}$$

The Phillips Curve

Average rate of wage increase in the economy:

$$\frac{\Delta W_t}{W - t_1} = \lambda \frac{\Delta W_t^x}{W_{t-1}} (1-\lambda) \frac{\Delta W_t^r}{W_{t-1}} = \lambda [\frac{\Delta W_t}{W_{t-1}} - b(u_t - u^n)] + (1-\lambda) \frac{\Delta W_t^e}{W_{t-1}}$$

$$\implies \frac{\Delta W_t}{W_{t-1}} (1-\lambda) = (1-\lambda) \frac{\Delta W_t^e}{W_{t-1}} - \lambda b (u_t - u^n)$$

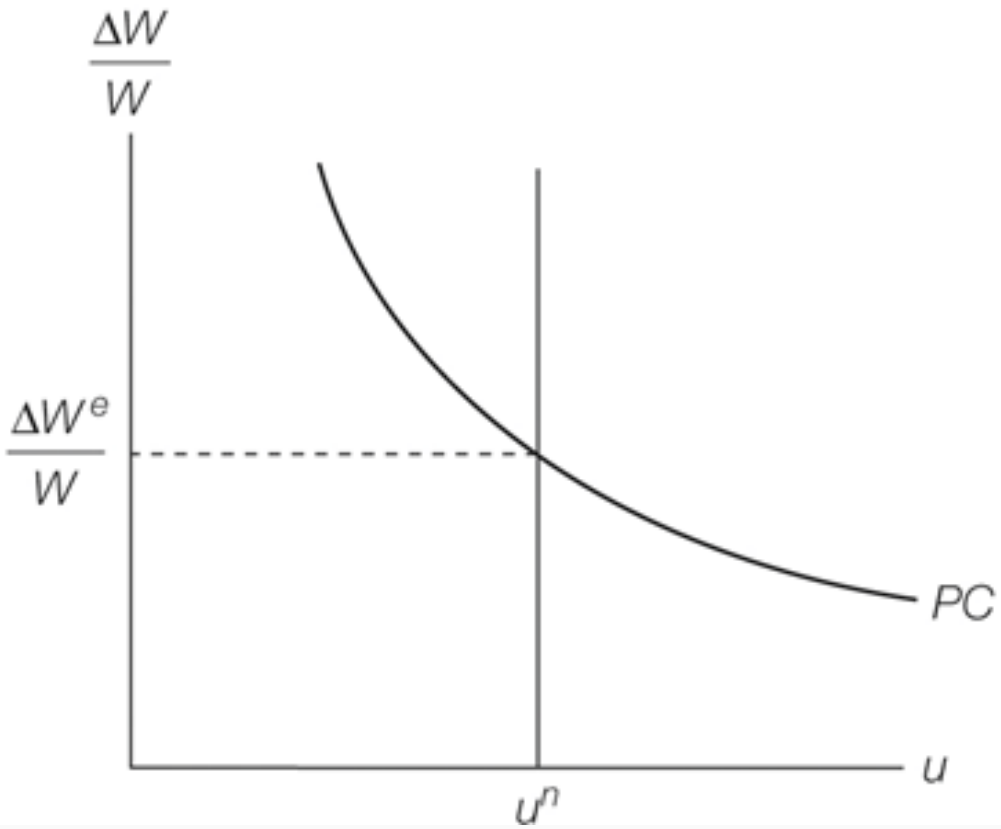
$$\implies \frac{\Delta W_t}{W_{t-1}} = \frac{\Delta W_t^e}{W_{t-1}} - \frac{\lambda b}{1-\lambda} (u^t - u^n)$$

$$\implies \frac{\Delta W_t}{W_{t-1}} = \frac{\Delta W_t^e}{W_{t-1}} - \hat{b} (u^t - u^n)$$

where $\hat{b} = \frac{\lambda b}{(1-\lambda)}$ is called the Phillips curve.

The Phillips Curve

Fig. 9.2 *The Phillips curve in terms of unemployment and wage inflation*



Parameters of PC

The slope of the Phillips curve is determined by:

