Aggregate Demand and Aggregate Supply Analysis

This lecture develops an aggregate demand and aggregate supply model to study the effects of monetary policy on output and inflation.

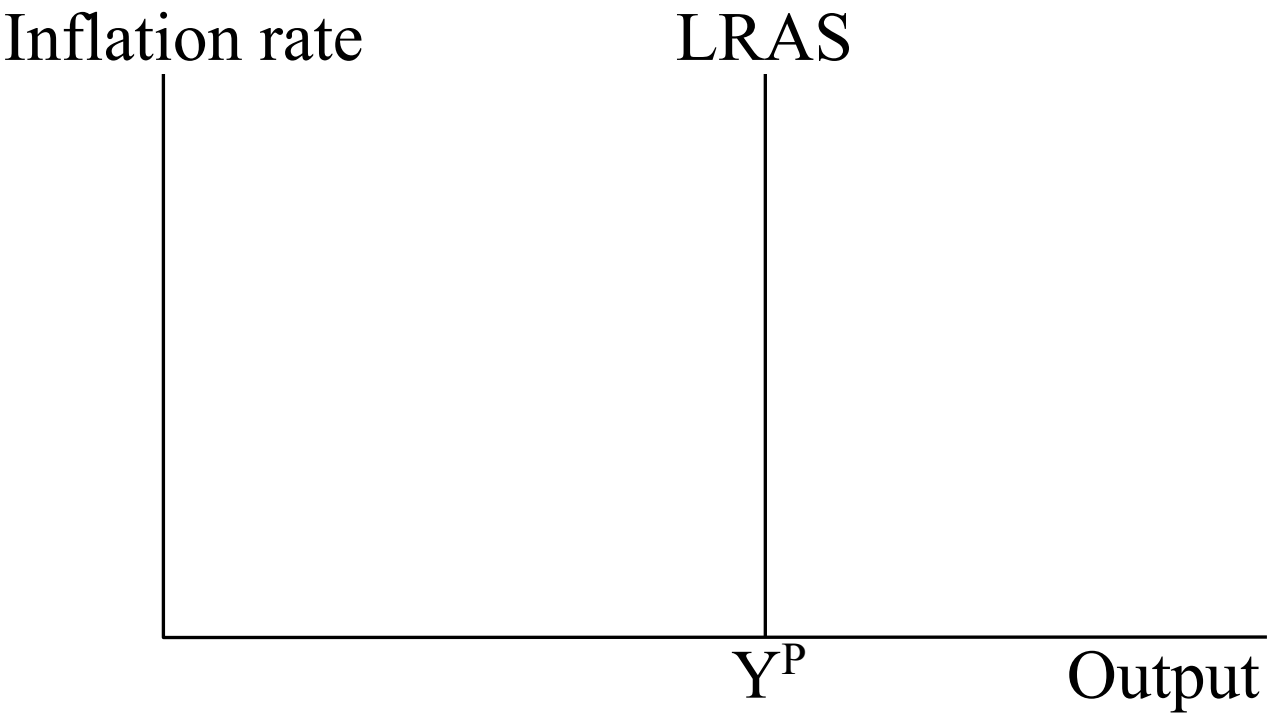
Aggregate Supply

A. Aggregate supply is the total amount of output that firms supply at different inflation rates.

   1. The long-run aggregate supply (LRAS) curve is vertical because prices and wages are flexible in the long run.
   2. The short-run aggregate supply (AS) curve is upward sloping because prices and wages are sticky in the short run.

B. The long-run aggregate supply curve

1. The LRAS curve denotes the level of output produced in the long run, which is called potential output (Y^P).
2. Potential output is the level of output when the economy is at full employment/the natural rate of unemployment.
3. Potential output is independent of the inflation rate, so the LRAS curve is vertical.



C. The short-run aggregate supply (AS) curve

1. There are three factors that affect inflation in the AS curve.

   a. Expected inflation (π^e)

      i. When π^e rises, the real wage declines causing workers to reduce their labor supply, which pushes up nominal wage inflation. Higher wage inflation raises production costs, which encourages firms to raise prices and results in higher inflation [$\pi^e\uparrow \rightarrow \pi\uparrow$].

   b. Output gap $(Y - Y^P)/Y^P$

      i. The output gap is the percent difference between actual output (Y) and potential output (Y^P).

      ii. As Y rises above Y^P, less idle labor is available, which puts upward pressure on wage inflation. The increased labor costs then lead to higher price inflation [$(Y - Y^P)/Y^P\uparrow \rightarrow \pi\uparrow$].

c. Inflation shocks (ρ)

   i. Inflation shocks are shocks to the supply of goods and services in the economy that are independent of π^e and the $(Y - Y^P)/Y^P$. [$\rho\uparrow \rightarrow \pi\uparrow$]

