Monetary Policy at the Zero Lower Bound

This lecture examines the impact of monetary policy when the nominal interest rate is stuck at zero. (R cannot fall below zero.)

The Monetary Policy (MP) Curve with a Zero Lower Bound

A. The Fisher equation

1. We assume the expected inflation rate (π^e) equals the actual inflation rate (π).

2. The Fisher equation relates the nominal interest rate (R) to the real interest rate (r) and the inflation rate

$$R = r + \pi. \tag{1}$$

B. The MP curve equation when $R > 0$

1. The monetary policy rule when $R > 0$ is

$$R = \bar{r} + \pi + \theta \times (\pi - \pi^*), \tag{2}$$

where $\bar{r} > 0$ is the autonomous real interest rate, π^* is the target inflation rate, and $\theta > 0$.

2. Substitute (2) into (1) to get the MP curve equation when $R > 0$:

$$r = \bar{r} + \theta \times (\pi - \pi^*). \tag{3}$$

3. There is a positive relationship between the real interest rate (r) and the inflation rate (π) when $R > 0$.

C. The MP curve equation when $R = 0$

1. The monetary policy rule in (2) becomes

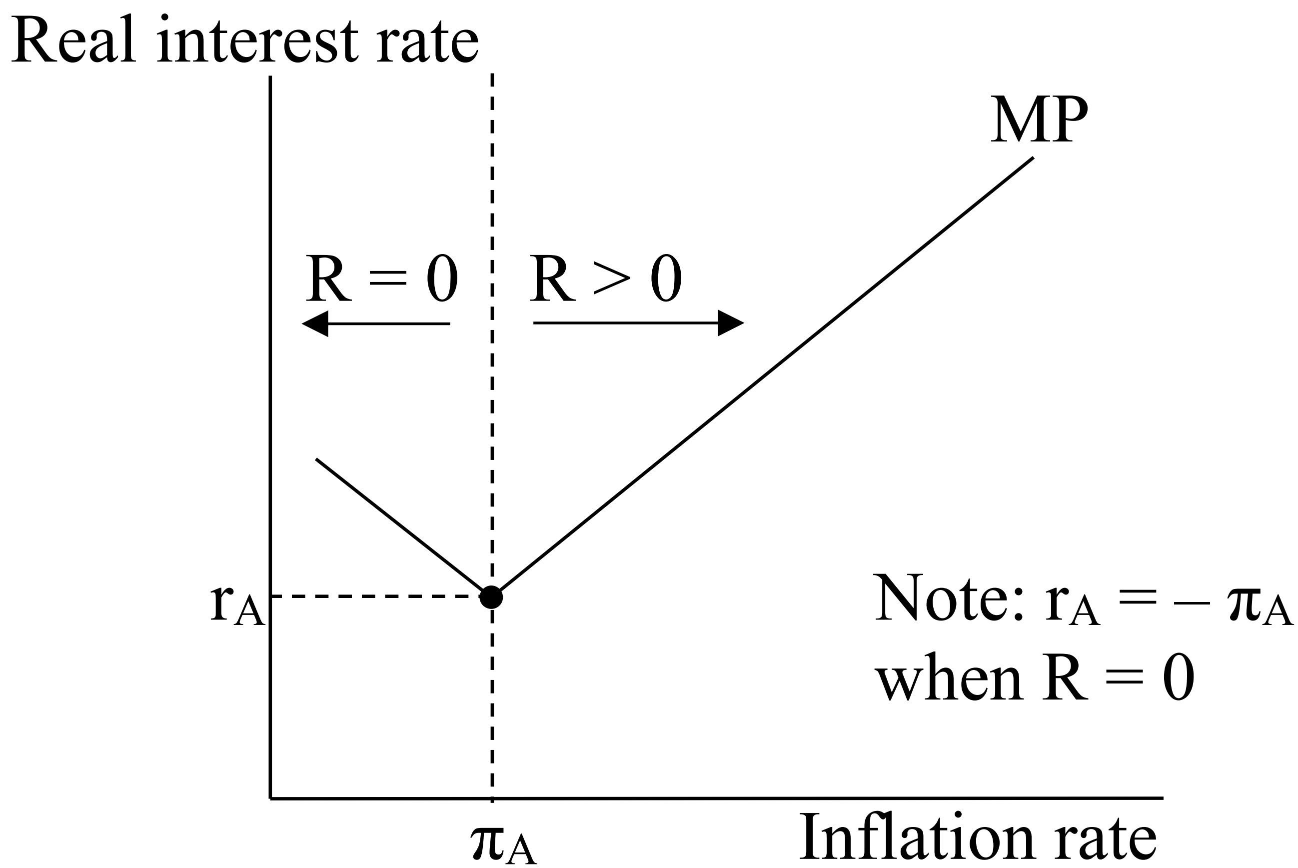
$$R = 0. \tag{4}$$

2. Substitute (4) into (1) to get the MP curve equation when $R = 0$:

$$r = -\pi. \tag{4}$$

3. There is a negative relationship between the real interest rate (r) and the inflation rate (π) when $R = 0$.

D. The graph of the monetary policy curve



1. When $\pi > \pi_A$, the nominal interest rate is above the zero lower bound ($R > 0$).

2. When $\pi \leq \pi_A$, the nominal interest rate is at the zero lower bound ($R = 0$).

The Aggregate Demand (AD) Curve and the Zero Lower Bound

A. The IS curve equation is

$$Y = \frac{\bar{C} + \bar{I} + \bar{G} + \overline{NX} - d \times \bar{f} - MPC \times \bar{T}}{1 - MPC} - \frac{d + x}{1 - MPC} \times r. \qquad (5)$$

B. The AD curve equation when R > 0

1. Substitute (3) into (5) to get

$$Y = \frac{\bar{C} + \bar{I} + \bar{G} + \overline{NX} - d \times \bar{f} - MPC \times \bar{T} - (d+x) \times (\bar{r} - \theta \times \pi^{*})}{1 - MPC} - \frac{(d + x) \times \theta}{1 - MPC} \times \pi.$$

