

W8

Great depression = \downarrow GDP (%) by 30%
 \uparrow unemployment by 25%

2007-2008 = \uparrow unemployment by 10%

Why these happens?



1. AD-AS Framework (Keynesian Framework)



Short-Run changes in GDP is caused by aggregate demand



In order to establish aggregate demand curve,
we need to show the IS curve.



Investment - Saving Curve

IS curve = shows relationship between real interest rate (r)
and GDP (%)

IS curves helps to explain

1) Why fluctuation happens?

2) Role of Monetary policy in correcting fluctuations?

2. Understand Actual and planned Expenditure

Expenditures

Actual Expenditures

Planned Expenditures

3. 4 players in the Economy

① Government



③ Foreigners



② Households



④ Firms



Decisions made by the 4 players affect the aggregate Demand.

We can define the Aggregate Demand (γ^{ad}) as =
total amount of output demanded

$$\gamma^{ad} = \text{planned Expenditure} = \underbrace{C}_{\text{aggregate consumption}} + \underbrace{I}_{\text{investment}} + \underbrace{G}_{\text{gov expenditure}} + \underbrace{NX}_{\text{net export}}$$

(1) Consumption Expenditures (Household)

$$C = \bar{C} + mpc \cdot Y_d$$

\bar{C} = autonomous Consumption (自主消费支出)

↳ the amount of expenditures independent of disposable Income

mpc = Marginal Propensity to Consume

↓

mpc = $\frac{\Delta C}{\Delta Y_d} \Rightarrow$ the change in consumer expenditure

↓ with additional dollar disposable Income

Slope of Consumption Function

mpc condition =

$$0 \leq MPC \leq 1$$

y_d = Disposable Income

↓

$$Y_d = Y - T$$

~ Tax
gross income

(2) Investment (Business)

1) Fixed Investment 固定投资 (总是在计划内)

(Always planned)

E.g. Equipment, Structures (factories), new housing

2) Inventory Investment 库存投资 (不一定在计划内)

(can be unplanned)

E.g. raw materials, plants, finished product

Ex = Toyota

31st Dec 2023 = 100,000 cars inventories

31st Dec 2024 = 150,000 cars inventories

Δ inventory = 50,000

↓

unplanned increase in inventory

$I =$ (planned) Fixed Investment

+

planned Inventory Investment

$I = \bar{I} - d \cdot r_c \rightarrow$ real cost of investment / borrowing

autonomous \rightarrow responsiveness
investment of investment
 \downarrow

how responsive is your investment to
real cost of investment

$0 \leq d \leq 1$
 \downarrow
not responsive responsive

Firm's Decision

1) without excess Funds

\downarrow

need to borrow

\downarrow

invest if rate of return > real cost of investment (r_c)

2) with Excess Funds

\downarrow

Do not need to borrow

\downarrow

Invest if rate of return > opportunity cost of investing
(r_c)

We can define (r_c) as =

real $\frac{r_c}{r}$ = $r + \bar{f}$ financial frictions
cost of Borrowing real interest rate

real cost of borrowing (r_c) > real interest rate (r_d)

Due to Financial Friction



financial frictions are directly related to

Asymmetric Info

{ 1) Adverse Selection
2) Moral Hazard

$$I = \bar{I} - d \cdot r_c$$

$$I = \bar{I} - d(r + \bar{f})$$

$$I \uparrow \Rightarrow \bar{I} \uparrow$$

$$r \downarrow \Rightarrow I \uparrow$$

$$\bar{f} \uparrow \Rightarrow I \uparrow$$

(3) Net Export

$$NX = \underbrace{N\bar{X}}_{\substack{\text{autonomous} \\ \text{net exports}}} - \underbrace{X \cdot r}_{\substack{\text{responsiveness} \\ \text{of interest rates}}} \rightarrow \text{real interest rate}$$

autonomous net exports responsiveness of interest rates

If $r_{\text{domestic}} \uparrow \Rightarrow$ Demand for Domestic Assets \uparrow



Domestic currency appreciates ↑



Import ($M \uparrow$), Export ($X \downarrow$)



Net Export ($X - M \downarrow$)

(4) Gov Expenditures (G)

$$G = \bar{G}$$

Fixed autonomous expenditure

(gov spending is independent of interest rate)