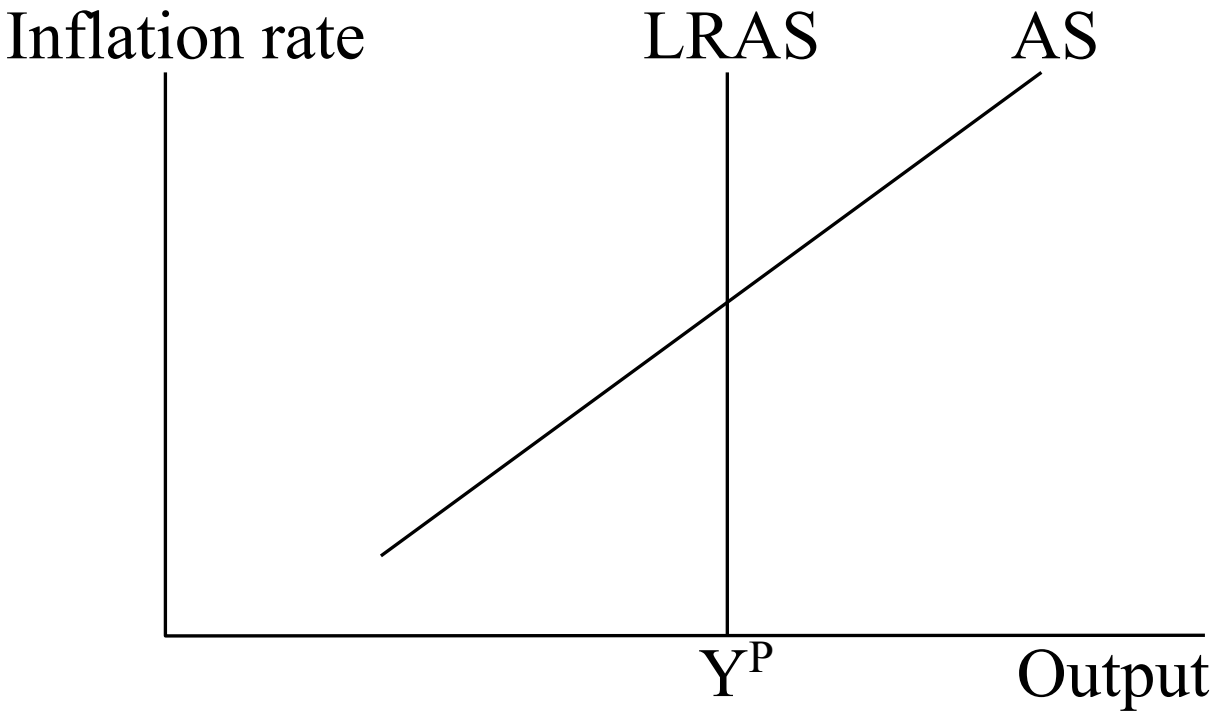
   ii. Example: Increases in the demand or decreases in the supply of energy can raise production costs, thus pushing up the inflation rate.

2. The short-run AS curve equation shows that π is a function of π^e, $(Y - Y^P)/Y^P$, and ρ

$$\pi = \pi^e + \gamma \times (Y - Y^P)/Y^P + \rho, \qquad (1)$$

where $\gamma > 0$ is the sensitivity of π to $(Y - Y^P)/Y^P$.

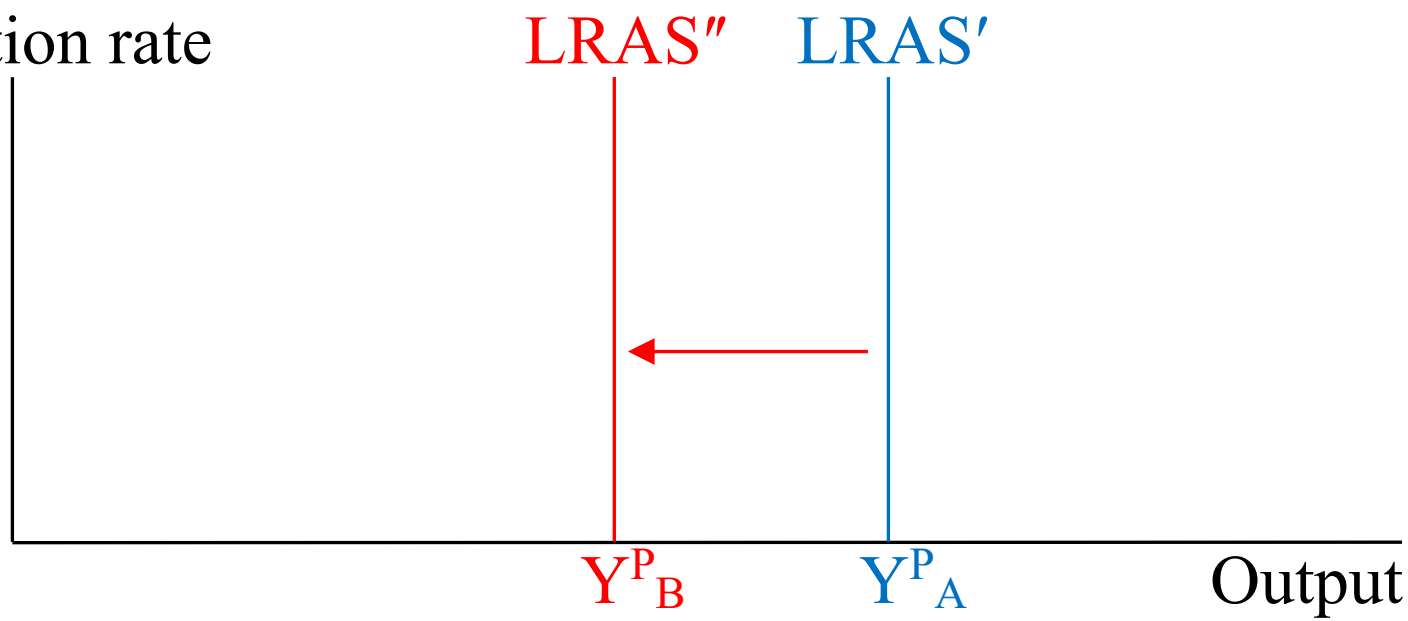
3. When prices and wages are stickier (like in the short run), γ is smaller and the slope of the AS curve is flatter. When prices and wages are flexible (like in the long-run), γ is infinite and the AS (LRAS) curve is vertical.