2. There is a negative relationship between output (Y) and the inflation rate (π) when R > 0.

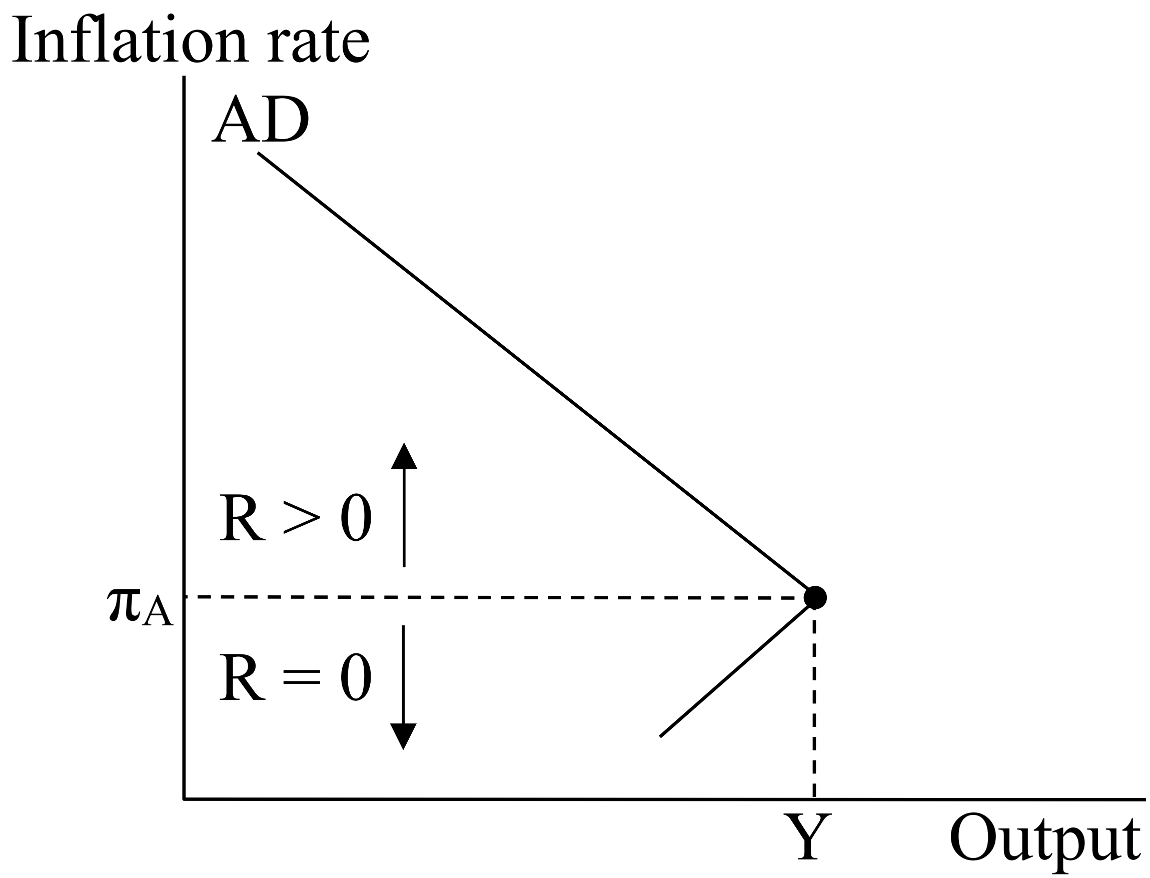
C. The AD curve equation when R = 0

1. Substitute (4) into (5) to get

$$Y = \frac{\bar{C} + \bar{I} + \bar{G} + \overline{NX} - d \times \bar{f} - MPC \times \bar{T}}{1 - MPC} + \frac{d + x}{1 - MPC} \times \pi. \qquad (6)$$