To finance gov expenditure, gov needs to collect Taxes

$$T = \bar{T}$$

Taxes



We can write Disposable Income (Y^D) as =

$$Y^D = Y - T \rightarrow Y^D = Y - \bar{T}$$



We can rewrite C as =

$$C = \bar{C} + MPC \cdot Y^D$$

$$C = \bar{C} + MPC (Y - \bar{T})$$

$$\uparrow \bar{T} \Rightarrow Y^D \downarrow \Rightarrow C \downarrow$$

$$Y^D = Y - \bar{T} \quad C = \bar{C} + MPC \cdot Y^D$$

3. Goods Market Equilibrium

$$Y = \underbrace{Y}_{\substack{\text{Total quantity} \\ \text{of output}}} \underbrace{ad}_{\substack{\text{Total amount} \\ \text{of aggregate demand}}}$$

Total quantity of output Total amount of aggregate demand



Planned spending = Output produced

$$\text{recall: } \gamma^{\text{ad}} = C + I + G + NX$$

so: In Equilibrium

$$\gamma = \gamma^{\text{ad}} = C + I + G + NX$$

$$= \frac{\bar{C} + MPC(\gamma - \bar{r})}{C} + \frac{\bar{I} - d(r + f)}{I} + \frac{\bar{G}}{G} + \frac{\bar{N}X}{NX} - \lambda \cdot r$$

$$= (\bar{C} - MPC \cdot \bar{r} + \bar{I} - df + \bar{G} + \bar{N}X)$$

Independent from interest rate (\bar{A})

$$+ (MPC \cdot \gamma - d \cdot r - x \cdot r)$$

Autonomous



we can write =

$$\gamma = \bar{A} + (MPC \cdot \gamma - d \cdot r - x \cdot r)$$

$$\gamma - MPC \cdot \gamma = \bar{A} - (d + x) \cdot r$$

$$(1 - MPC) \gamma = \bar{A} - (d + x) \cdot r$$

$$\gamma = \underbrace{\frac{\bar{A}}{(1 - C)}}_{\text{Shifts in IS}} - \underbrace{\frac{(d + x)}{(1 - C)} \cdot r}_{\text{movements along IS curve}}$$



The relationship between interest rate (r) and GDP (γ)



"IS curve Equation"

4. Shift of IS curve

(i) Shift IS curve to the right

$\uparrow \bar{C}, \uparrow \bar{I}, \uparrow \bar{G}, \uparrow \bar{N}X$

$\downarrow \bar{r}, \downarrow f$

At a given interest rate, more GDP will be produced.

$$Ex = \bar{C} = \$1.4 \quad I = \$1.2 \quad G = \$3 \quad \bar{T} = \$3 \quad Nx = \$1.3$$

$$\bar{F} = 1 \quad \underbrace{c}_{MPC} = 0.6 \quad d = 0.3 \quad x = 0.1$$

$$IS = Y = \frac{\bar{A}}{(1-c)} - \frac{(d+x)}{(1-c)} \cdot r$$

$$\bar{A} = \bar{C} - MPC \cdot \bar{T} + \bar{I} - d\bar{F} + \bar{G} + \bar{N}x$$

