

Economics 100B: Macroeconomics

The Phillips Curve and Aggregate Supply

October 2, 2020

Reading:

- Mishkin – Chapter 11.

The Phillips Curve and Aggregate Supply

Agenda:

- 1 The Phillips Curve: $u = f_1(\pi)$.
- 2 Okun's Law: $u = f_2(y)$.
- 3 Aggregate Supply: $y = f_3(\pi)$

The Phillips Curve

Phillips, A. W. (1958). The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957. *Economica*, 25 (100), 283–299.

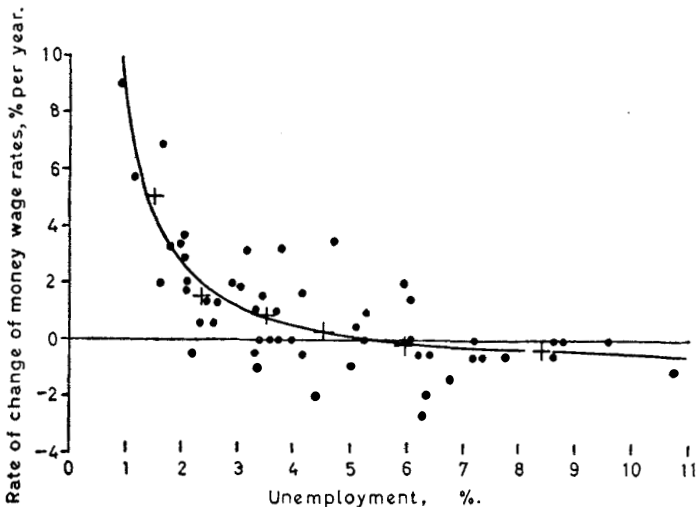


Fig.1.1861 – 1913

The Phillips Curve

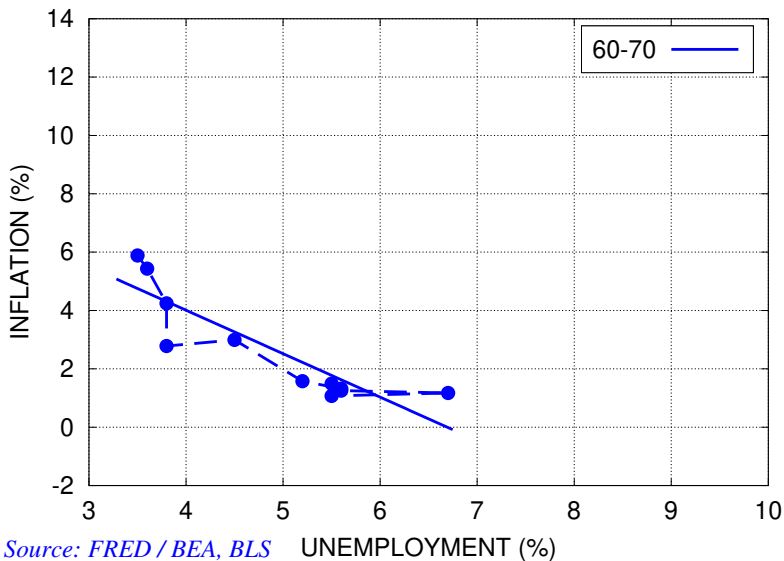
Original form

The *Phillips curve* is the *inverse relationship between inflation and unemployment*.

- When unemployment is unusually low, the demand for labor will exceed the supply of labor and wages will rise more quickly.
- Because wages are a major input into total costs, more rapidly rising wages leads to higher inflation.

The Phillips Curve

Empirical motivation based on data from 1960-1970

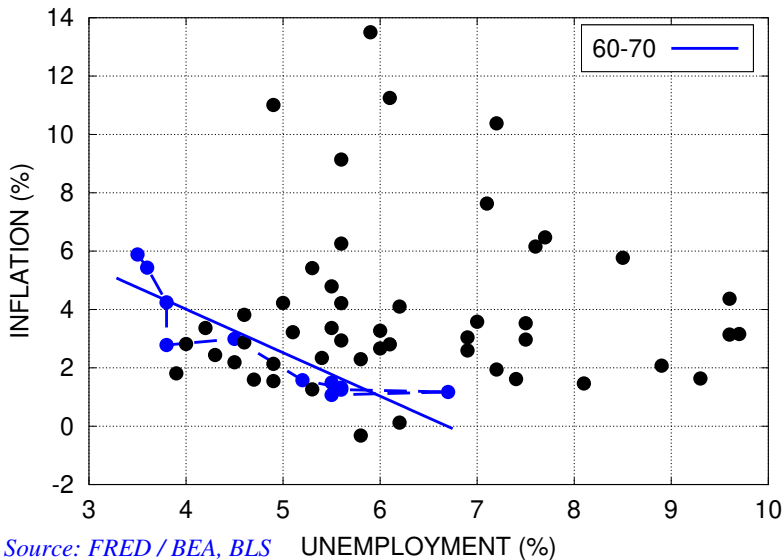


Source: FRED / BEA, BLS

UNEMPLOYMENT (%)

The Phillips Curve

Direct extension to later time is problematic.

