The Phillips Curve & Aggregate Supply

Week 07

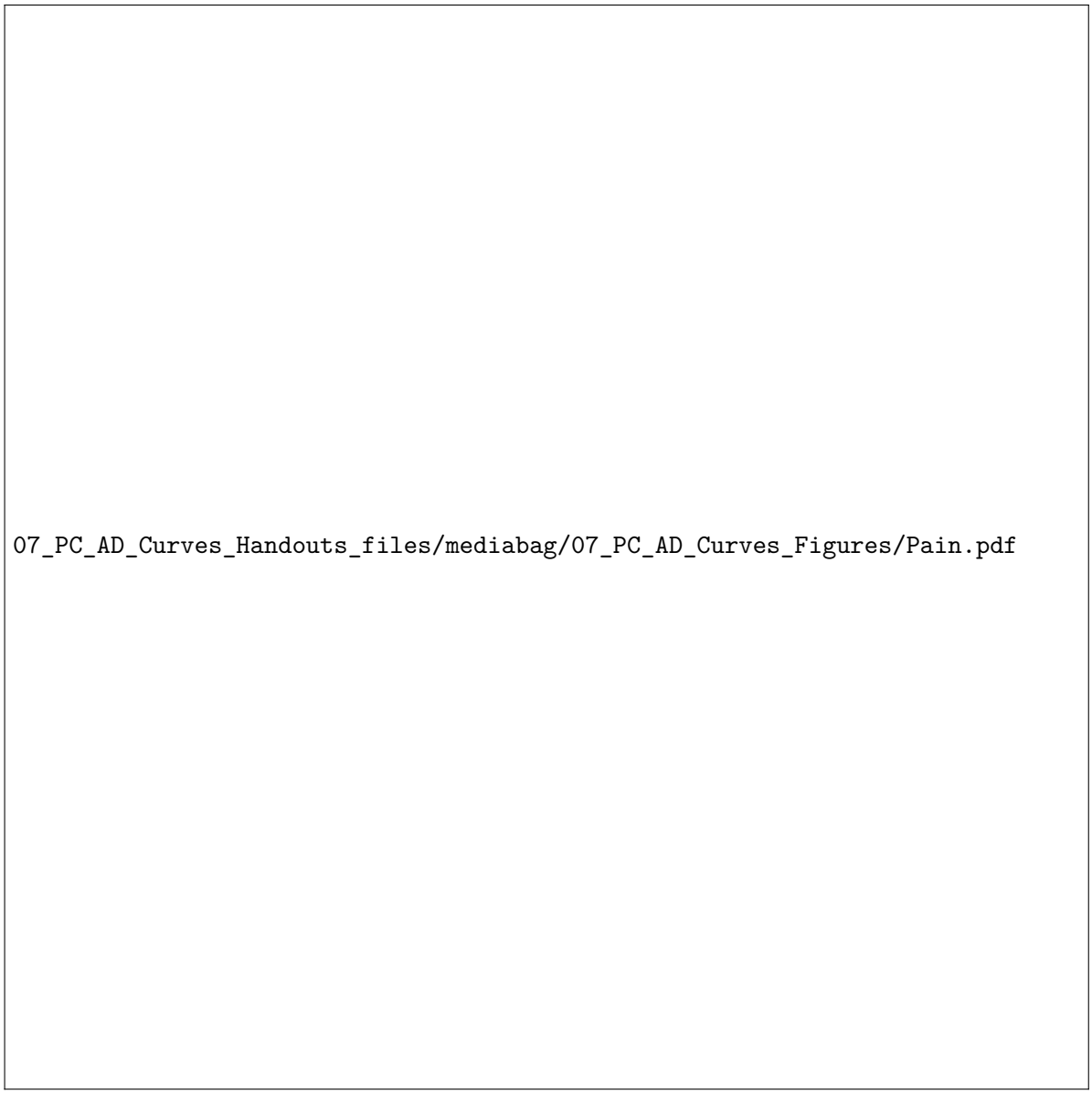
Vivaldo Mendes

2025-03-24

1. The Phillips Curve

The Pains of Fighting Inflation

> *"We have got to get inflation behind us. I wish there were a* **painless way** *to do that."* ***There isn't*** ." Jerome Powel, Fed's Chair, 21 Sept. 2022



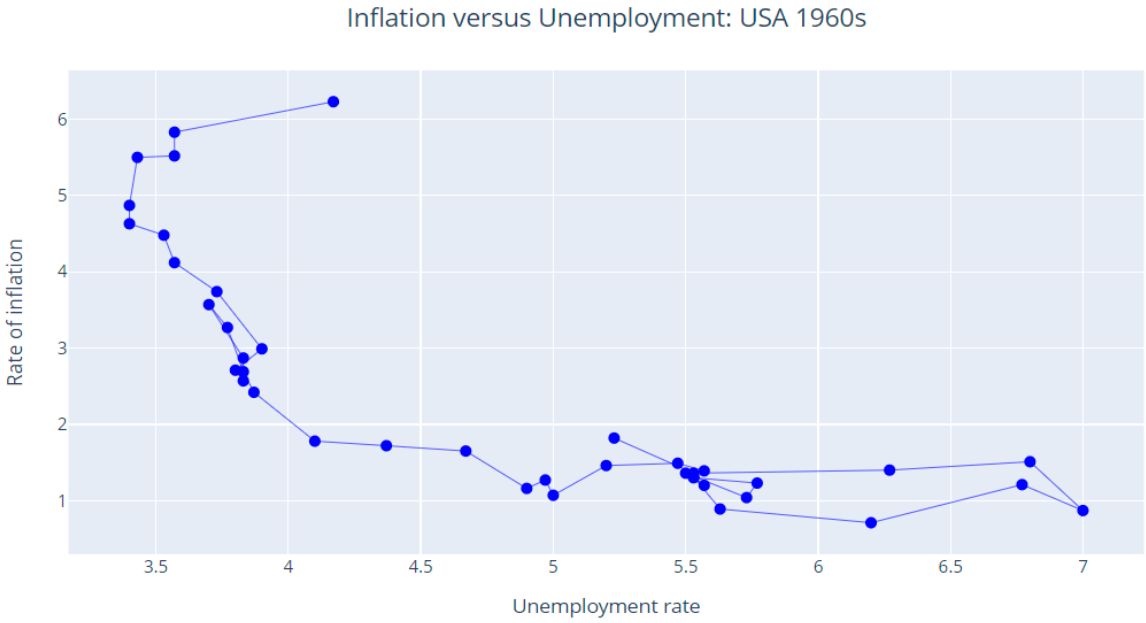
The Phillips Curve (PC)

- Almarin Phillips discovered in the 1950s the ***kind of pain*** we have to suffer from reducing inflation.
- The PC shows how much more unemployment we will get ($\uparrow U$), to reduce the inflation rate ($\downarrow \pi$).