$$= 1.4 - 0.6(3) + 1.2 - 0.3(1) + 3 + 1.3 = 4.8$$

$$\frac{\bar{A}}{1-c} = \frac{4.8}{1-0.6} = 12$$

$$\frac{d+x}{1-c} \cdot r = \frac{0.2 + 0.1}{1-0.6} \cdot r$$

↓

$$Y = 12 - r$$

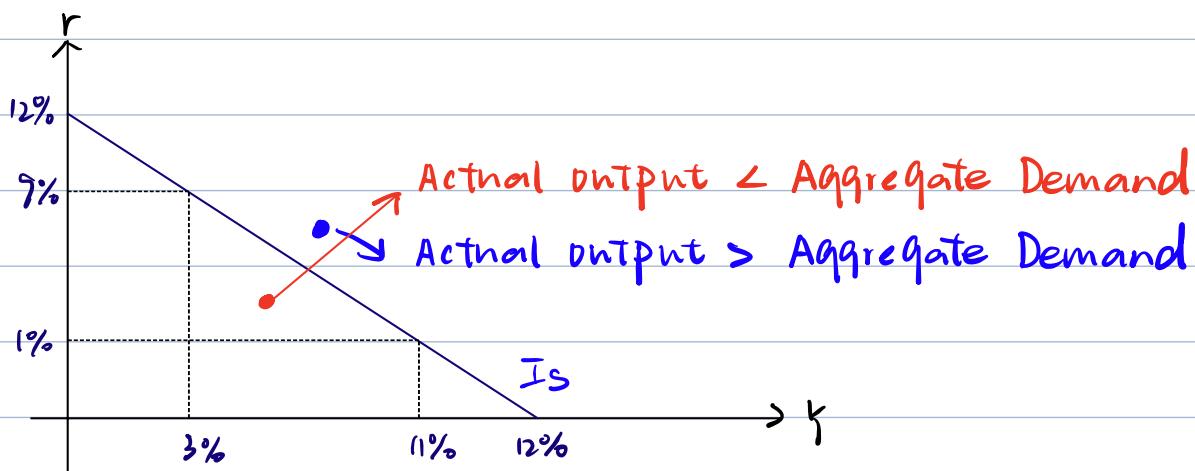
↓

We draw the IS curve =

$$r = 0\% , \quad Y = 12$$

⋮

$$r = 12\% \quad Y = 0$$



1) If Actual Output < Aggregate Demand



we need to ↑ production

2) If Aggregate Output > Aggregate Demand



left with unsold inventories

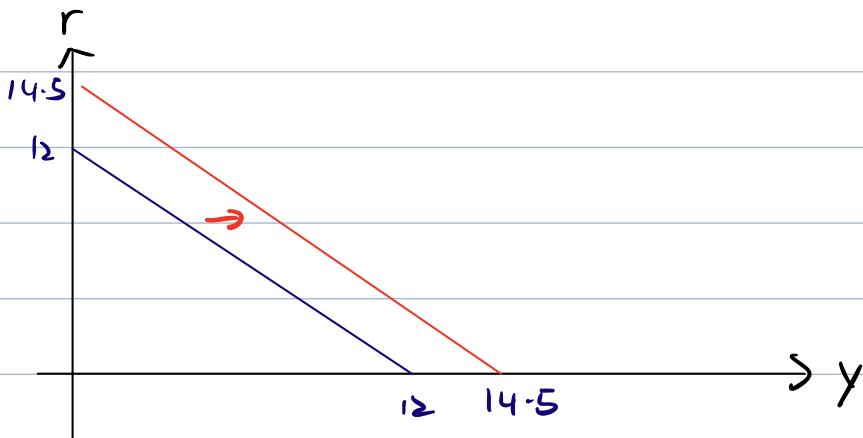


cut production ↓

4.1 ↑ \bar{G} shifts IS curve to the right

Suppose ↑ \bar{G} from \$3 to \$4

$$\begin{cases} IS_1 = Y = 12 - r \quad \text{when } \bar{G} = 3 \\ IS_2 = Y = 14.5 - r \quad \text{when } \bar{G} = 4 \end{cases}$$



$\uparrow \bar{G}$ shifts IS curve to the right

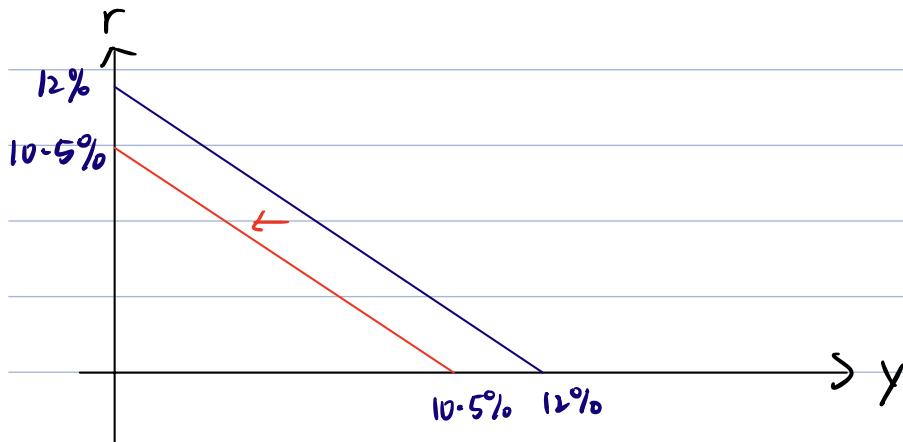
AT a given interest rate = more output is produced