- The parameter b

How much unemployment influences the company's wage-setting decisions

- The parameter λ

What percentage of companies can adjust wages freely

If b and λ are large, the Phillips curve has a steep slope and vice-versa

Inflation revisited

Definition of inflation: $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$

To analyze short run wage and price adjustment, we simplify the production function and set $\alpha = 0$:

$$Y = EN \implies MPL = APL = \frac{Y}{N} = E$$

Price setting: $P = (1+\mu)MC = (1+\mu)\frac{W}{MPL} = (1+\mu)\frac{W}{E}$

Inflation: $\pi = \frac{\Delta W}{W} - \frac{\Delta E}{E}$

Expected inflation: $\pi^e = \frac{\Delta W^e}{W} - \frac{\Delta E^e}{E}$

Another Phillips Curve

We can write the Phillips curve in terms of unemployment and price inflation:

$$\pi = \frac{\Delta W}{W} - \frac{\Delta E}{E} = \frac{\Delta W^e}{W} - \hat{b}(u - u^n) - \frac{\Delta E}{E}$$

$$\pi = \pi^e + \frac{\Delta E^e}{E} - \hat{b}(u - u^n) - \frac{\Delta E}{E} = \pi^e - \hat{b}(u - u^n) - (\frac{\Delta E}{E} - \frac{\Delta E^e}{E})$$

Inflation is determined by:

- expected inflation
- unemployment
- unexpected changes in productivity

Another Phillips Curve

The Phillips curve in terms of unemployment and inflation:

$$\pi = \pi^e - \hat{b}(u - u^n) - (\frac{\Delta E}{E} - \frac{\Delta E^e}{E})$$

Simply

$$\pi = \pi^e - \hat{b}(u - u^n) + z$$

where z represents unexpected changes in productivity and also changes in cost or taxes that affect prices when wages have been set

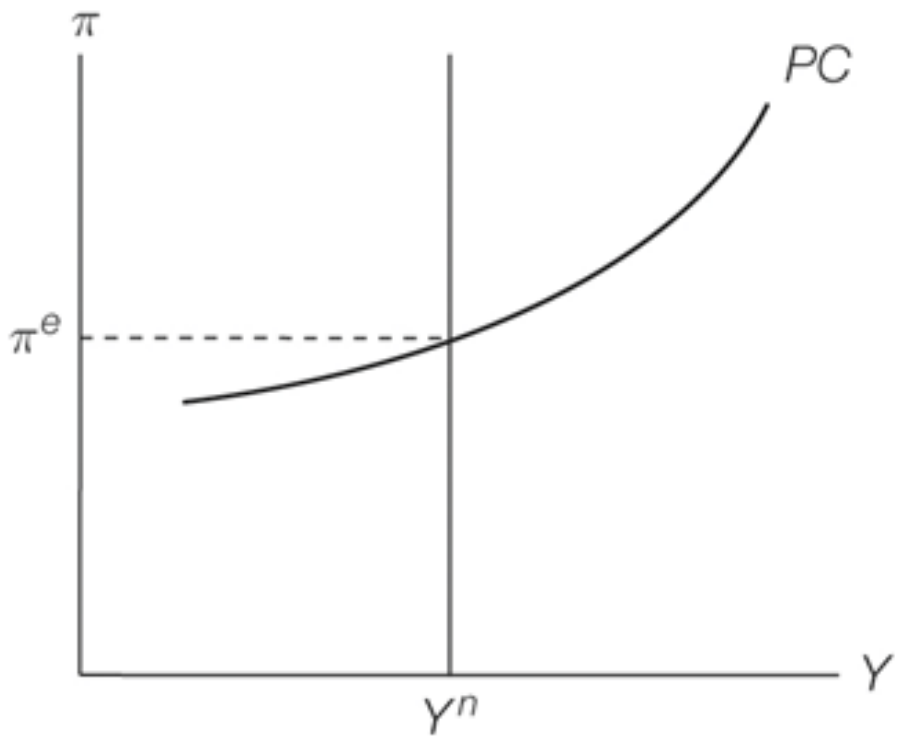
Yet, Another Phillips Curve

- Definition, unemployment: $u = \frac{L-N}{L}$
- Production function: $Y = EN$ and $Y^n = EN^n$
- $u - u^n = \frac{L-N}{L} - \frac{L-N^n}{L} = -\frac{N-N^n}{L} = -\frac{Y/E-Y^n/E}{L} = -\frac{Y^n}{EL}\frac{Y-Y^n}{Y^n}$
- When production is above the natural level, unemployment is below the natural level
- Definition, output gap: $\hat{Y} = \frac{Y-Y^n}{Y^n}$
- PC: $\pi = \pi^e + \beta\hat{Y} + z$ where $\beta = \hat{b}\frac{Y^n}{EL} = \frac{\lambda b}{1-\lambda}\frac{Y^n}{EL}$

PC Graph

$$\pi = \pi^e + \beta\hat{Y} + z$$

Fig. 9.3 *The Phillips curve in terms of production and inflation*



PC Variables

Inflation is determined by: • Expected inflation

• Output gap

• Unexpected shocks to productivity and non-wage costs such as energy prices

Adjustment

Adjustment is probably slower for several reasons:

- Many wage agreements are multi-year agreements
- Those who set wages and prices have imperfect information about the economic situation and it takes time to react
- Changes in wages and prices are not synchronized

All these factors influence the speed of wage and price adjustment and hence the slope of the Phillips curve

A very important question

The position of the Phillips curve depends on expected inflation, but how are expectations about inflation formed and what are the consequences for the relation between inflation and production/employment?