2. There is a positive relationship between output (Y) and the inflation rate (π) when R = 0.

D. The graph of the aggregate demand curve

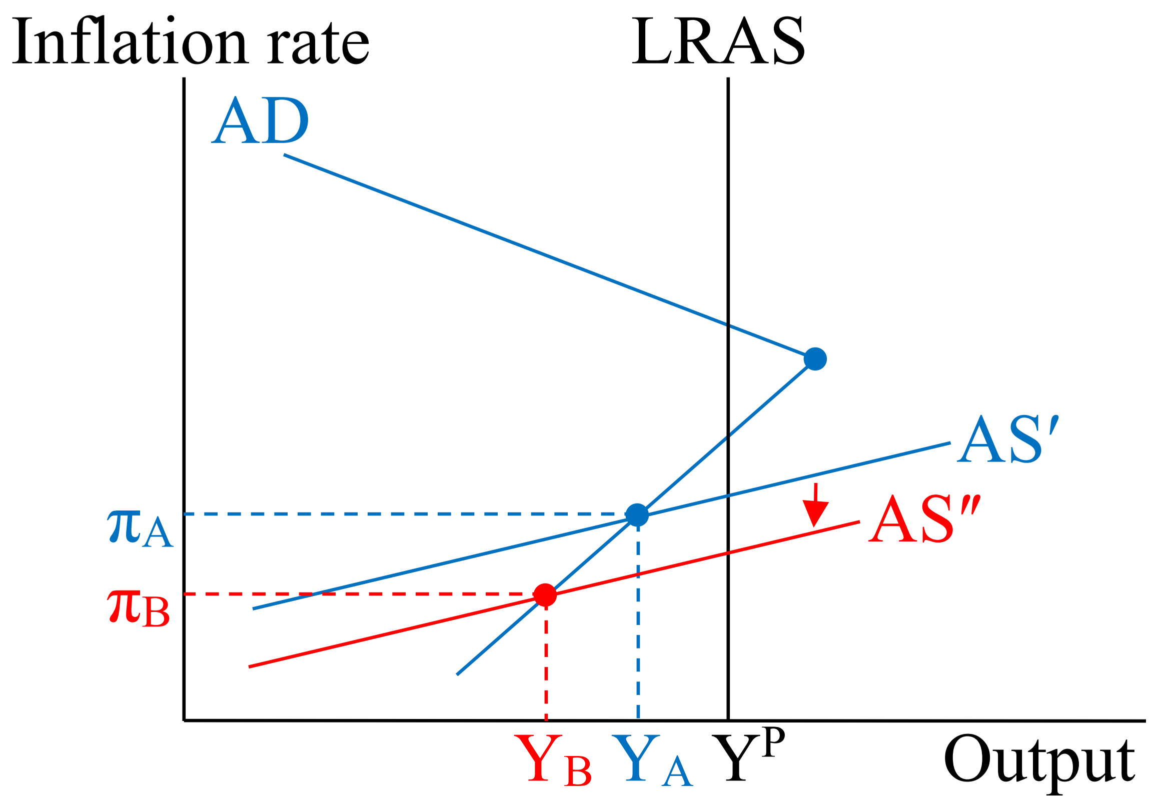


1. When $\pi > \pi_A$, the nominal interest rate