4.2 ↑ \bar{T} shifts IS curve to the left

Suppose ↑ \bar{T} from \$3 to \$4

$$IS_1 = 12 - r \quad \text{when } \bar{T} = 3$$

$$IS_2 = 10.5 - r \quad \text{when } \bar{T} = 4$$



5. Central Bank and Monetary Policy

(I) How Monetary Policy affects Aggregate Demand



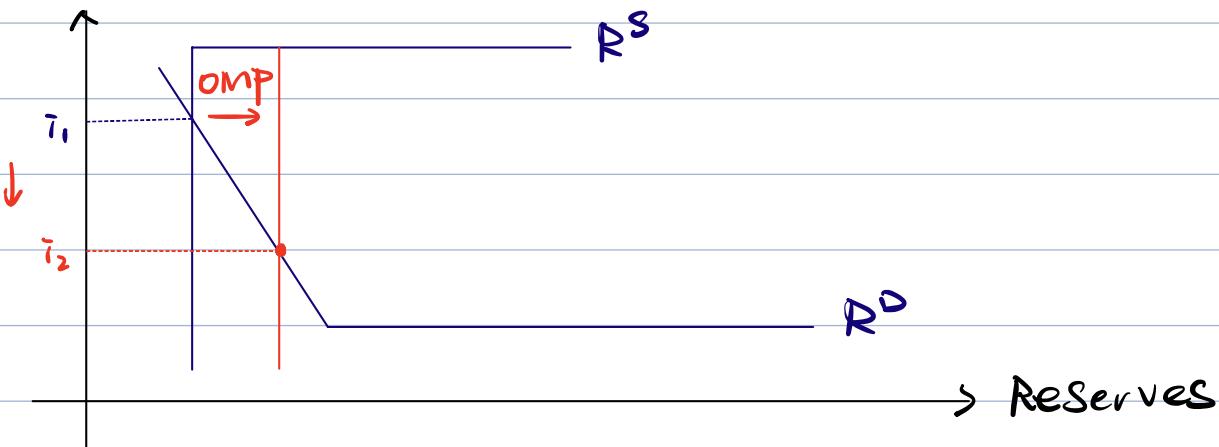
US use Short-term nominal interest rate (policy rate)

as their main tool



in the Federal Fund Market

Policy rate



OMP = interest rate ↓ \Rightarrow "Expansionary MP"

"policy rate" is a nominal interest rate

Real interest rate affects

- ① Net export
- ② Investment

By Simplified Fisher Equation =

$$\underline{r} = \underline{i} - \underline{\pi^e}$$

real interest rate ↓ nominal interest rate ↳ Expected inflation rate



why CB want to make sure expected inflation does not change?

the change in nominal interest rate (i) can affect the real interest rate (r) only if the expected inflation (π^e) does not change

Fact: prices are sticky,

the change in expected inflation is very slow



So CB $\downarrow i \Rightarrow \downarrow r$



Conclusion:

CB want to change real interest rate,

but they cannot change directly,

they can change (r) through nominal interest rate (i)

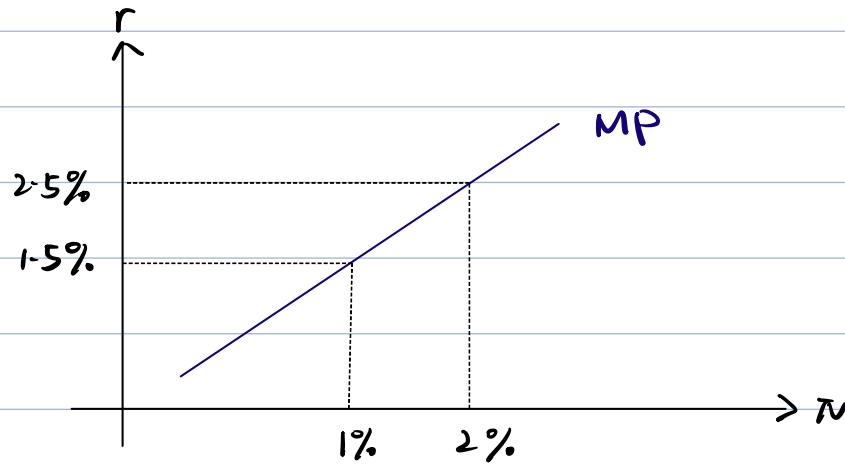
Monetary policy curve (MP)

$$r = \underbrace{F}_{\downarrow \text{ responsiveness}} + \underbrace{\pi}_{\text{inflation rate}}$$

Autonomous component
of interest rate

(不受通胀影响的真实利率)

Ex: let $r = 1 + 0.5\pi$



why Monetary policy curve (MP) is upward-sloping?