- The PC was easily confirmed in the 1960s.
- See next slide for the PC in the 1960s.

The Phillips Curve (PC)

In the 1960s, the PC was easy to spot and confirmed Phillips discovery.

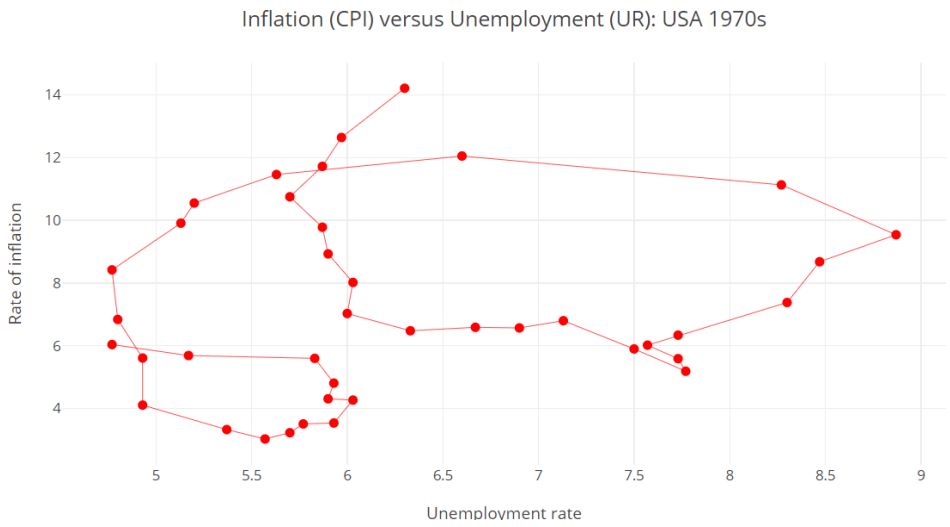


The Phillips Curve in the 1970s

. . .

- In the 1970s, the PC begins to display a strange configuration: it seems to move constantly, looping around.

. . .

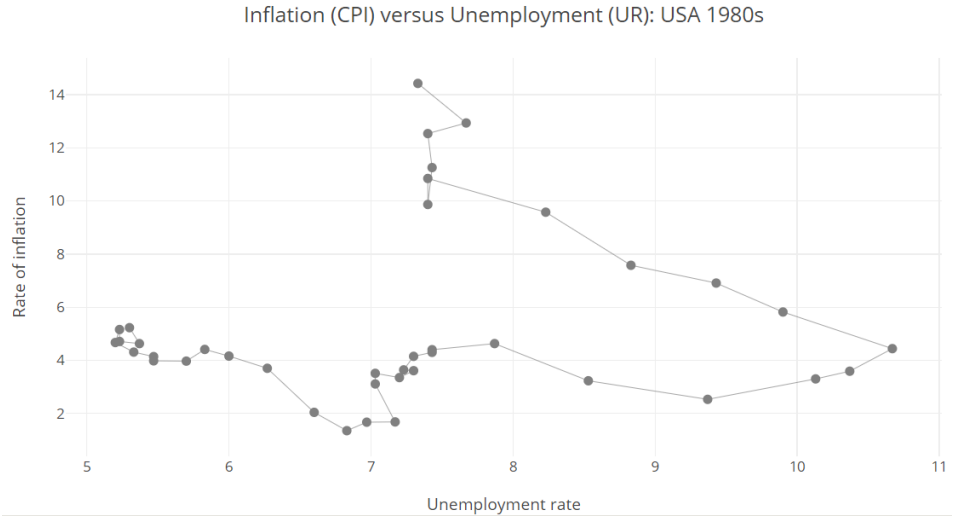


The Phillips Curve in the 1980s

. . .

- In the 1980s, the PC seems to have different slopes.

. . .



The Friedman-Phelps PC Curve

- Two Nobel prize winners – Milton Friedman and Edmund Phelps – showed how to write a PC that was able to explain those strange configurations.
- Following them, the ***expectations-augmented Phillips Curve*** should be written as:

$$\pi = \pi^e - \omega\left(U - U^n\right) \tag{7.1}$$

- π inflation rate
- U unemployment rate
- ω is a parameter

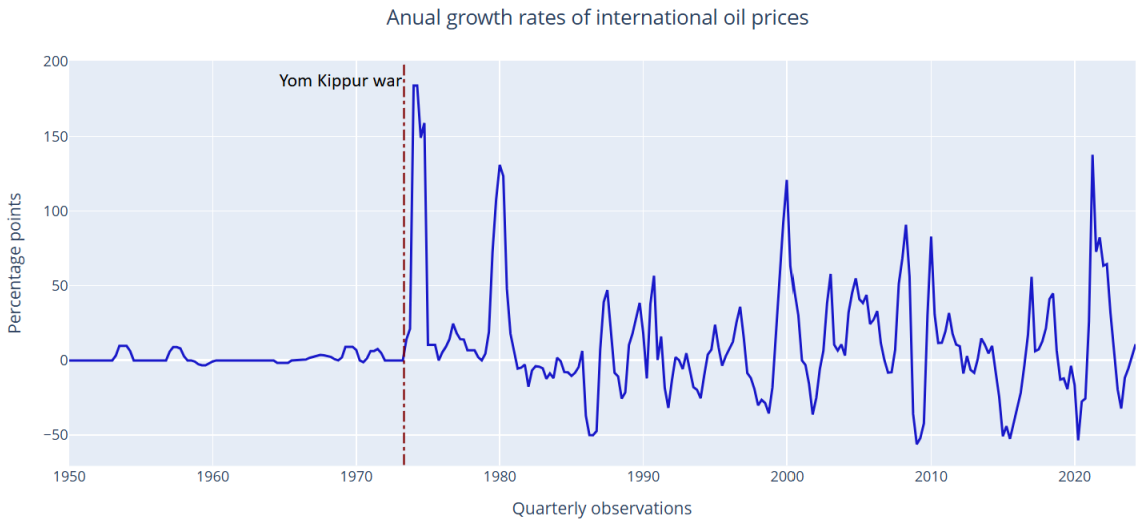
- π^e expected inflation rate
- $(U - U^n)$ cyclical unemployment rate
- U^n natural unemployment rate