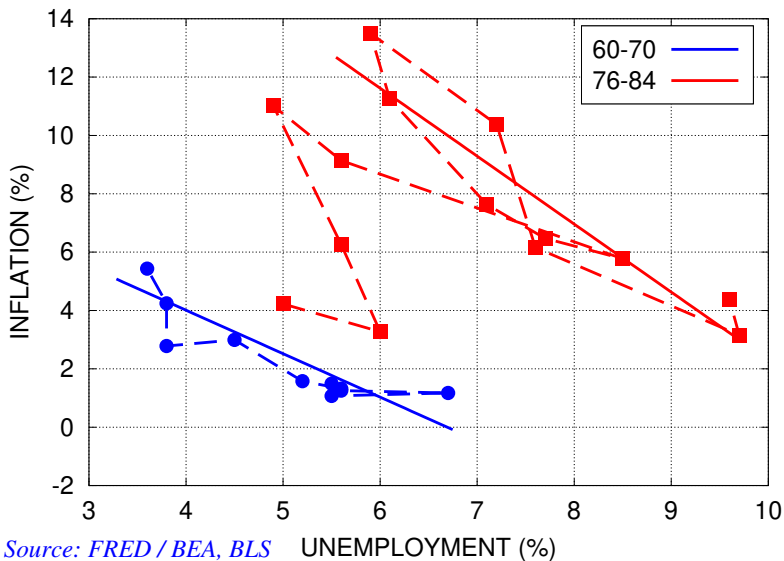


Source: FRED / BEA, BLS

UNEMPLOYMENT (%)

The Phillips Curve

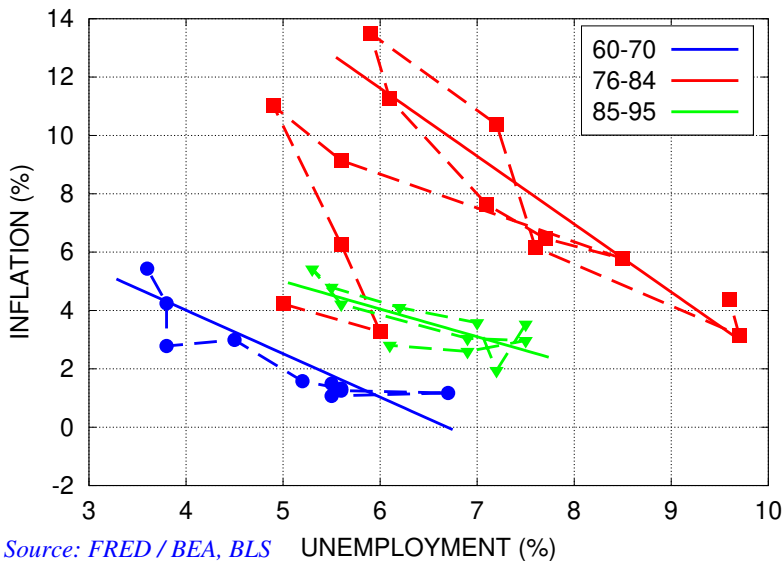
Fed inflation-credibility issue, 1973 oil-price shock & Volker inflation fight.



Source: FRED / BEA, BLS

The Phillips Curve

Fed inflation-fighting credibility restored.

