TA note 6 - Mar 14th

In microeconomics, we learned one type of equilibrium. In which, we were given the behaviors of 2 sides: Consumers (D) and Suppliers (S). From that, we have to find equilibrium (Q, P) that satisfies both D & S.

In short:
+ Given: D, S
+ Outcome: equilibrium Q, P.

Now, in macroeconomics, there's another type of equilibrium
+ Given: Y, TE
+ Outcome: equilibrium output

TA note 6 - Mar 15^{th}

We're now working on a new type of equilibrium. How much output (Y) should be produced?

Goal: Find Y^*

In our economy: You wish to coincides what you produce and spend:

Produce	Planned total expenditure
output Y	planned investment I + consumption C

In macro, equilibrium happens when what is produced equals what is purchased.

We'll learn 3 ways to find this equilibrium. They are actually the same thing at their cores, but have different presentations.

Method 1: Table

given	given	calculated	given	calculated
Y	C	S	I	TE
output	consumption based on that output	what's left after country consumes ($S = Y - C$)	planned investment	total expenditure ($TE = C + I$)

Example 1:

Y	C	S	I	TE
500	600	500-600 = - 100	300	

We produce $Y = 500$

We spend on consumption $C = 600$ and investment $I = 300$

$\Rightarrow TE = C + I = 600 + 300 = 900 > 500 \rightarrow$ Not equilibrium!

Example 2: Where is equilibrium? Y = TE !

Y	C	S	I	TE
500	600	-100	300	900
1000	1000	0	300	1300
1500	1400	100	300	1700
2000	1800	200	300	2100
2500	2200	300	300	2500
3000	2600	400	300	2900

Note: There is one feature we assume for this economy, that is

$$\boxed{MPC = \frac{\Delta C}{\Delta Y} \text{ doesn't change}}$$

We call this ratio "Marginal propensity to consume" (MPC)

Example 3: Calculate MPC from table.

Y	C
500	600
1000	1000
1500	1400
2000	1800
2500	2200

$\Delta Y = 500$ (500 to 1000); $\Delta C = 400 \Rightarrow \frac{\Delta C}{\Delta Y} = \frac{400}{500} = .8$

$\Delta Y = 500$ (2000 to 2500); $\Delta C = 400 \Rightarrow \frac{\Delta C}{\Delta Y} = \frac{400}{500} = .8$

Example 4: Suppose Y = 1400. What is C? What is S?

First, calculate $MPC = \frac{\Delta C}{\Delta Y} = 0.8$ (in example 3)

Now, let's go from Y = 1000 and C = 1000 (second row on the table):

To reach Y = 1400, we need $\Delta Y = 400$

We know $\frac{\Delta C}{\Delta Y} = 0.8 \Rightarrow \Delta C = .8 \times \Delta Y = 320 \Rightarrow C = 1000 + 320 = 1320$

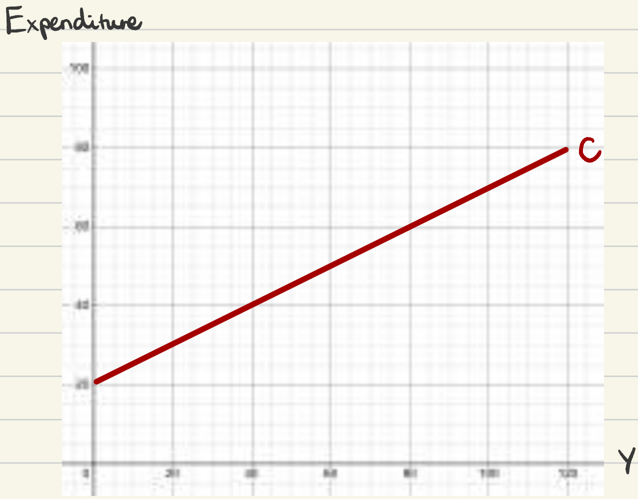
Y	C
500	600
1000	1000
1400	1320

$\Delta Y = 400$; $\Delta C = MPC \times \Delta Y = 320$

We know Y = C + S, or 1400 = 1320 + S, thus S = 80.