is above the zero lower bound (R > 0).

2. When $\pi \leq \pi_A$, the nominal interest rate is at the zero lower bound (R = 0).

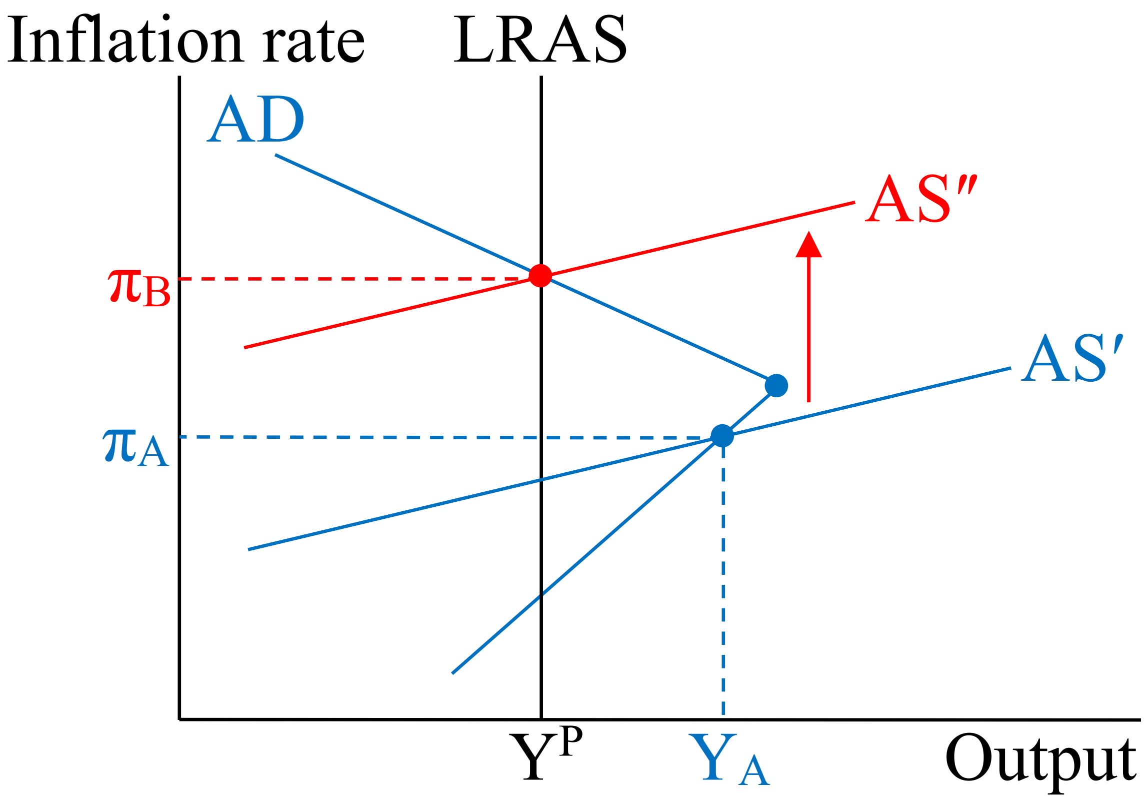
Output Might Not Return to Potential at the Zero Lower Bound