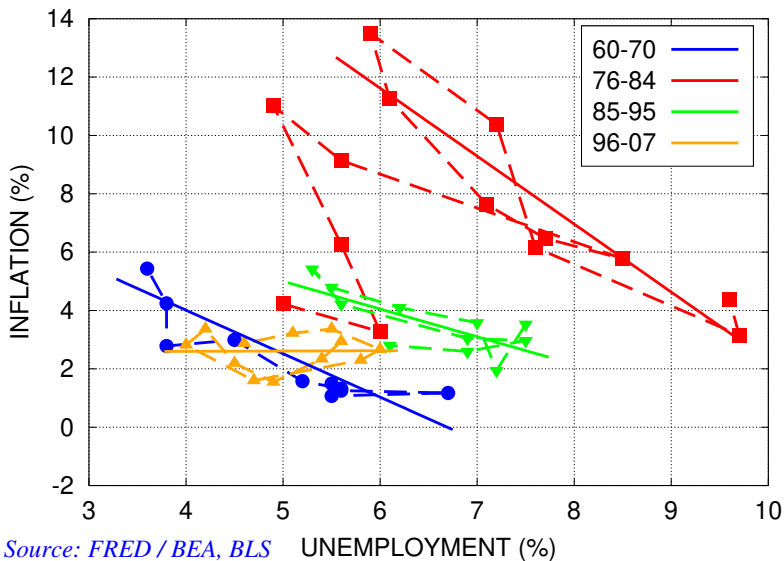


Source: FRED / BEA, BLS

UNEMPLOYMENT (%)

The Phillips Curve

Natural rate of unemployment declines further?

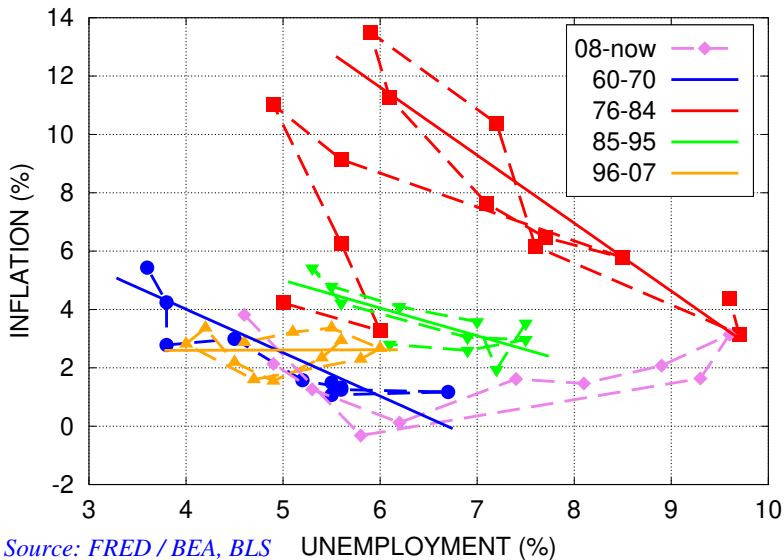


Source: FRED / BEA, BLS

UNEMPLOYMENT (%)

The Phillips Curve

The financial crisis of 2008 and beyond.



Source: FRED / BEA, BLS

UNEMPLOYMENT (%)

The Phillips Curve

Early modification

- The Phillips curve also implies *an inverse relationship* between *nominal wages* and *unemployment*.
- A major flaw in the original Phillips curve analysis was that it failed to distinguish between nominal wages and real wages.
 - ① Labor market incentives for working and hiring are determined by real, not nominal, wages.
 - ② If workers and businesses expect inflation to increase, they will also adjust nominal wages higher so that the real wage does not fall.

The Phillips Curve

Early modification

- This suggests there is a positive one-for-one relationship between *wages and inflation* and *expected inflation*.
- *In the long-run*, when all wages and prices are completely flexible, unemployment would be at the *natural rate of unemployment*, u_N .
 - 1 This is also called the *full-employment level of unemployment*.
 - 2 This is the unemployment rate consistent with the economy's long-run steady state.

The Phillips Curve

The expectations-augmented Phillips curve

Incorporating these changes, the Phillips curve becomes the *expectations-augmented Phillips curve*:

$$\pi = \pi^e - \omega(u - u_N)$$

which gives inflation π as a function of

- expected inflation π^e .
- the *unemployment gap*: $u - u_N$.

The Phillips Curve

The expectations-augmented Phillips curve.

Implications

The *expectations-augmented Phillips curve*:

$$\pi = \pi^e - \omega(u - u_N)$$

implies that if

$$u = u_N$$

then

$$\pi = \pi^e$$

Note that in the long-run $u = u_N$:

- There is *no long-run trade-off* between unemployment and inflation.

The Phillips Curve

The expectations-augmented Phillips curve.

Three important conclusions:

- ① There are two types of Phillips curves:
 - Short-run Phillips curves.
 - Long-run Phillips curves.
- ② *There may be a short-run trade-off* between unemployment and inflation.
- ③ *There is no long-run trade-off* between unemployment and inflation.