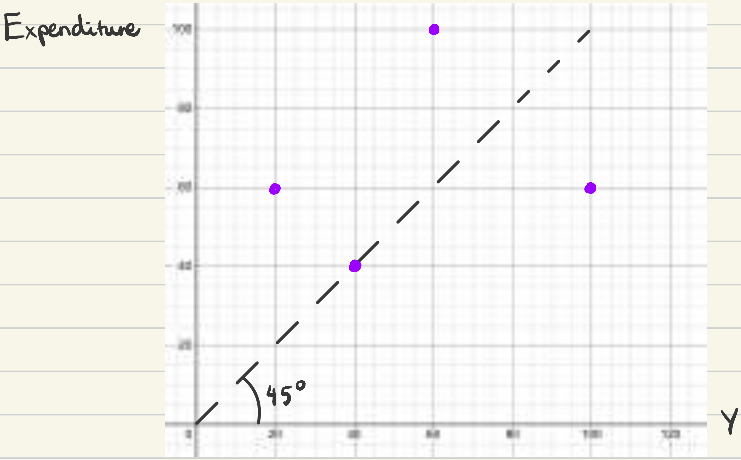
Method 2 Graph

+ Expenditure side : Response to output



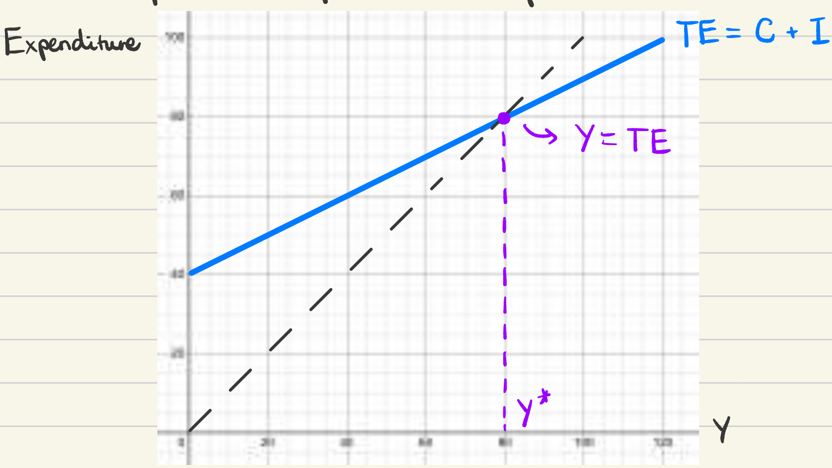
With investment

+ Production side : how to understand the 45° line ?



+ Combining expenditure & production to find equilibrium

⟨ Reminder: In macro, equilibrium happens when what is produced equals what is purchased. ⟩



- When $Y < TE$ $(Y < Y^*)$ ⇒ Inventories fall ⇒ We'll want to increase shipments ⇒ factories increases production ⇒ Y increases until $Y = TE$
- When $Y > TE$ $(Y > Y^*)$ ⇒ Inventories ↑ ⇒ cancel shipments ⇒ cut production ⇒ Y falls until $Y = TE$

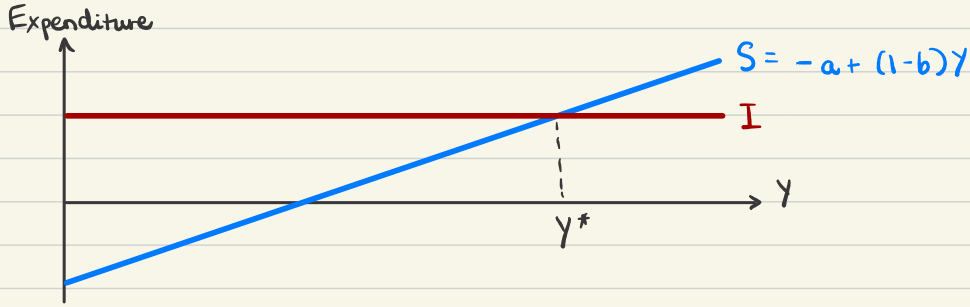
Method 3:

We want $Y = TE$

We know $\begin{cases} Y = C + S \\ TE = C + I \end{cases}$ → Just compare S and I directly

Equilibrium when $S = I$!