CB want to keep price stability (control inflation)
↓

So CB follows "Taylor Principles"

when there's inflation = CB ↑ policy rate (π^e) more than
inflation rate ($\pi^e > \pi$) So that real interest rate ($r - \pi^e$) ↑

泰勒原则的核心思想是：当通胀上升时，中央银行需要将名义利率（即图中的 r ）上调，而且上调幅度要大于通胀上升的幅度。这样可以确保实际利率（名义利率减去通胀率）也在上升，从而有助于控制通胀。

在图中，货币政策曲线（MP曲线）是上升的，说明随着通胀率 (π) 的上升，中央银行提高利率 r 。在这个例子中，给定的公式 $r = 1 + 0.5\pi$ 表示：当通胀率每上升 1 个百分点，名义利率就会增加 0.5 个百分点。

Q = what happens if we do not follow

"Taylor principle"

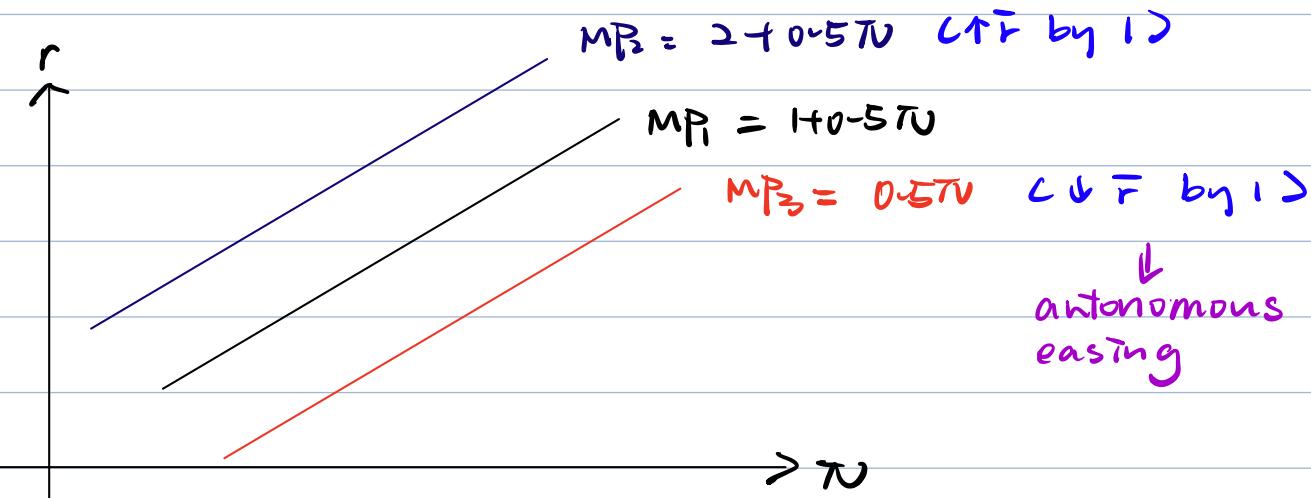
$$\text{if } \pi \uparrow \Rightarrow \underbrace{\downarrow r}_{\downarrow} \Rightarrow \uparrow y \Rightarrow \uparrow \pi \Rightarrow r \downarrow \Rightarrow \pi \downarrow$$

Not follow Taylor principle cause "Hyper inflation"
(↓ nominal interest rates)

Shift in Monetary policy

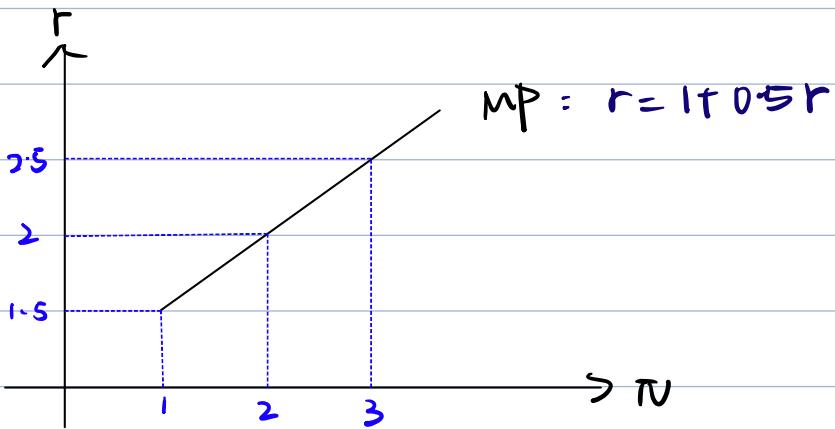
1. **扩张性货币政策 (Monetary Policy Easing)**: 当中央银行采取扩张性的货币政策时，意味着降低政策利率 r ，即 r 下降。扩张性货币政策通过降低利率，鼓励借贷和投资，进而刺激经济增长。这会导致 MP 曲线向下移动。 $\Rightarrow \downarrow \bar{r} \Rightarrow \text{decrease along MP curve}$
2. **紧缩性货币政策 (Monetary Policy Tightening)**: 紧缩性货币政策则是相反的情况，中央银行通过提高政策利率 r ，抑制经济中的过度借贷和消费，控制通货膨胀。这会导致 MP 曲线向上移动。 $\Rightarrow \uparrow \bar{r} \Rightarrow \text{increase along MP curve}$
3. **自主性货币政策的调整 (Autonomous Changes in MP)**: 当 MP 曲线向上移动时，表示货币政策的紧缩，通常表现为自主部分的利率 \bar{r} 上升；当 MP 曲线向下移动时，表示扩张性的货币政策，自主部分的利率 \bar{r} 下降。