Oil Price Shocks

. . .

Large shocks in oil prices have been a recurrent major characteristic of the world economy since the early 1970s. They are ***temporary shocks***.

. . .



The PC with Supply Shocks

- Shocks in oil prices affect production costs and as such they interfere in the relationship between inflation and unemployment.
  - If oil prices increase a lot, production costs will also rise substantially, and inflation goes up, for every level of unemployment.
- The Covid19 pandemic has been a colossal shock on the supply side.
- The textbook calls these kind of shocks as ***temporary shocks***:

$$\rho$$

- The PC can easily accommodate these ***temporary shocks***:

$$\pi = \pi^e - \omega\left(U - U^n\right) fragment + \rho \tag{7.2}$$

Inflation Expectations in the PC

- If inflation has been increasing recently, private agents expect that such ***trend*** will continue in the near future. A mathematical way of describing such a process is:

$$\pi_t^e = \pi_{t-1} + \sigma(\pi_{t-1} - \pi_{t-2}) \tag{7.3}$$

- π_t^e is the inflation expectation for period t.
- π_t and π_{t-1} are the inflation levels at periods t and $t-1$.
- σ is a parameter of the degree of persistence of inflation expectations.
- To simplify the exposition, ***the textbook assumes*** that $\sigma = 0$, and we get:

$$\pi_t^e = \pi_{t-1} \tag{7.4}$$

The PC with all Ingredients

The PC we will work with in this course includes three major ingredients:

1. Trending (or adaptive) expectations: $\pi^e = \pi_{-1}$
2. Cyclical unemployment: $\omega(U - U^n)$
3. Temporary supply shocks: ρ

Therefore, the final version of the PC is given by:

$$\pi = \pi_{-1} - \omega\left(U - U^n\right) + \rho$$

The PC: Graphical Representation

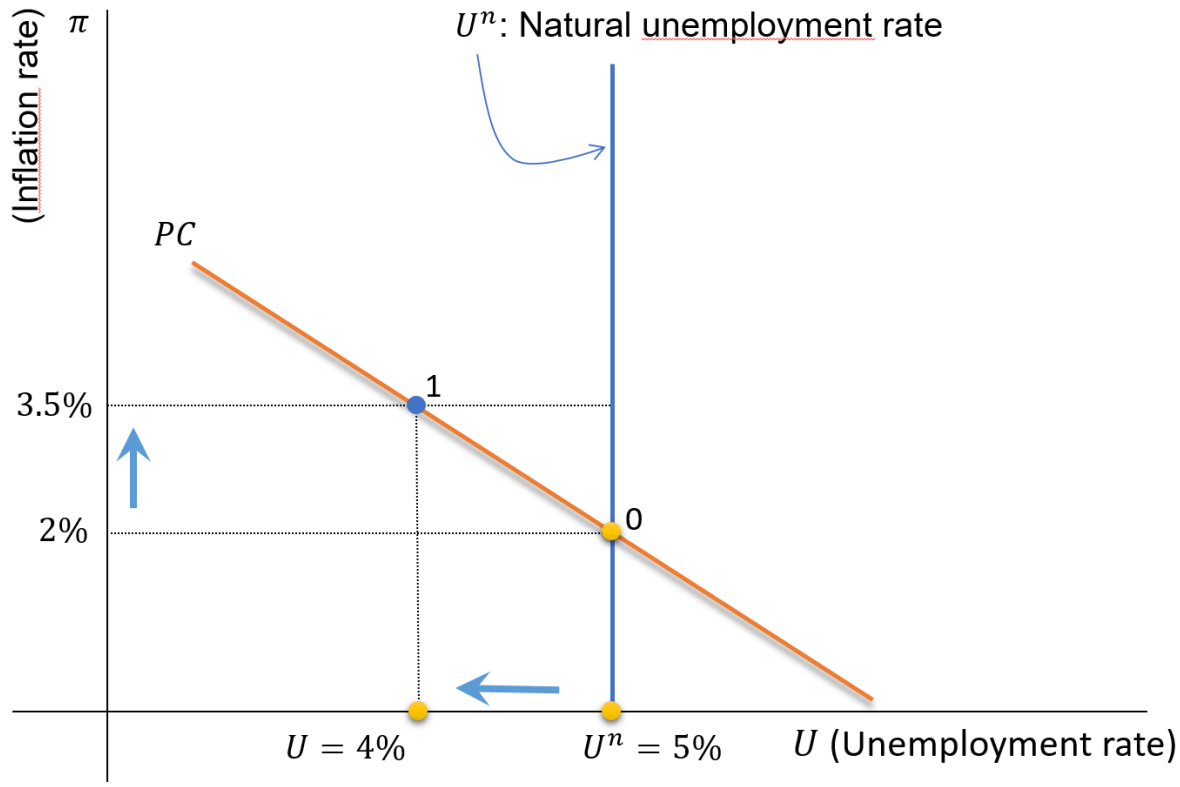
$$\pi = \pi^e - \omega\left(U - U^n\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

If we want a lower unemployment rate ($\downarrow U$), we have to accept a higher inflation rate ($\uparrow \pi$); assuming ***everything else constant*** (U^n, π^e, ρ).