A. Suppose $Y < Y^P$ and $R = 0$



1. If $Y < Y^P$ at the zero lower bound, then Y will continue to decline over time. (AS curve shifts down.) Thus, the economy does not self-correct.

B. Suppose $Y > Y^P$ and $R = 0$



1. If $Y > Y^P$ at the zero lower bound, then Y will decline to Y^P over time. (AS curve shifts up.) Thus, the economy self-corrects.

C. In most cases when $R = 0$, $Y < Y^P$, so the economy will not be able to self-correct.

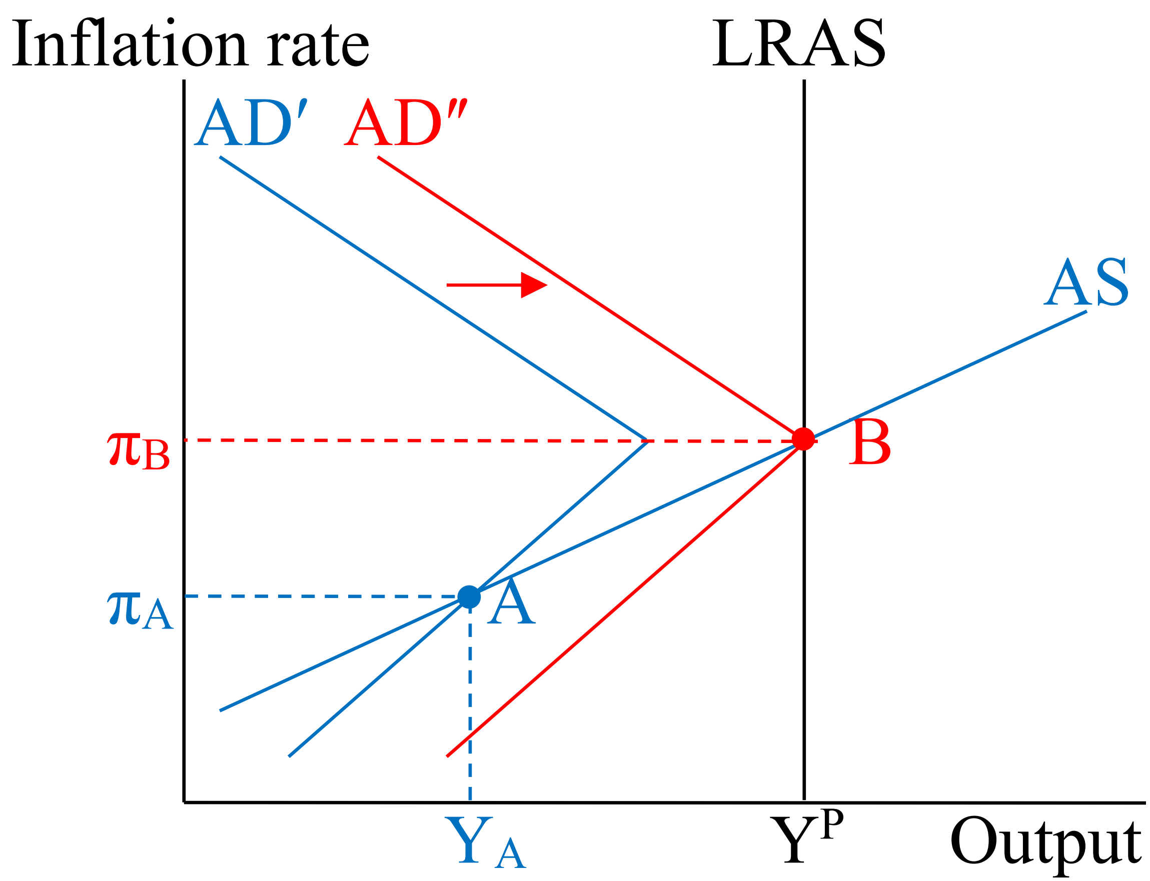
The Impact of Unconventional Monetary Policy at the Zero Lower Bound