Shifts in the Aggregate Supply Curves

A. Factors that decrease Y^P and shift the LRAS curve to the left.

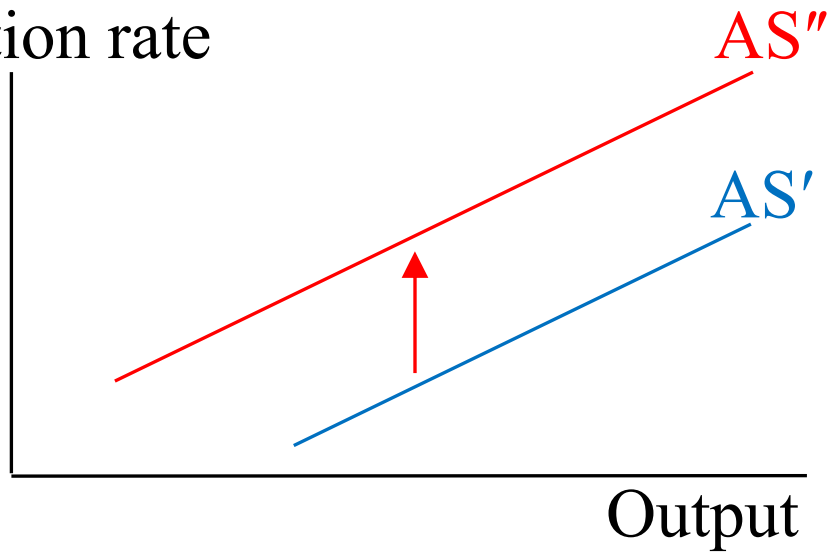
1. A decrease in the total amount of capital
2. A decrease in the total amount of labor
3. A decrease in available technology
4. A rise in the natural rate of unemployment
5. Flawed government policies like ill-advised regulations



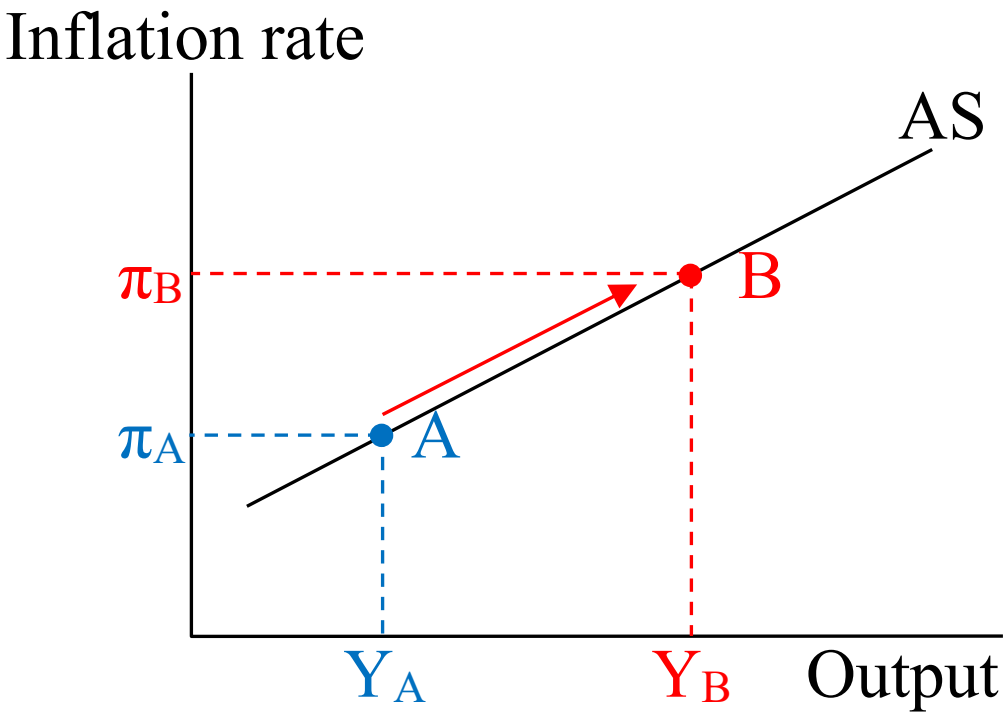
B. Since capital, labor, and technology usually grow at a steady rate, the LRAS curve shifts right at a steady pace over time.

C. Factors that shift the short-run AS curve up.

1. An increase in expected inflation [$\pi^e\uparrow \rightarrow \pi\uparrow$]
2. An unfavorable inflation shock [$\rho\uparrow \rightarrow \pi\uparrow$]
3. A decrease in potential output [$Y^P\downarrow \rightarrow \pi\uparrow$]