Example 5:



- If $I > S$: You are adding more to expenditure (in the form of I) than is being taken out (in the form of S), so output rises.
- If $I < S$: You are adding less to expenditure (in the form of I) than is being taken out (in the form of S), so output falls.

TA note 7 - Mar 22nd

Prelim 2 coming up!

1. Why multiplier?

   Assume you increase government spending by \$1. Would Y increase by \$1 at equilibrium?

   No! Government spend \$1 more ($G\uparrow$)
   - → We produce Y at \$1 more to meet government's need ($Y\uparrow$)
   - → Income increases, so people spend more ($C\uparrow$)
   - → We'll need to produce even more Y to meet consumer's need ($Y\uparrow\uparrow$)
   - → Income increases more, so people spend even more ($C\uparrow\uparrow$)
   - → ...

   ⇒ Multiplier effect!

   Now, how do we calculate these effects? First, let's review some math.

2. Some mathematical concepts

2.1. Δ denotes change ('delta')

eg: ΔY = change in output (or income)

ΔLST = change in lump-sum tax

ΔTR = change in transfer

ΔG = change in government spending

If something does not change, its Δ equals 0. For example, if investment I does not change, then $\Delta I = 0$.

In our problem(s), Y often changes, so $\Delta Y \neq 0$. There will be some other things changing, given by the question.

2.2. Consumption C is a function of income Y

$$C = a + b\underbrace{(Y - LST - tY + TR)}_{\text{disposable income}}$$

corrected. I wrote "lump-sum transfer" before

in which: LST = lump-sum tax (taken away from your income → −)

t = proportional tax rate (" → −)

TR = transfer (added to your income → +)

About a and b

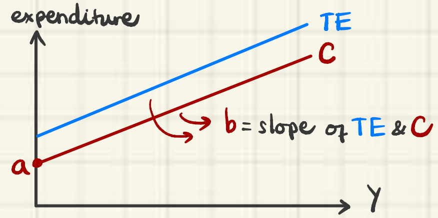
+ They are just constant numbers and should be treated as such:

eg: $\Delta(b \times TR) = b \times (\Delta TR)$ (b can be taken out)

~ Change in $(b \times TR) = b \times$ (Change in TR)

+ b = MPC = Slope of C & TE

+ a = Consumption when no income



In some simple cases, eg:

No taxes, no transfer: $C = a + b(Y - \cancel{LST}^{\,0} - \cancel{t}^{\,0}Y + \cancel{TR}^{\,0}) = a + bY$

No proportional tax t: $C = a + b(Y - LST - \cancel{t}_{\,0}Y + TR) = a + b(Y - LST + TR)$

2.3. Total differentiation

It's simple if we see ΔI

or $\Delta(b \times TR)$ ($= b \times \Delta TR$ since b is just a constant)

But what if we see $\Delta(t \times Y)$?

→ can't just "take out" t or Y like we did with b

→ We'll need to use total differential rule

$$\Delta(t \times Y) = (\Delta t) \times Y + (\Delta Y) \times t$$

example: $\Delta t = 0.1$, $\Delta Y = 100$, so

$$\Delta(t \times Y) = 0.1 \times Y + 100 \times t$$

3. Now let's derive the multiplier(s)

We know that at equilibrium:

$$Y = TE$$

$$Y = \underset{\substack{\sim\text{Consumer's}\\ \text{expenditure}}}{C} + \underset{\substack{\text{firm's}\\ \text{exp}}}{I} + \underset{\substack{\text{gov's}\\ \text{exp}}}{G} + \underset{\substack{\text{foreign's}\\ \text{exp}}}{NX} \qquad (\text{assuming } \bar{I}, \bar{G}, \overline{NX} \text{ constants})$$

Expand C to get:

$$Y = \underbrace{a + b(Y - LST - tY + TR)}_{C} + I + G + NX$$

Open the ( ):

$$Y = a + bY - bLST - btY + bTR + I + G + NX$$

Note that changes on left-hand side equals changes on right-hand side:

$$\Delta Y = \Delta a + \Delta(bY) - \Delta(bLST) - \Delta(btY) + \Delta(bTR) + \Delta I + \Delta G + \Delta NX$$