The Phillips Curve

The short-run expectations-augmented Phillips curve with supply shocks.

The extension to include supply shocks:

- Supply shocks are events that affect inflation that are independent of:
 - labor-market conditions, and/or
 - inflationary expectations.
- Experience with price shocks ρ led to the modern short-run Phillips curve:

$$\pi = \pi^e - \omega(u - u_N) + \rho$$

The Phillips Curve

The short-run expectations-augmented Phillips curve with supply shocks.

The extension to include supply shocks:

$$\pi = \pi^e - \omega(u - u_N) + \rho$$

- This modern version of the Phillips curve implies that wages and prices are sticky.
 - ① The more flexible wages and prices are, the more they and inflation respond to the unemployment gap, i.e., ω is larger.
 - ② If wages and prices were completely flexible, then $\omega = \infty$ and the short-run Phillips curve becomes vertical and identical to the long-run Phillips curve.

The Phillips Curve

The modern Phillips curve with adaptive expectations

The extension to include inflationary expectations:

In the simplest version, we assume that inflation expectations are *adaptive* (or backward-looking):

$$\pi_t^e = \pi_{t-1}$$

and write the short-run Phillips curve

$$\pi = \pi^e - \omega(u - u_N) + \rho$$

as

$$\pi_t = \pi_{t-1} - \omega(u_t - u_N) + \rho_t$$

The Phillips Curve

The modern Phillips curve with adaptive expectations

The extension to include adaptive expectations:

Characteristics of the Phillips curve

$$\pi_t = \pi_{t-1} - \omega (u_t - u_N) + \rho_t$$

include:

- A very convenient analytical form.
- Reasons for sticky prices.
 - 1 Slow changes in inflation expectations.
 - 2 Some wage & price contracts may depend on past inflation.
- A simple (and popular) view of how inflation expectations are formed.

The Phillips Curve

The modern Phillips curve with adaptive expectations

The accelerationist Phillips curve:

Our Phillips curve

$$\pi_t = \pi_{t-1} - \omega(u_t - u_N) + \rho_t$$

written as

$$\Delta\pi_t = -\omega(u_t - u_N) + \rho_t$$

is referred to as the *accelerationist Phillips curve*.

- Inflation is a *rate*, so the time-change of inflation is an *acceleration*.
- If $u_t < u_N$ then $\Delta\pi_t > 0$ if $\rho_t = 0$.
- If $u_t = u_N$ then $\Delta\pi_t = 0$ if $\rho_t = 0$.

The Phillips curve and aggregate supply:

- The Phillips curve is the basis for deriving the aggregate supply curve.
- Because there are both long-run and short-run Phillips curves, there are both long-run and short-run aggregate supply curves.

The Aggregate Supply Curve

Definition:

The aggregate supply curve represents the positive relationship between:

- the quantity of output that businesses are willing to produce, and
- the inflation rate.

The Aggregate Supply Curve

Long-Run Aggregate Supply

The long-run aggregate supply curve, LRAS, depends upon:

- the amount of labor, L ,
- the amount of capital, K , and
- the total factor productivity, A .

The level of aggregate output supplied at the natural rate of unemployment is referred to as:

- *the natural rate of output*, or as
- *potential output*, Y^P .

The Aggregate Supply Curve

Short-Run Aggregate Supply

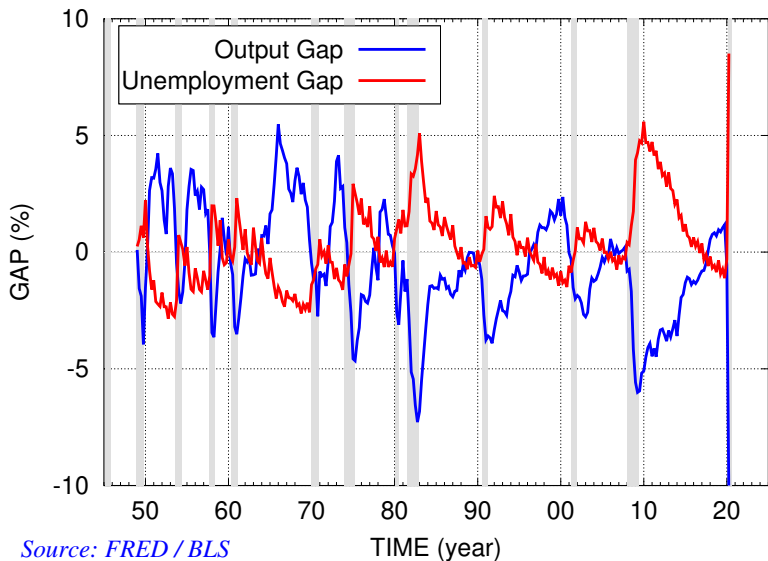
The short-run aggregate supply curve, SRAS, is derived from the short-run Phillips curve by replacing:

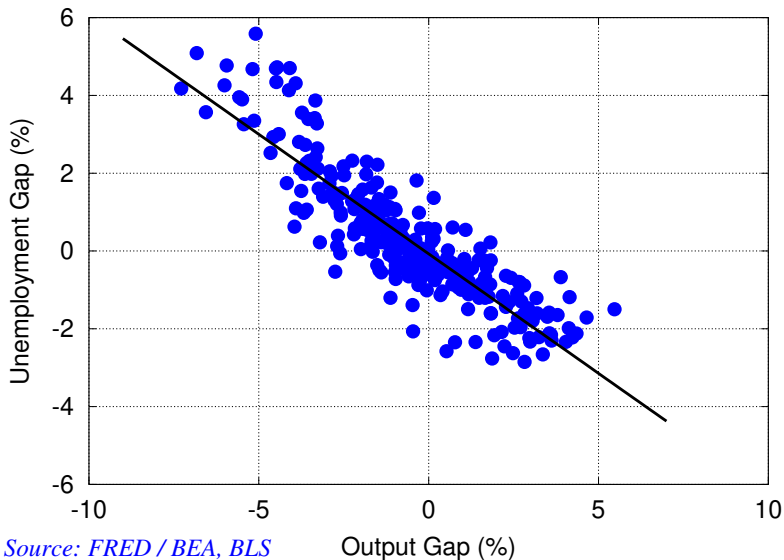
- the unemployment gap, $u - u_N$, with
- the output gap, $y - y^P$.

And to justify that empirically we need Okun's Law.

Okun's Law

Casual empiricism of the relationship between GDP and unemployment.





The Short-Run Aggregate Supply Curve

Derivation

Given the *modern Phillips curve*

$$\pi_t = \pi_{t-1} - \omega (u_t - u_N) + \rho_t$$

and Okun's law

$$(u_t - u_N) = C_{\text{Okun}} (y_t - y^P)$$

via substitution we get

$$\pi_t = \pi_{t-1} - C_{\text{Okun}} \omega (y_t - y^P) + \rho_t$$

or *the short-run aggregate-supply curve*:

$$\pi_t = \pi_{t-1} + \gamma (y_t - y^P) + \rho_t$$

The Aggregate Supply Curve

LRAS from the SRAS

The short-run aggregate-supply curve

$$\pi_t = \pi_{t-1} + \gamma (y_t - y^P) + \rho_t$$

or

$$\frac{\pi_t - \pi_{t-1} - \rho_t}{\gamma} = (y_t - y^P)$$

becomes, as $\gamma \rightarrow \infty$ (i.e. complete wage & price flexibility),

$$y_t = y^P$$

which is the *long-run aggregate supply curve*.

The Aggregate Supply Curve

Inheritance from the Phillips curve

Because the short-run Phillips curve embeds *sticky wages and prices*:

- The short-run aggregate supply curve also embeds sticky wages and prices.
- The more flexible wages and prices are:
 - 1 the more inflation responds to the output gap,
 - 2 the higher the value of γ and,
 - 3 the steeper the short-run aggregate supply curve.

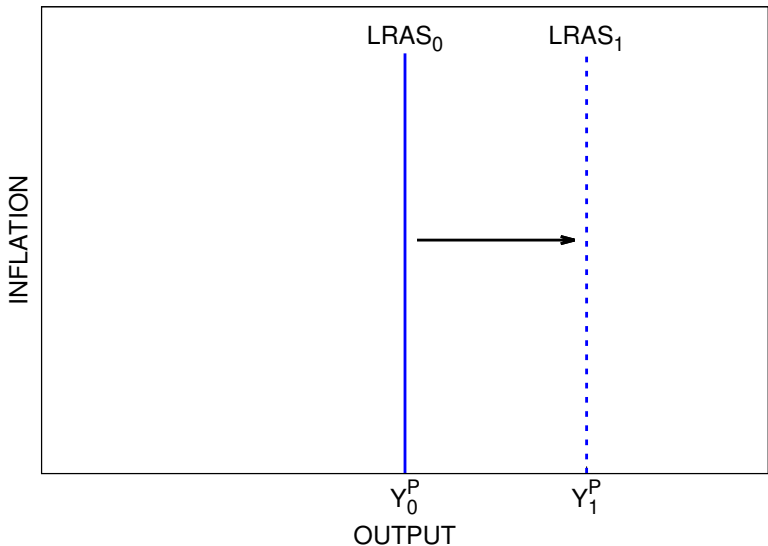
The Aggregate Supply Curve

Factors that will shift the LRAS curve

- ① A change in total factor productivity, ΔA .
- ② A change in capital, ΔK .
- ③ A change in labor, ΔL .
- ④ *A change in the natural rate of unemployment, Δu_N .*