D. A rise in output causes an upward movement along the AS curve. [Y↑→π↑]

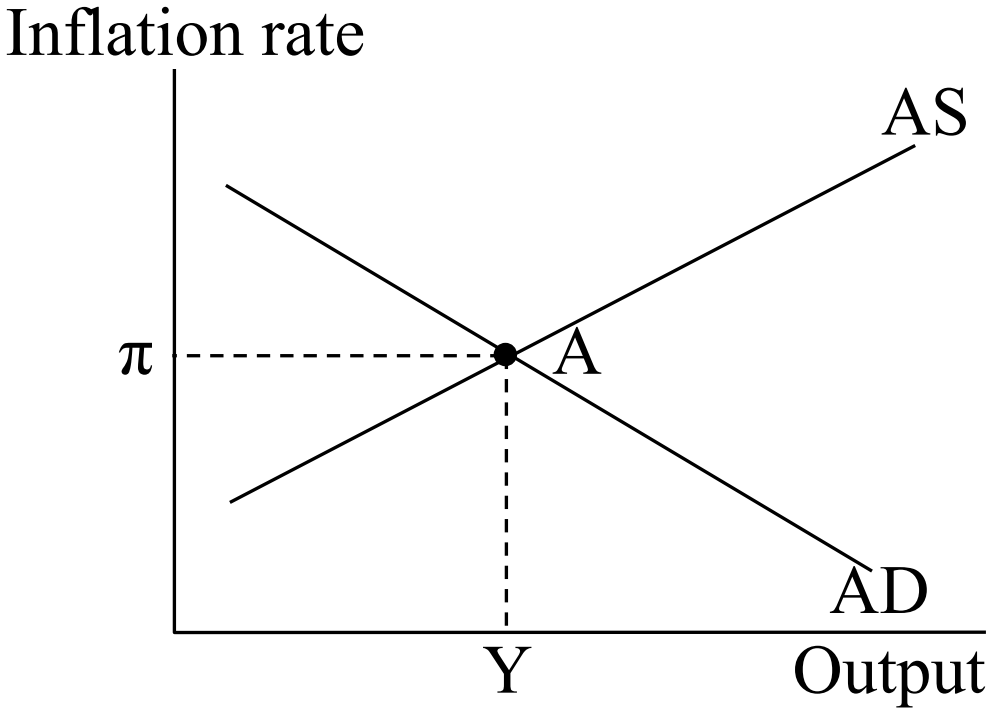


Equilibrium in Aggregate Demand and Aggregate Supply

A. The AD/AS model has both a short-run equilibrium and a long-run equilibrium.

B. In the short run, the equilibrium occurs where the AD and AS curves intersect.

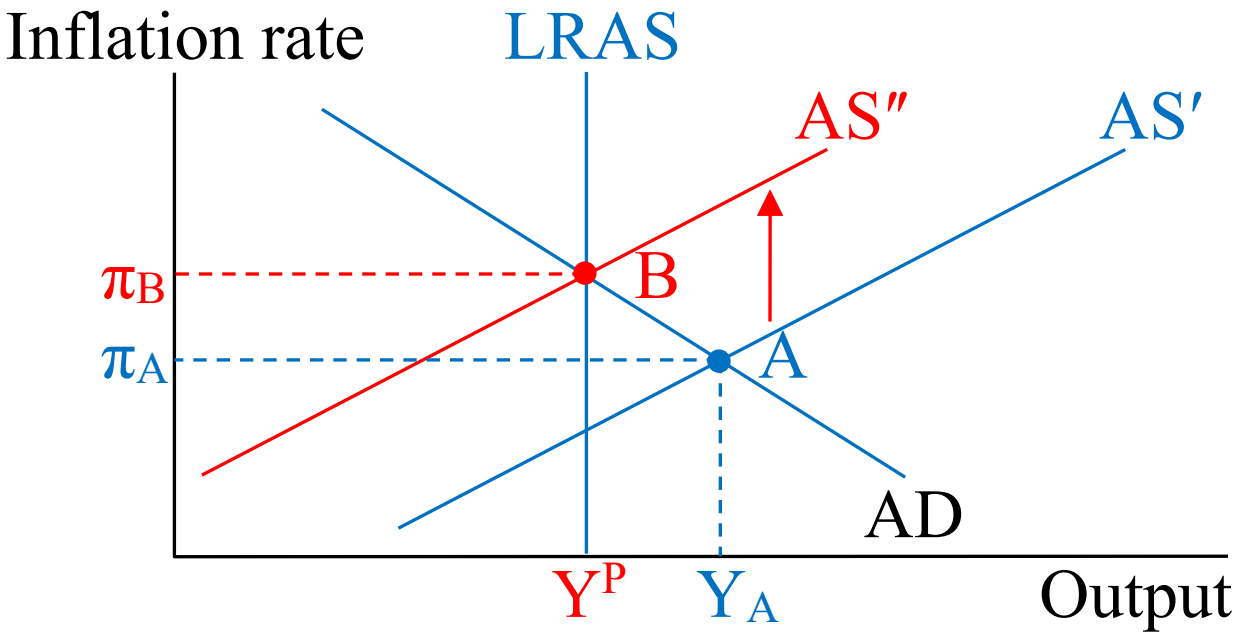
C. The short-run equilibrium level of output (Y) can be above or below potential output (Y^P).



D. As prices and wages become flexible over time, the economy moves from its short-run equilibrium to its long-run equilibrium. (i.e., Output moves to its potential.)