The PC: Graphical Representation

$$\pi = \pi^e - \omega\left(U - U^n\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

. . .



Example:

- $\pi_{-1} = 2\%$,
- $\omega = 1.5$
- $U^n = 5\%$
- If $U = 4\%$
- $U < U^n \Rightarrow \uparrow \pi$
- $\pi = 3.5\%$

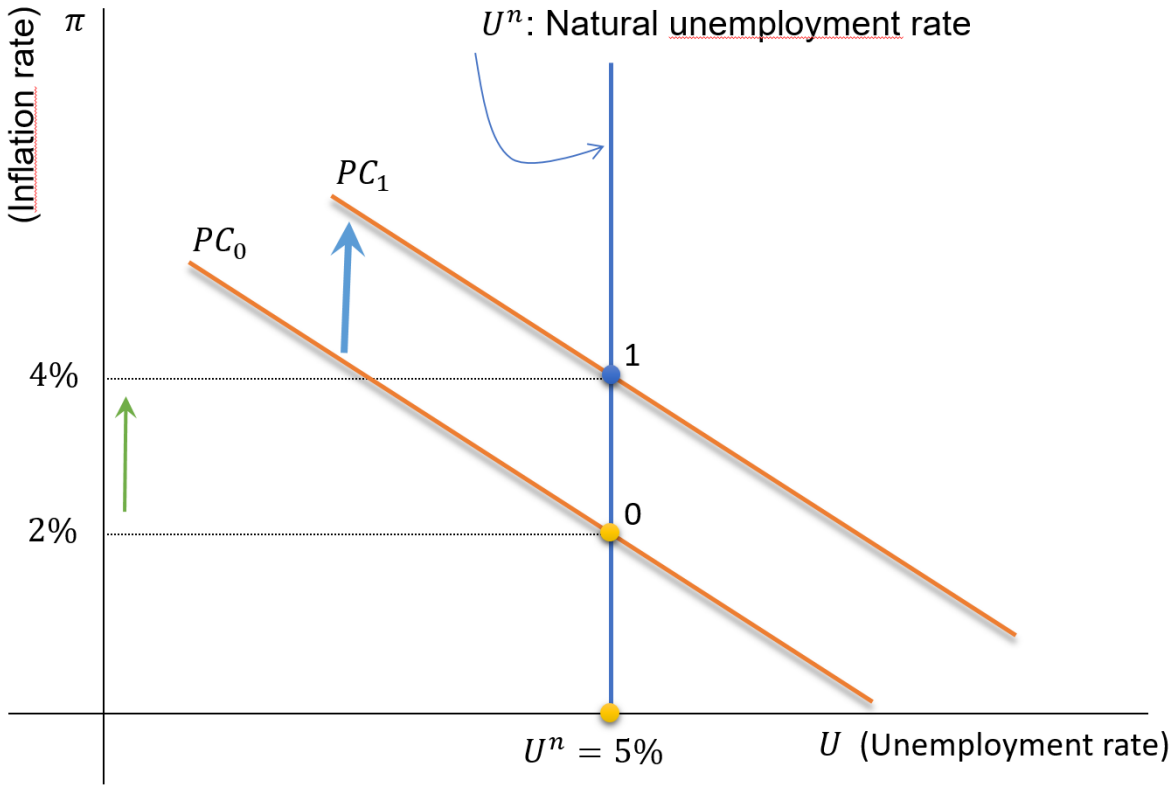
2. Shifts in the Phillips Curve

Shifts in the Phillips Curve $(\pi^e,\ \rho)$

$$\pi = \pi^e - \omega\,(U - U^n) + \rho \quad , \quad \pi^e = \pi_{-1}$$

- The Phillips Curve shifts when the following forces change:
  - ***Expected inflation*** (π^e)
  - ***Supply shocks*** (ρ)
  - Natural unemployment rate (U^n)
- Let us concentrate on the first two forces.

Shifts in the Phillips Curve (π^e, ρ)



The PC shifts to the right if:

- $\uparrow \pi^e$, or
- $\uparrow \rho$

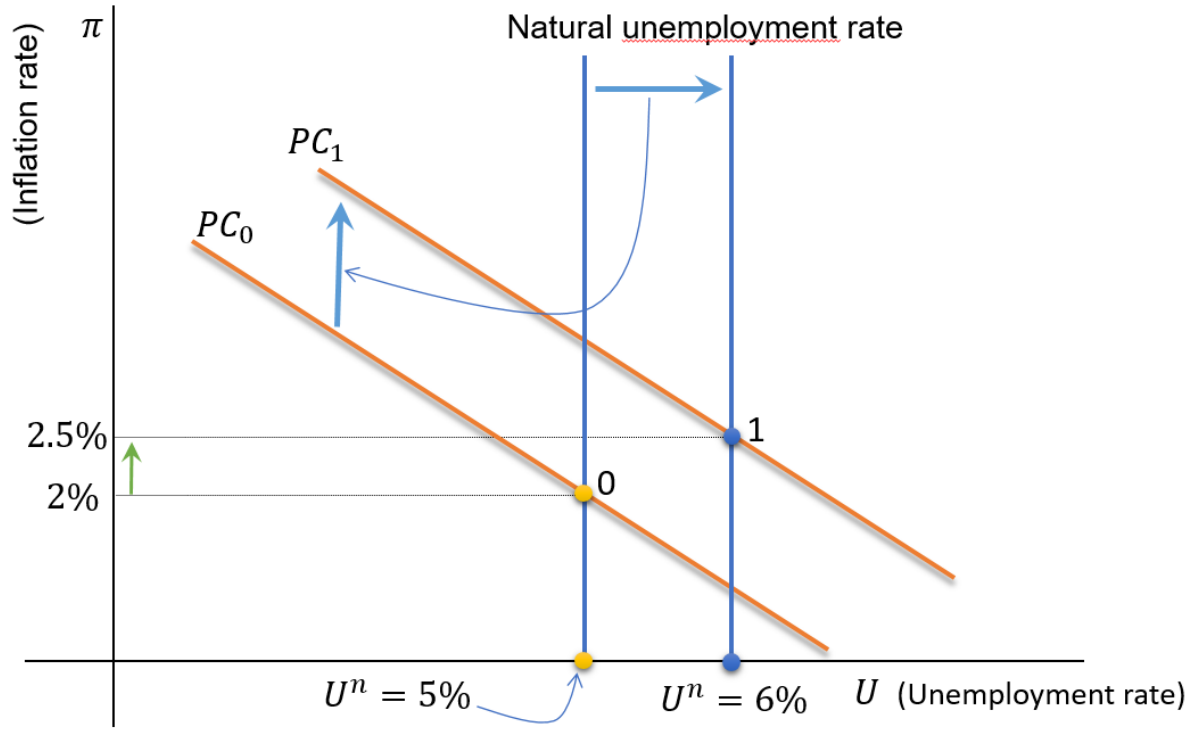
Shifts in the Phillips Curve (U^n)