The Aggregate Supply Curve

Long-Run Aggregate Supply



The Aggregate Supply Curve

Factors that will shift the SRAS curve

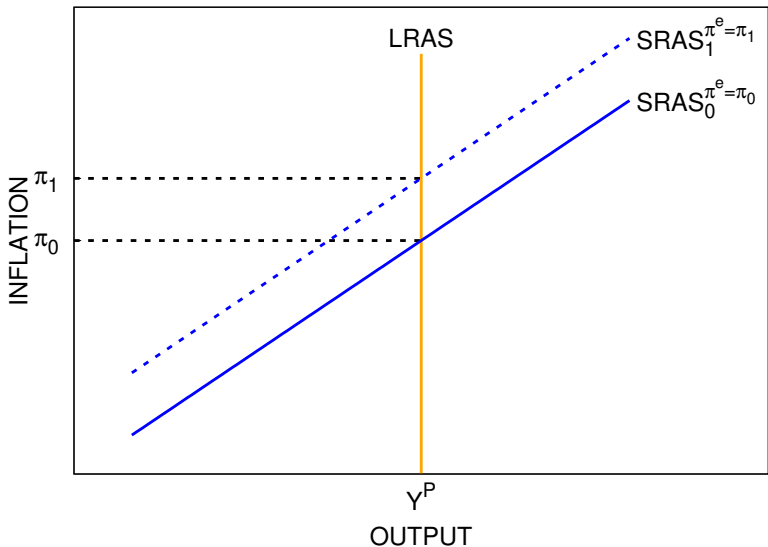
$$\pi_t = \underbrace{\pi_{t-1}}_1 + \gamma \underbrace{(y_t - y^P)}_2 + \underbrace{\rho_t}_3$$

- ① A change in expected inflation, $\Delta\pi^e$.
- ② *A persistant output gap, $y - y^P$.*
- ③ A price shock, ρ_t .

The Short-Run Aggregate Supply Curve:

$$\pi_t = \pi_{t-1} + \gamma (y_t - y^P) + \rho_t$$

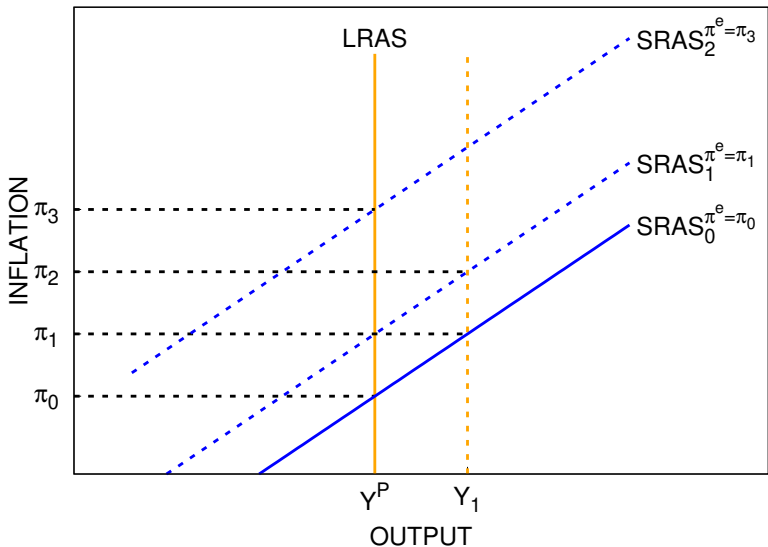
A change in expected inflation, $\Delta\pi^e$.



The Short-Run Aggregate Supply Curve:

$$\pi_t = \pi_{t-1} + \gamma (y_t - y^P) + \rho_t$$

A persistent output gap, $y - y^P$.



The Short-Run Aggregate Supply Curve:

$$\pi_t = \pi_{t-1} + \gamma (y_t - y^P) + \rho_t$$

A price shock, ρ .