{ 1) Autonomous Easing $\Rightarrow \downarrow \bar{r}$
2) Autonomous tightening = $\uparrow \bar{r}$ autonomous tightening

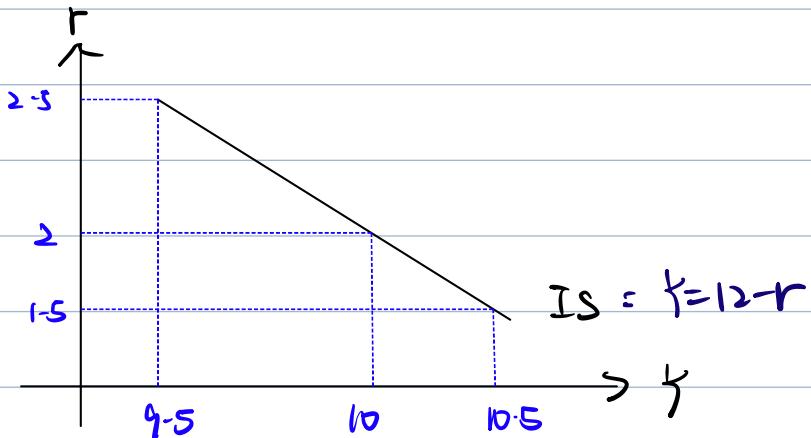


AD curves

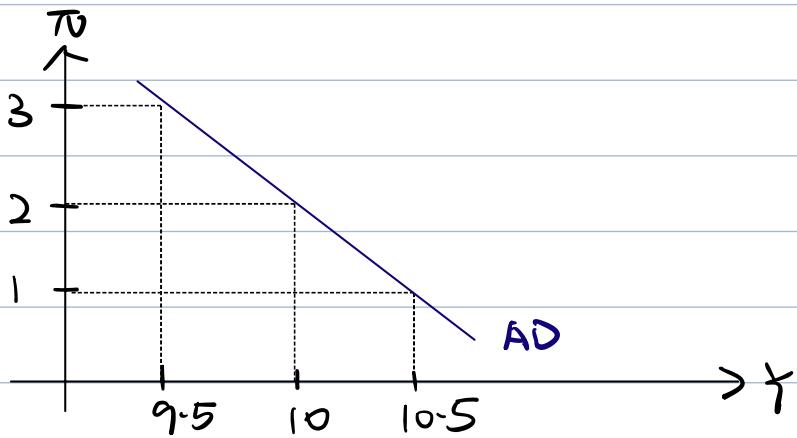
① MP curve



② IS curve



From (1): $MP : r = 1 + 0.5\pi \Rightarrow AD : \dot{\gamma} = 11 - 0.5\pi$
(2): $IS : \dot{\gamma} = 12 - r$



Generic formula for AD =

$$IS: Y = \frac{\bar{A}}{(1-c)} - \frac{(d+x)}{(1-c)} \cdot r$$

$$\bar{A} = \bar{C} - MPC \cdot \bar{T} + \bar{I} - d\bar{F} + \bar{G} + \bar{N}x$$

$$MP: r = \bar{r} + \lambda \pi_0$$

$$AD: Y = \frac{\bar{A}}{(1-c)} - \frac{(d+x)}{(1-c)} (\bar{F} + \lambda \pi_0)$$

Shift in AD

1) Shift in IS

$\uparrow \bar{C} / \bar{I} / \bar{G} / \bar{N}x$

$\downarrow \bar{T} / \bar{F}$

Shift IS to the right

also shift AD to the right

2) Shift in MP

$\uparrow \bar{F}$

"Contractionary Policy"

\downarrow Aggregate Demand

shift MP curve up

will shift AD to the left