$$\pi = \pi^e - \omega\,(U - U^n) + \rho \quad , \quad \pi^e = \pi_{-1}$$

- The Phillips Curve shifts when the following forces change:
  - Expected inflation (π^e)
  - Supply shocks (ρ)
  - ***Natural unemployment rate*** ***(U^n)***

- Let us concentrate on the last force.

Shifts in the Phillips Curve (U^n)



The PC will shift to the right if:

- $\uparrow U^n$
- Stable inflation will now be at 2.5%

Shifts in the PC: Inflationary Spiral

$$\pi = \pi^e - \omega\left(U - U^n\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

- What happens if the government or the central bank try to ***keep the unemployment rate below the natural rate*** ?
  - $U < U^n$
  - The Phillips Curve will shift to the right
- ***Inflationary expectations*** : inflation will increase systematically over time

Shifts in the PC: Inflationary Spiral

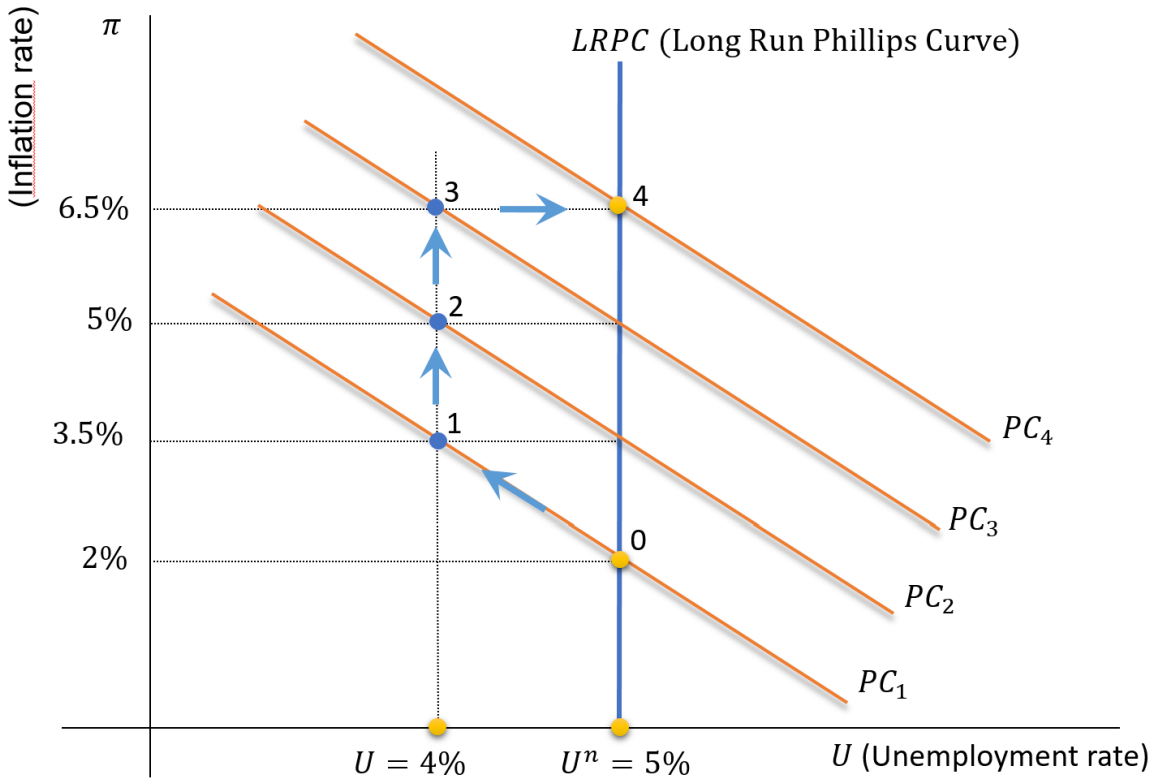
$$\pi = \pi^e - \omega\left(U - U^n\right), \quad \omega = 1.5, \quad \pi_t^e = \pi_{t-1}$$

	Values in percentage points			
Period	U^n	U	π^e	π
0	5	5	2	2
1	5	4	2	3.5
2	5	4	3.5	5
3	5	4	5	6.5
4	5	5	6.5	6.5

- Suppose $\pi_0 = 2\%$
- If, $U_1 < U_1^n$ Inflation will only stop if U returns to the U^n level
- But the result will be a higher π and the same initial U

Shifts in the PC: Inflationary Spiral

$$\pi = \pi^e - \omega\left(U - U^n\right), \quad \omega = 1.5, \quad \pi_t^e = \pi_{t-1}$$



- Suppose $\pi_0 = 2\%$
- Inflation will only stop if the U returns to the U^n level
- But the result will be a higher π and the same initial U

3. The Okun's Law

The Okun's Law

- Arthur Okun showed in the early 1960s that there is a negative relationship between cyclical unemployment and the output-gap:

$$\underbrace{U - U^n}_{\text{Cyclical unemployment}} = -\theta \times \underbrace{\left(Y - Y^P\right)}_{\text{Output-gap}}$$