A. Unconventional monetary policy is designed to stimulate the economy by reducing asymmetric information problems ($\bar{f}\downarrow$) when the nominal interest rate is at the zero lower bound.

B. There are three types of unconventional monetary policy.

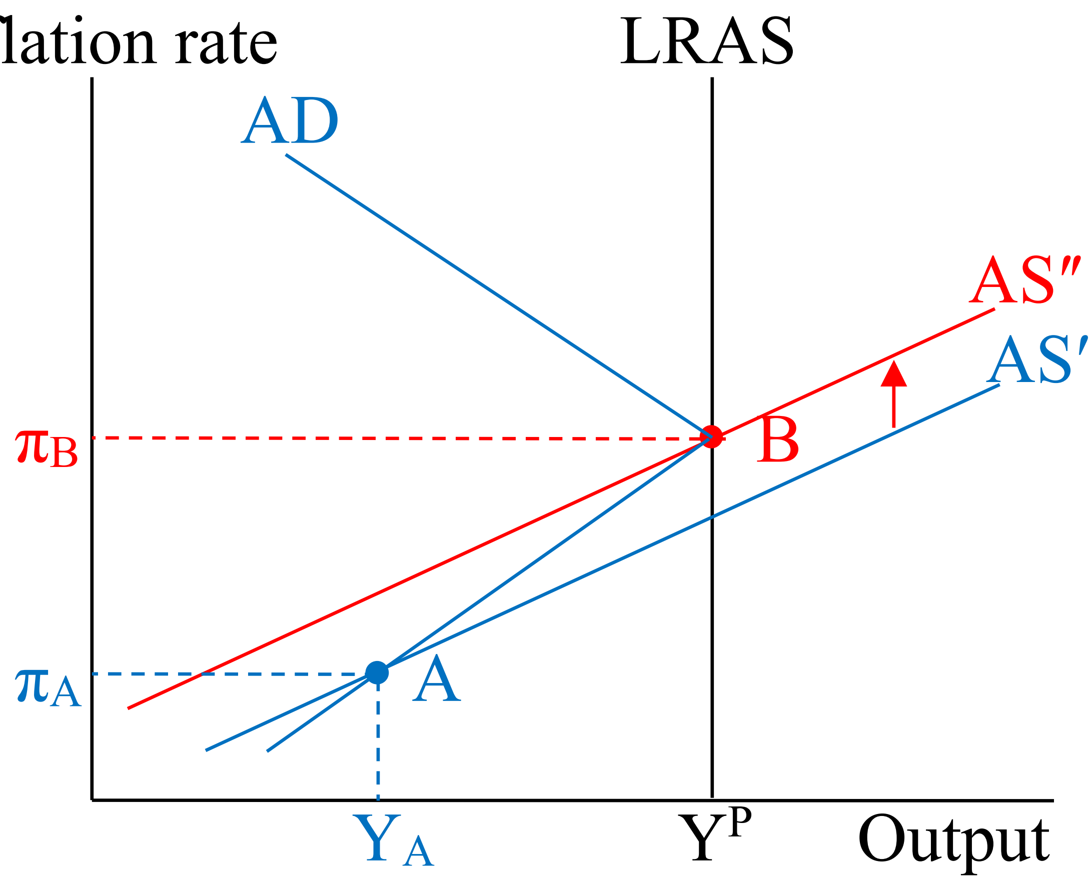
   1. Programs to provide liquidity to financial markets
   2. Large-scale asset purchases (quantitative easing)
   3. Forward guidance (managing expectations)

C. When $Y < Y^P$ and $R = 0$, unconventional monetary policy lowers $\bar{f}$ and shifts the AD curve right.



1. This rightward shift in the AD curve from unconventional monetary policy causes both output and inflation to rise. [point B]

D. When $Y < Y^P$ and $R = 0$, forward guidance can, in some cases, cause inflation expectations to rise, which is represented by an upward shift in the AS curve.