Expectations

Three cases

$\pi^e = 0$ The *price level* is expected to be the *same* always

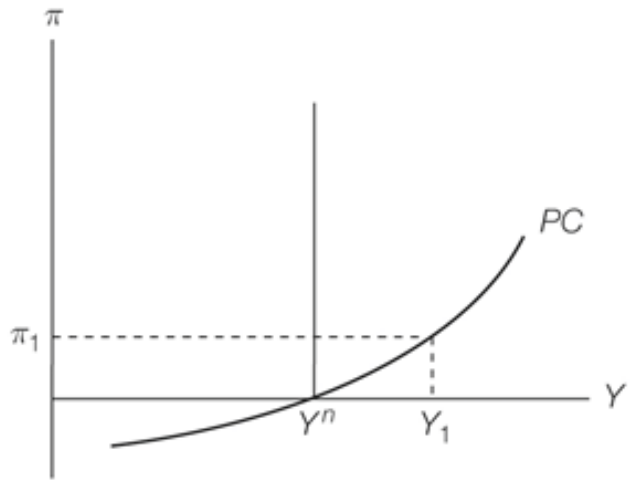
$\pi^e_t = \pi_{t-1}$ Inflation is expected to be the *same* as last year

$\pi^e = \pi^{\otimes}$ Inflation is expected to equal the *inflation target*

What happens if the money supply increases more quickly?

$\pi^e = 0$

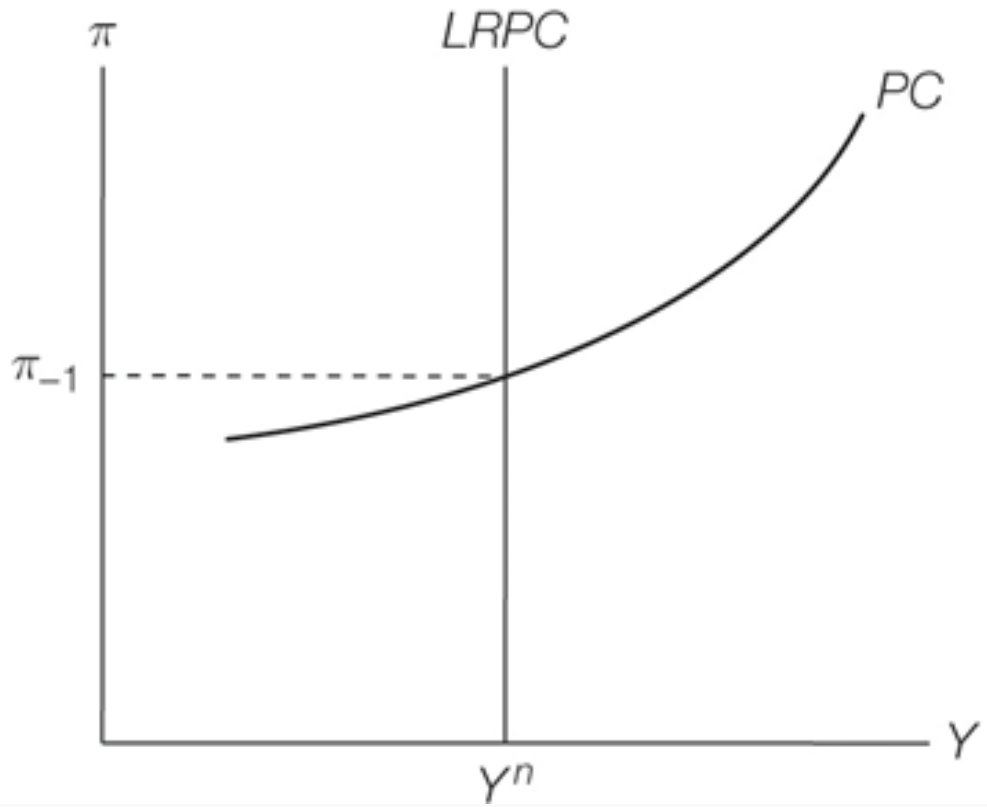
Fig. 9.4 *The Phillips curve when prices are expected to remain constant*



The effect of increasing M will be higher inflation and higher production and employment. There is a trade-off between inflation and unemployment