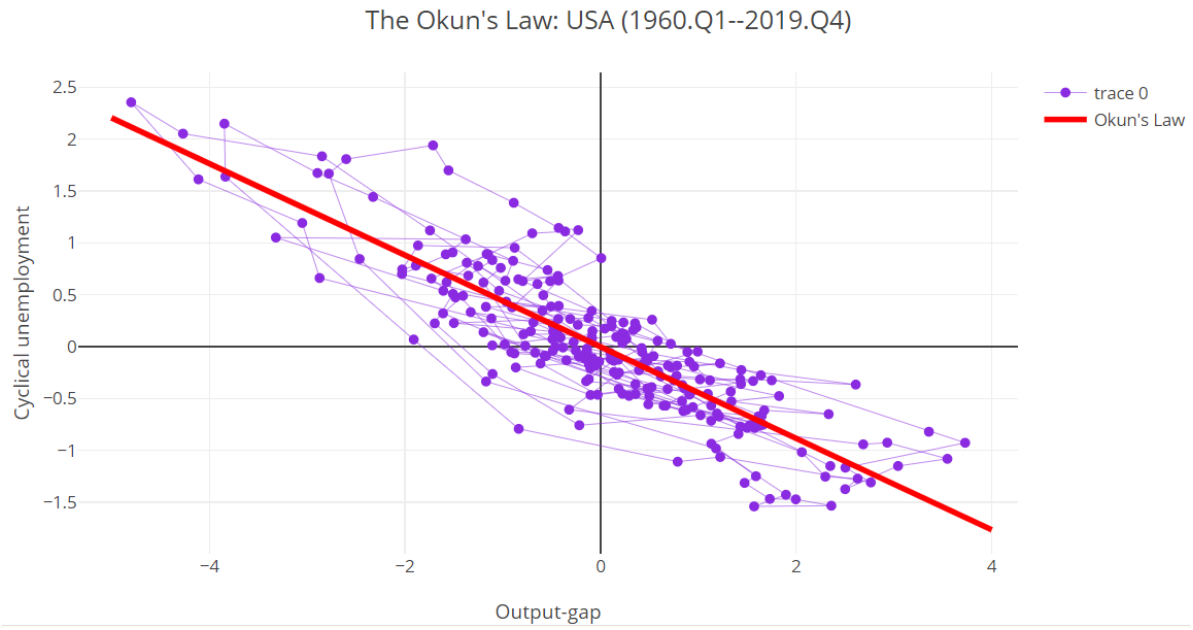
- where θ is a parameter, for the USA economy usually close to:

$$\theta \simeq 0.5$$

Arthur M. Okun (1962). "Potential GNP: Its Measurement and Significance". Reprinted as Cowles Foundation Paper 190.

The Okun's Law for the USA

The slope of the curve was 0.441 for the period 1960-2019.



4. The Aggregate Supply Curve (AS)

The Short-Run AS Curve: Derivation

The Phillips Curve (PC):

$$\pi = \pi^e - \omega \left(U - U^n\right) + \rho$$

The Okun's law:

$$U - U^n = -\theta \times \left(Y - Y^P\right)$$

- The short-run Aggregate Supply curve (AS) is obtained by inserting the Okun's law into the Phillips Curve (PC). Therefore:

$$\pi = \pi^e - \omega \times \underbrace{\left[-\theta \left(Y - Y^P\right)\right]}_{=U-U^n} + \rho \tag{7.5}$$

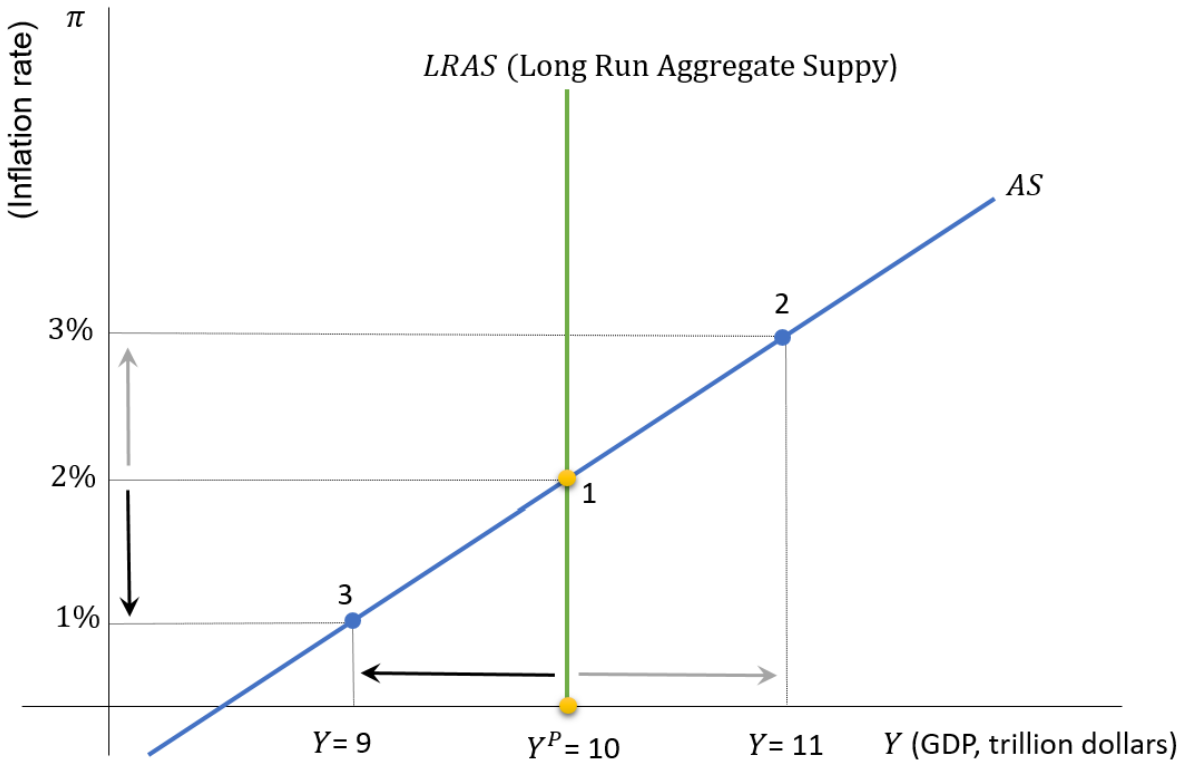
- To simplify notation we will use: $\gamma = \omega\theta$.
- So, the short-run AS curve is given by:

$$\pi = \pi^e + \gamma \left(Y - Y^P\right) + \rho \tag{7.6}$$

The AS Curve: Graphical Representation

$$\pi = \pi^e + \gamma \left(Y - Y^P\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

. . .