1. This upward shift in the AS curve from forward guidance causes both output and inflation to rise. [point B]

Numerical Problem

Suppose the following equations describe the economy:

$$Y = C + I + G + NX,$$
$$C = 150 + 0.75\times(Y - 1{,}200),$$
$$I = 1{,}450 - 8{,}000\times r,$$
$$G = 1{,}250,$$
$$NX = 200 - 12{,}000\times r,$$
$$R = 0,$$
$$R = r + \pi,$$
$$\pi = 0.02 + 0.4\times(Y - 8{,}000)/8{,}000,$$

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: $C = 150 + 0.75\times(Y - 1{,}200)$,

Investment function: $I = 1{,}450 - 8{,}000\times r$,

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

Net exports function: $NX = 200 - 12{,}000\times r$.

$$Y = 150+0.75\times(Y-1{,}200)+1{,}450-8{,}000\times r+1{,}250+200-12{,}000\times r$$

$$Y = 150-900+1{,}450+1{,}250+200+0.75\times Y-8{,}000\times r-12{,}000\times r$$

$$Y = 2{,}150 + 0.75\times Y - 20{,}000\times r$$

$$0.25\times Y = 2{,}150 - 20{,}000\times r$$

$$Y = 8{,}600 - 80{,}000\times r$$

B. Derive the equation for the monetary policy curve.

Monetary policy rule: $R = 0$,
Fischer equation: $R = r + \pi$.

$$r + \pi = 0$$
$$r = -\pi$$

C. Derive the equation for the aggregate demand curve.

IS curve: $Y = 8{,}600 - 80{,}000 \times r$,
MP curve: $r = -\pi$.

$$Y = 8{,}600 - 80{,}000 \times (-\pi)$$
$$Y = 8{,}600 + 80{,}000 \times \pi.$$

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

$$\text{AD curve: } Y = 8{,}600 + 80{,}000\times\pi,$$
$$\text{AS curve: } \pi = 0.015 + (Y - 8{,}000)/8{,}000.$$

$$\pi = 0.015 + (Y - 8{,}000)/8{,}000$$
$$8{,}000\times\pi = 120 + Y - 8{,}000$$
$$Y = 8{,}000\times\pi + 7{,}880$$

$$8{,}600 + 80{,}000\times\pi = 8{,}000\times\pi + 7{,}880$$
$$72{,}000\times\pi = -\,720$$
$$\pi = -\,720/72{,}000$$
$$\pi = -\,0.01$$

$$Y = Y = 8{,}600 + 80{,}000\times(-\,0.01)$$
$$Y = 8{,}600 - 800$$
$$Y = 7{,}800$$

E. Calculate the equilibrium real interest rate.

$$\text{MP curve: } R = 0,$$
$$\text{Fisher equation: } R = r + \pi.$$

$$r + \pi = 0$$
$$r = -\pi$$
$$r = 0.01$$

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

$$\text{Consumption function: } C = 150 + 0.75\times(Y - 1{,}200),$$
$$\text{Investment function: } I = 1{,}450 - 8{,}000\times r,$$
$$\text{Net exports function: } NX = 200 - 12{,}000\times r.$$

$$C = 150 + 0.75\times(7{,}800 - 1{,}200)$$
$$C = 150 + 4{,}950$$
$$C = 5{,}100$$

$$I = 1{,}450 - 8{,}000\times 0.01$$
$$I = 1{,}450 - 80$$
$$I = 1{,}370$$

$$NX = 200 - 12{,}000\times 0.01$$
$$NX = 200 - 120$$
$$NX = 80$$