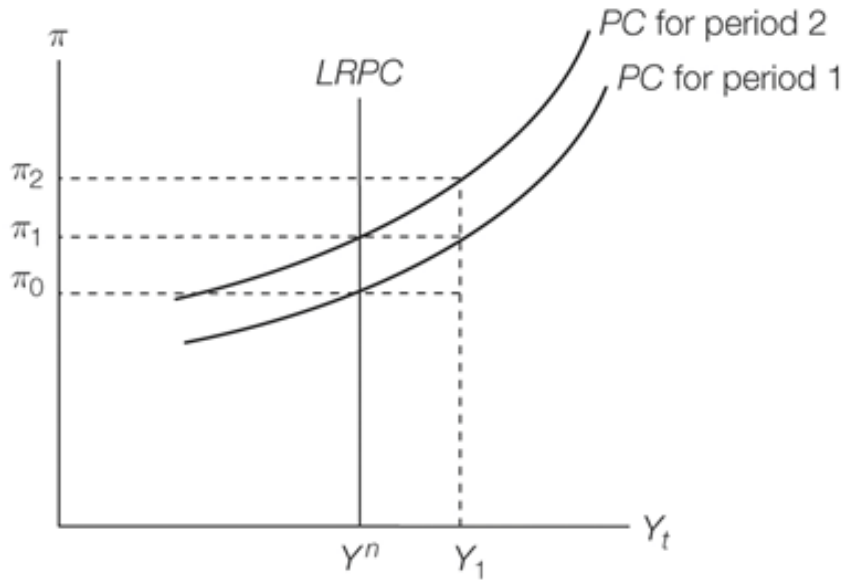
But if inflation is higher, people should realize that sooner or later. An alternative Phillips curve is

Fig. 9.5 *The Phillips curve when expected inflation equals inflation in the previ*



What happens if the money supply increases faster?

Fig. 9.6 *The effect of a period of expansionary monetary policy when* $\pi_t^e = \pi_{t-1}$



Phillips curve is not stable: when expectations have adjusted, the effect of a faster increase of M is higher inflation but no effect on unemployment

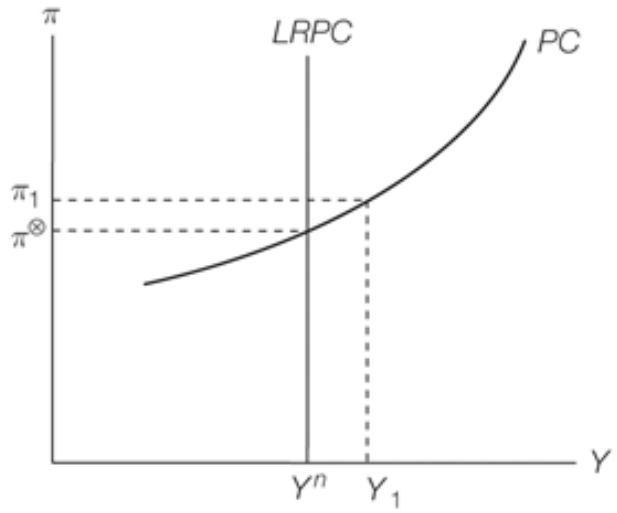
Some Terminology

- Phillips curve: $\pi = \pi_{-1} + \beta\hat{Y} + z$
- Subtract π_{-1} to get $\Delta\pi = \beta\hat{Y} + z$
- If production is kept above the equilibrium level, inflation will accelerate and vice-versa
- Equilibrium unemployment is sometimes called the non-accelerating-inflation rate of unemployment (NAIRU)
- The vertical line at the equilibrium level of production (or unemployment rate) is sometimes called the long-run Phillips curve (LRPC)

- In the long run there is no real choice between inflation and unemployment
- It is costly to keep production above the natural level: the result will be permanently higher inflation
- If inflation is high, it can be worthwhile to try to reduce it even if it is costly in terms of production and employment in the short run. The result is permanently lower inflation

What happens if the money supply increases faster?

Fig. 9.7 *The Phillips curve when the expected inflation rate equals the inflation target*



The effect of increased M is higher inflation and production.
The Phillips curve is not affected as long as the target remains credible

Economic Activity and Inflation

Why is there no clear relation no stable Phillips curve?

- When inflation has increased to a high level, it tends to remain high because expected inflation is higher
- Equilibrium unemployment can change over time

On the other hand there is a fairly strong relation between the output gap and the change in inflation, which supports the Phillips curve with $\pi^e = \pi_{-1}$ so $\Delta\pi = \beta\bar{Y} + z$