1. If $Y > Y^P$, then actual inflation (π) is greater than expected inflation (π^e) assuming $\rho = 0$ (see equation 1). [Blue]

2. Since $\pi^e < \pi$, $\pi^e\uparrow$ in subsequent periods causing the AS curve to shift up. This process continues until $Y=Y^P$. [Red]
[$(Y > Y^P)\rightarrow(\pi^e < \pi)\rightarrow\pi^e\uparrow\rightarrow\pi\uparrow\rightarrow r\uparrow\rightarrow(I\downarrow \text{ \& } NX\downarrow)\rightarrow Y\downarrow$]



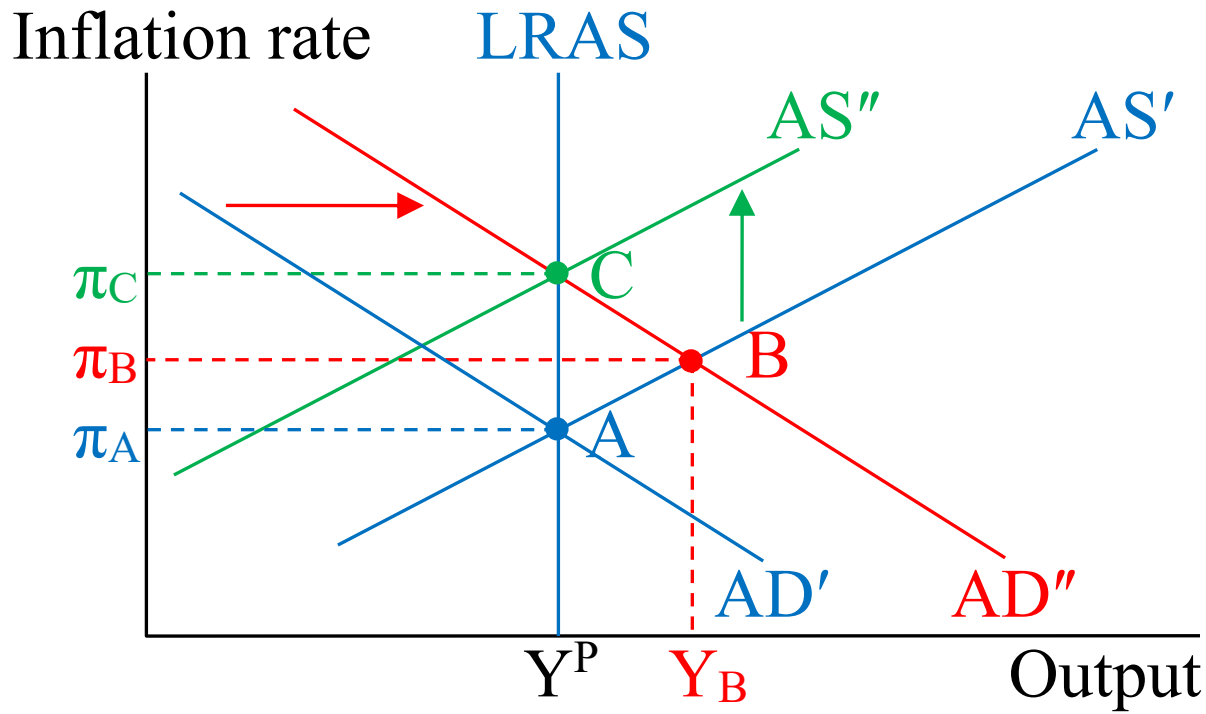
Aggregate Demand Shocks

A. AD Curve Shocks: The Short-Run and Long-Run Effects

1. Factors that shift the AD curve to the right
   a. An increase in autonomous consumption ($\bar{C}$) [$\bar{C}\uparrow \rightarrow Y\uparrow$]
   b. An increase in autonomous investment ($\bar{I}$) [$\bar{I}\uparrow \rightarrow Y\uparrow$]
   c. An increase in government spending ($\bar{G}$) [$\bar{G}\uparrow \rightarrow Y\uparrow$]
   d. A decrease in taxes ($\bar{T}$) [$T\downarrow \rightarrow Y^{D}\uparrow \rightarrow C\uparrow \rightarrow Y\uparrow$]
   e. An increase in auto. net exports ($\overline{NX}$) [$\overline{NX}\uparrow \rightarrow Y\uparrow$]
   f. A decrease in financial frictions ($\bar{f}$) [$\bar{f}\downarrow \rightarrow I\uparrow \rightarrow Y\uparrow$]
   g. A decrease in the autonomous real interest rate ($\bar{r}$)
      [$\bar{r}\downarrow \rightarrow r\downarrow \rightarrow (I\uparrow \ \& \ NX\uparrow) \rightarrow Y\uparrow$]
   h. An increase in the target inflation rate (π^{*})
      [$\pi^{*}\uparrow \rightarrow r\downarrow \rightarrow (I\uparrow \ \& \ NX\uparrow) \rightarrow Y\uparrow$]

2. The rightward shift in the AD curve causes an increase in both output and inflation in the short run. [($Y\uparrow \rightarrow \pi\uparrow$]

3. Since $\pi > \pi^e$ (because $Y > Y^P$), $\pi\uparrow$ and $Y\downarrow$ (the AS curve shifts up) as the economy transitions to the long run. This shift continues until Y returns to Y^P.
[$(Y < Y^P) \rightarrow (\pi^e > \pi) \rightarrow \pi^e\downarrow \rightarrow \pi\downarrow \rightarrow r\downarrow \rightarrow (I\uparrow \text{ \& } NX\uparrow) \rightarrow Y\uparrow$]