- In 1, $Y = Y^P$
- In 2, $Y > Y^P$, economic boom, π increases to 3%
- In 3, $Y < Y^P$, economic recession, π decreases to 1%

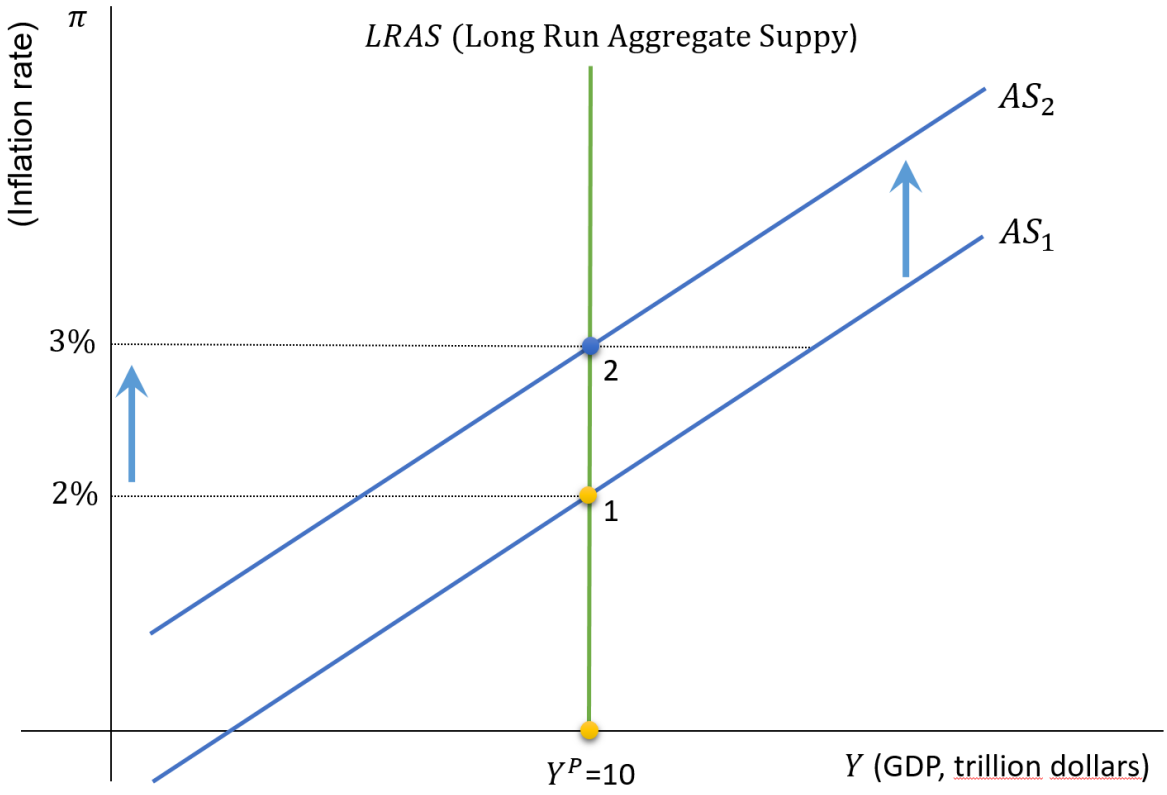
Shifts in the AS Curve (π^e, ρ)

$$\pi = \pi^e + \gamma\left(Y - Y^P\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

- The AS Curve shifts when the following forces change:
  - ***Expected inflation*** (π^e)
  - ***Supply shocks*** (ρ)
  - Potential GDP (Y^P)

- Let us concentrate on the two first forces.

Shifts in the AS Curve (π^e, ρ)



The AS shifts to the left if:

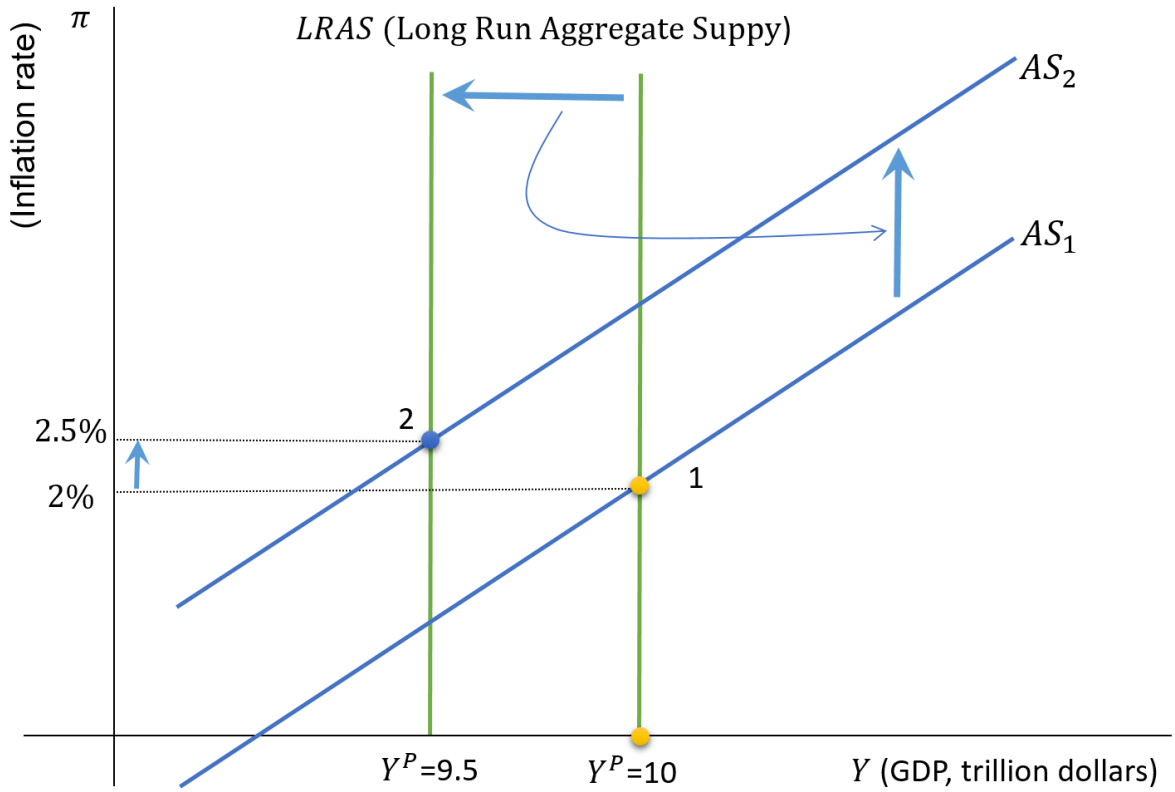
- $\uparrow \pi^e$, or
- $\uparrow \rho$