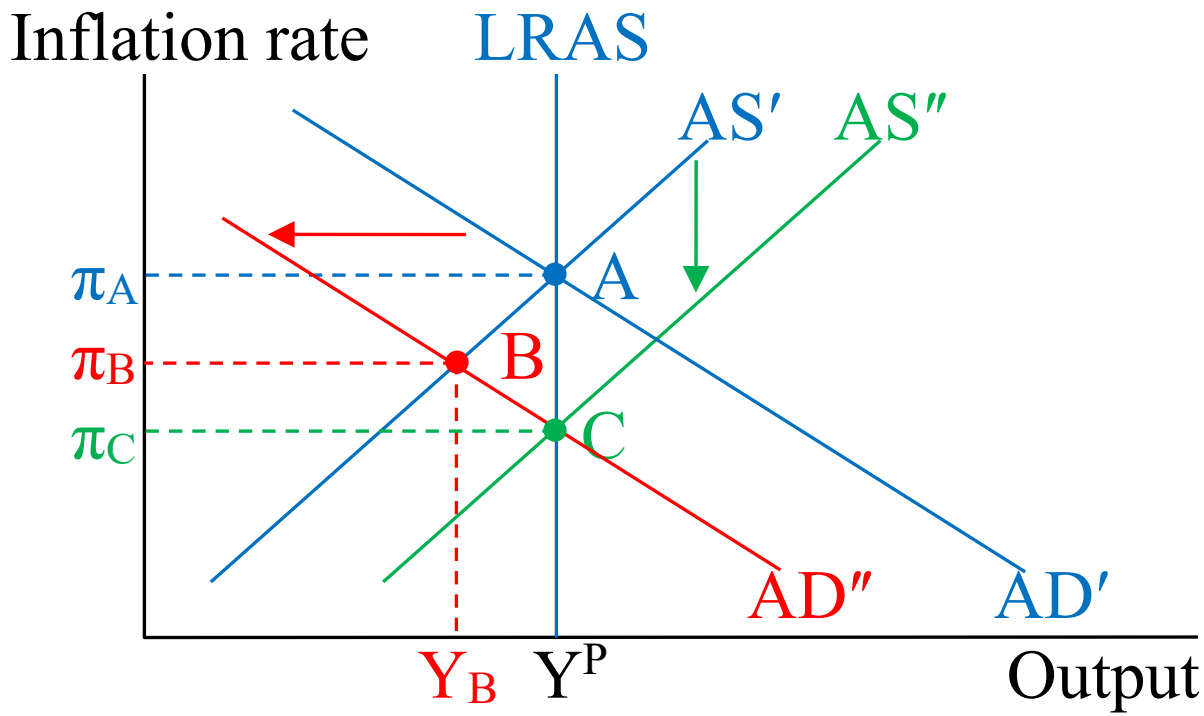
B. Case Study: The Volcker Disinflation, 1980-1986

1. When Paul Volcker became Fed chair in August 1979, the inflation rate exceeded 10%.
2. Volcker sought to lower inflation (π^* declines) by raising the federal funds rate to over 20% in early 1981.
3. A recession ensued and unemployment peaked at 10.8% in November 1982.
4. By 1984, the economy was in a strong expansion and the inflation rate fell to 1.9% in 1986.

5. The Volcker disinflation according to the AD/AS model.

   a. When the Fed lowers its inflation target, the real interest rate rises, which pushes output below its potential. [$\pi^{*}\downarrow \rightarrow r\uparrow \rightarrow (I\downarrow \text{ \& } NX\downarrow) \rightarrow Y\downarrow$]

   b. As $\pi^{e}\downarrow$, the aggregate supply curve shifts down causing inflation to fal; until output returns to its potential. [$(Y < Y^{P}) \rightarrow (\pi^{e} > \pi) \rightarrow \pi^{e}\downarrow \rightarrow \pi\downarrow \rightarrow r\downarrow \rightarrow (I\uparrow \text{ \& } NX\uparrow) \rightarrow Y\uparrow$]