Shifts in the AS Curve (Y^P)

$$\pi = \pi^e + \gamma\left(Y - Y^P\right) + \rho \quad , \quad \pi^e = \pi_{-1}$$

- The AS Curve shifts when the following forces change:
  - Expected inflation (π^e)
  - Supply shocks (ρ)]
  - ***Potential GDP*** ***(Y^P)***
- Let us concentrate on the last force.

Shifts in the AS Curve (Y^P)



AS shifts to the left if:

- $\downarrow Y^P$
- The economy will have stable π only at point 2.
- At 2: $\downarrow Y$, $\uparrow \pi$

What Factors Shift the LRAS Curve?

- The factors that shift the LRAS curve are those that shift the production function studied in your Microeconomics course.
- The production function is given by:

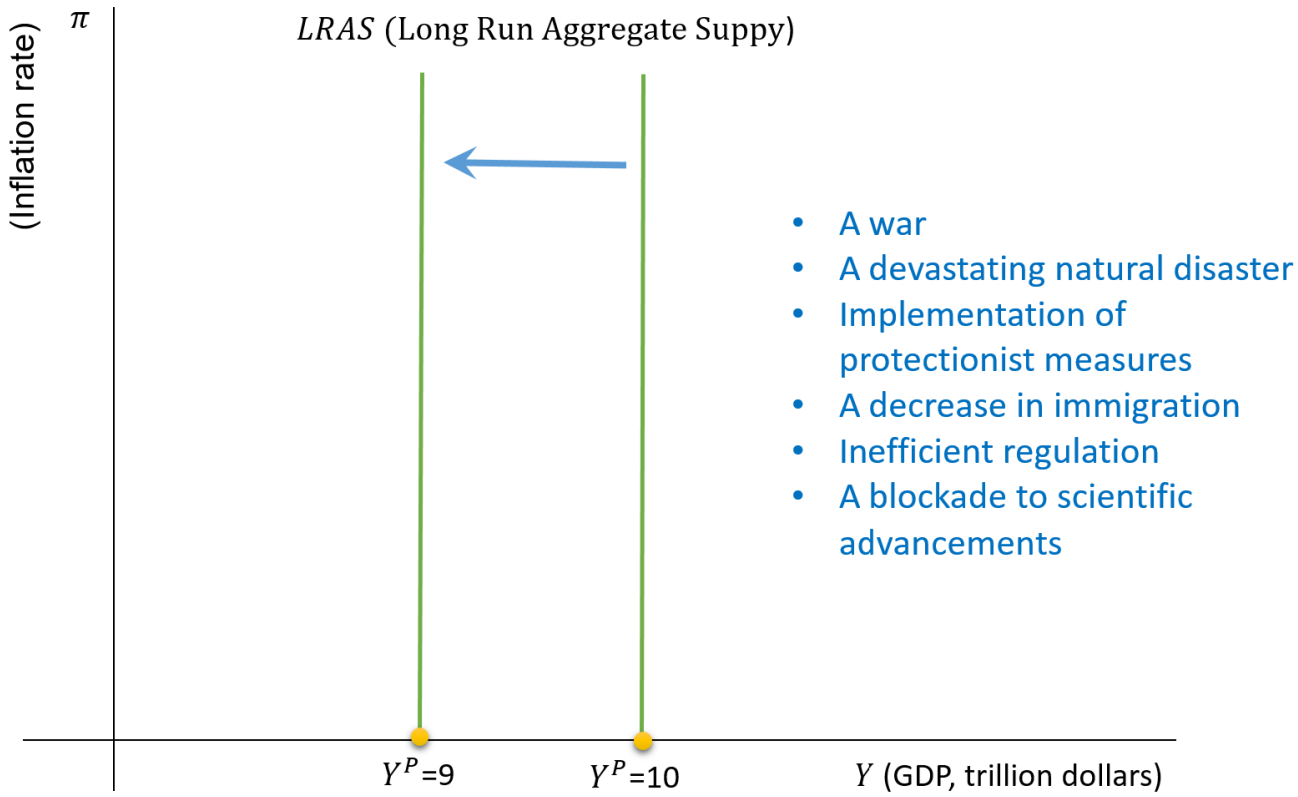
$$Y = F(\mathcal{T}, \mathcal{K}, \mathcal{L})$$

- The factors that shift the production function are:

- $\mathcal{T}$: Technology
- $\mathcal{K}$: Capital
- $\mathcal{L}$: Labor

What Factors Shift the LRAS Curve?

Forces reducing any of the factors $\{\mathcal{T}, \mathcal{K}, \mathcal{L}\}$ shift the LRAS to the left, and vice-versa.



5. Readings

Readings

Read ***Chapter 11*** of the adopted textbook:

Frederic S. Mishkin (2015). *Macroeconomics: Policy & Practice*, Second Edition, Pearson Editors.