Short-Run and Long-Run Aggregate Supply Shocks

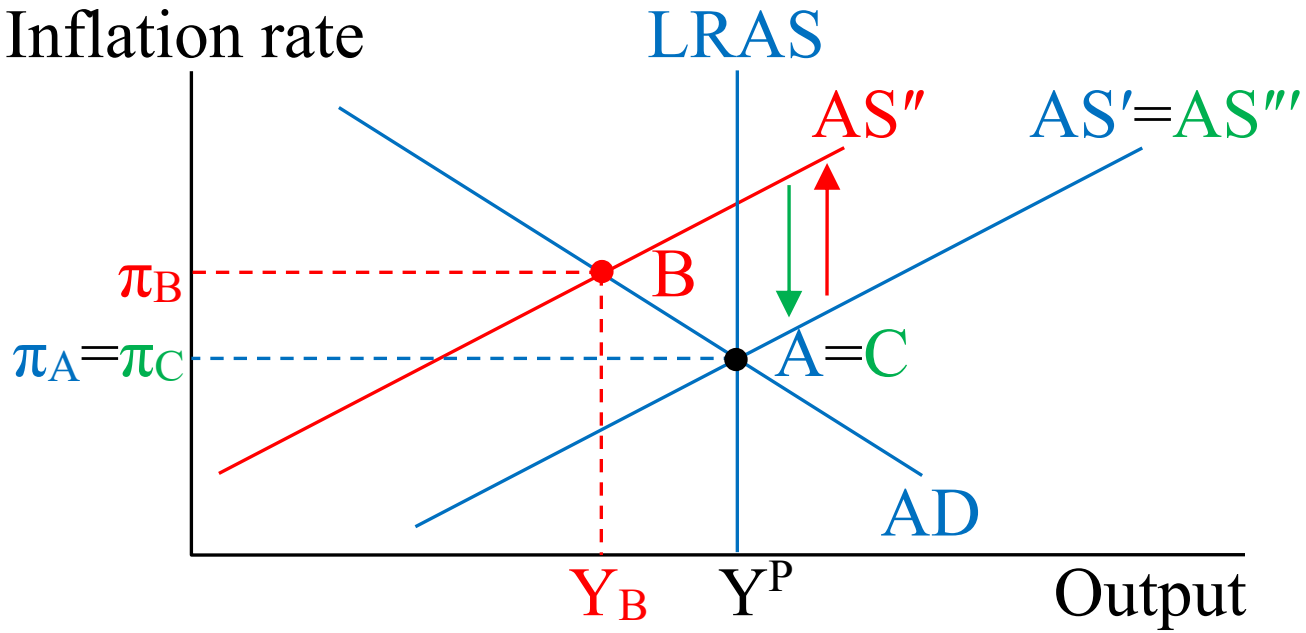
A. Short-Run Inflation Shocks

1. Unfavorable temporary inflation shocks can be caused by a large rise in oil prices, a sharp jump in food prices, and/or large wage increases that outpace productivity growth.

2. In the short run, higher ρ pushes up inflation, which causes the central bank to raise real interest rates. Higher rates dampen output by lowering investment and net exports.
   [$\rho\uparrow \rightarrow \pi\uparrow \rightarrow r\uparrow \rightarrow (I\downarrow \ \& \ NX\downarrow) \rightarrow Y\downarrow$]

3. In the long run, $Y < Y^P$ reduces inflation and inflation expectations. Those declines enable the central bank to lower the real interest rate, which stimulates output. This process continues until output returns to its potential.
   [$(Y < Y^P) \rightarrow (\pi^e > \pi) \rightarrow \pi^e\downarrow \rightarrow \pi\downarrow \rightarrow r\downarrow \rightarrow (I\uparrow \ \& \ NX\uparrow) \rightarrow Y\uparrow$]

4. Graph



5. <u>Stagflation</u> describes a situation where inflation is rising but aggregate output is falling.

B. Permanent Potential Output Shocks

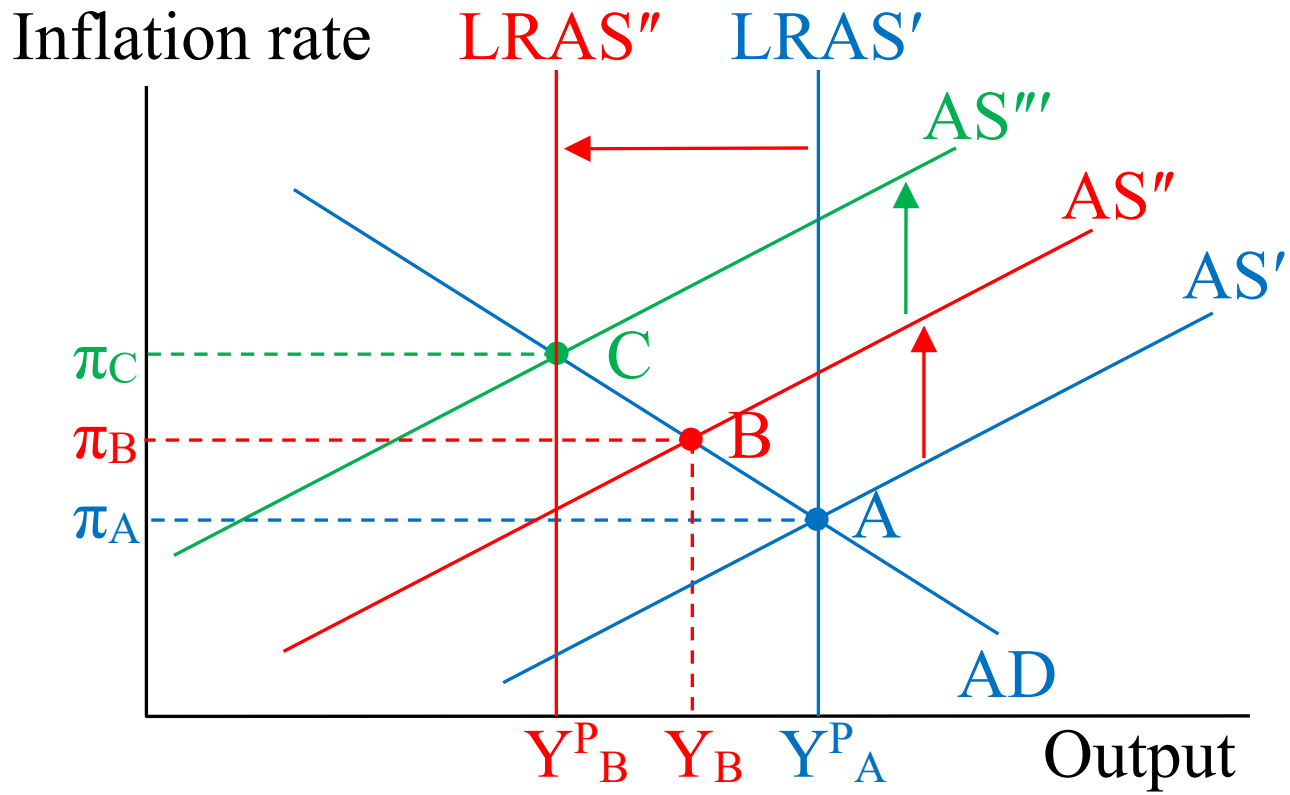
1. A permanent negative potential output shock causes by Y^P to fall from Y^P_A to Y^P_B by making the economy less efficient. LRAS curve shifts left LRAS′ from to LRAS″.

2. In the short run, a lower Y^P puts upward pressure on inflation, which causes the central bank to raise real interest rates. Higher rates dampen output by lowering investment and net exports. AS curve shift up from AS′ to AS″. [$Y^P\downarrow \rightarrow (Y > Y^P) \rightarrow \pi\uparrow \rightarrow r\uparrow \rightarrow (I\downarrow \text{ \& } NX\downarrow) \rightarrow Y\downarrow$]

3. As long as output remains above its potential, inflation and inflation expectations rise. Those increases push down output until $Y = Y^P_B$. AS curve shift up from AS″ to AS‴. [$(Y > Y^P) \rightarrow (\pi > \pi^e) \rightarrow \pi^e\uparrow \rightarrow \pi\uparrow \rightarrow r\uparrow \rightarrow (I\downarrow \text{ \& } NX\downarrow) \rightarrow Y\downarrow$]

4. In the long run, $Y^P\downarrow$ causes $\pi\uparrow$.

5. Graph



6. In most economies, potential output grows over time (long-run economic growth), which causes the LRAS curve to shift gradually to the right.

Numerical Problem

Suppose the following equations describe the economy:

$$Y = C + I + G + NX,$$
$$C = 150 + 0.8\times(Y - 1{,}200),$$
$$I = 1{,}410 - 5{,}000\times r,$$
$$G = 1{,}250,$$
$$NX = 200 - 7{,}000\times r,$$
$$R = 0.025 + \pi + 0.5\times(\pi - 0.02),$$
$$R = r + \pi,$$
$$\pi = 0.02 + 0.4\times(Y - 8{,}000)/8{,}000,$$

where Y is output, C is consumption, I is investment, G is government spending, NX is net exports, r is the real interest rate, R is the nominal interest rate, and π is the inflation rate.

A. Derive the equation for the IS curve.

Income identity: $Y = C + I + G + NX$

Consumption function: $C = 150 + 0.8\times(Y - 1{,}200)$,

Investment function: $I = 1{,}410 - 5{,}000\times r$,

Government spending: $G = 1{,}250$,

Net exports function: $NX = 200 - 7{,}000\times r$.

$$Y = 150+0.8\times(Y-1{,}200)+1{,}410-5{,}000\times r+1{,}250+200-7{,}000\times r$$

$$Y = 150-960+1{,}410+1{,}250+200+0.8\times Y-5{,}000\times r-7{,}000\times r$$

$$Y = 2{,}050 + 0.8\times Y - 12{,}000\times r$$

$$0.2\times Y = 2{,}050 - 12{,}000\times r$$

$$Y = 10{,}250 - 60{,}000\times r$$

B. Derive the equation for the monetary policy curve.

$$\text{Monetary policy rule: } R = 0.025 + \pi + 0.5\times(\pi - 0.02)$$
$$\text{Fischer equation: } R = r + \pi.$$

$$r + \pi = 0.025 + \pi + 0.5\times(\pi - 0.02)$$
$$r = 0.025 + 0.5\times\pi - 0.01$$
$$r = 0.015 + 0.5\times\pi$$

C. Derive the equation for the aggregate demand curve.

$$\text{IS curve: } Y = 10{,}250 - 60{,}000\times r$$
$$\text{MP curve: } r = 0.015 + 0.5\times\pi$$

$$Y = 10{,}250 - 60{,}000\times(0.015 + 0.5\times\pi)$$
$$Y = 10{,}250 - 900 - 30{,}000\times\pi$$
$$Y = 9{,}350 - 30{,}000\times\pi$$

D. Calculate the equilibrium inflation rate and level of output.

$$\text{AD curve: } Y = 9{,}350 - 30{,}000\times\pi,$$
$$\text{AS curve: } \pi = 0.02 + 0.4\times(Y - 8{,}000)/8{,}000.$$

$$\pi = 0.02 + 0.4\times(Y - 8{,}000)/8{,}000$$
$$\pi = 0.02 + (Y - 8{,}000)/20{,}000$$
$$20{,}000\times\pi = 400 + Y - 8{,}000$$
$$Y = 20{,}000\times\pi + 7{,}600$$

$$9{,}350 - 30{,}000\times\pi = 20{,}000\times\pi + 7{,}600$$
$$50{,}000\times\pi = 1{,}750$$
$$\pi = 1{,}750/50{,}000$$
$$\pi = 0.035$$

$$Y = 9{,}350 - 30{,}000\times(0.035)$$
$$Y = 9{,}350 - 1{,}050$$
$$Y = 8{,}300$$

E. Calculate the equilibrium real and nominal interest rates.

MP curve: $r = 0.015 + 0.5 \times \pi$,

Fisher equation: $R = r + \pi$.

$$r = 0.015 + 0.5 \times 0.035$$

$$r = 0.015 + 0.0175$$

$$r = 0.0325$$

$$R = 0.0325 + 0.035$$

$$R = 0.0675$$

F. Calculate equilibrium level of consumption, investment, and net exports.

Consumption function: $C = 150 + 0.8\times(Y - 1{,}200)$,
Investment function: $I = 1{,}410 - 5{,}000\times r$,
Net exports function: $NX = 200 - 7{,}000\times r$.

$$C = 150 + 0.8\times(8{,}300 - 1{,}200)$$
$$C = 150 + 5{,}680$$
$$C = 5{,}830$$

$$I = 1{,}410 - 5{,}000\times 0.0325$$
$$I = 1{,}410 - 162.5$$
$$I = 1{,}247.5$$

$$NX = 200 - 7{,}000\times 0.0325$$
$$NX = 200 - 227.5$$
$$NX = -27.5$$