Take b outside, since it's just a number:

$$\Delta Y = \Delta a + b\Delta Y - b\Delta LST - b\Delta(tY) + b\Delta TR + \Delta I + \Delta G + \Delta NX$$

Apply total differential for $\Delta(tY)$

$$\Delta Y = \Delta a + b\Delta Y - b\Delta LST - bt\Delta Y - bY\Delta t + b\Delta TR + \Delta I + \Delta G + \Delta NX$$

Anything with ΔY moved to left-hand side:

$$\Delta Y - b\Delta Y + bt\Delta Y = \Delta a - b\Delta LST - bY\Delta t + b\Delta TR + \Delta I + \Delta G + \Delta NX$$

$$(1 - b + bt)\Delta Y = \sim$$

Divide both sides by $(1 - b + bt)$:

$$\boxed{\Delta Y = \frac{\Delta a - b\Delta LST - bY\Delta t + b\Delta TR + \Delta I + \Delta G + \Delta NX}{1 - b + bt}}$$

when I, G, NX are not dependent on Y, only C does.

4. Application

eg1: There is no proportional tax ($t=0$).

The only things changing are government expenditure G and Y

Solution:

Recall:

$$\Delta Y = \frac{\cancel{\Delta a}^{0} - b\cancel{\Delta LST}^{0} - b\cancel{Y\Delta t}^{0} + b\cancel{\Delta TR}^{0} + \cancel{\Delta I}^{0} + \Delta G + \cancel{NX}^{0}}{1 - b + \cancel{bt}_{0}}$$

Which means:

$$\Delta Y = \frac{\Delta G}{1-b} = \frac{1}{1-b} \times \Delta G$$

→ \$1 increase in G ($\Delta G = \$1$) leads to $\frac{1}{1-b} \times \$1$ increase in Y ($\Delta Y = \frac{\$1}{1-b}$)

⇒ $\frac{1}{1-b}$ is the multiplier for ΔG

eg2: There is no proportional tax ($t=0$). We increase LST

Solution:

Recall

$$\Delta Y = \frac{\cancel{\Delta a}^{0} - b\Delta LST - b\cancel{Y\Delta t}^{0} + b\cancel{\Delta TR}^{0} + \cancel{\Delta I}^{0} + \cancel{\Delta G}^{0} + \cancel{\Delta NX}^{0}}{1 - b + \cancel{bt}_{0}}$$

Which means

$$\Delta Y = \frac{-b\,\Delta LST}{1-b} = \frac{-b}{1-b} \times \Delta LST$$

→ $\frac{-b}{1-b}$ is multiplier for ΔLST

eg3: $t=0$. What's the multiplier for ΔI ? $\left(\frac{1}{1-b}\right)$

eg4: What's the multiplier for Δt? $\left(\frac{-bY}{1-b+bt}\right)$

eg5: What's the multiplier for ΔTR? $\left(\frac{b}{1-b+bt}\right)$

5. Numerical example

eg: There's no t in the economy. Assume we were at equilibrium $Y = \$1000$, and MPC = 0.6. Now the government increases spending by \$200. What is the new Y?

Solution:

This question gives you $\Delta G = +\$200$ and ask what's ΔY.

Note that this scenario is similar to eg1 in section 4 above.

Thus, $$\Delta Y = \frac{1}{1-b} \times \Delta G$$

Or equivalently:

$$\Delta Y = \frac{1}{1-0.6} \times \$200 = \$500$$

$\Rightarrow$ Change in Y is $+\$500$

$\Rightarrow$ Now, new equilibrium Y is $\underset{\substack{\uparrow \\ \text{old } Y}}{\$1000} + \$500 = \$1500$.

eg2: Contractionary policies are designed to decrease the equilibrium level of spending. We can ↑ tax or ↓ G.

Expansionary policy: ↑ equilibrium level of spending thru ↓tax or ↑G.

Suppose $Y^* = 2500$ but $Y_F = 2000$. Assume MPC = 0.8. What ΔG is necessary to get to Y_F? Is it a contractionary or expansionary policy?

Solution: We have $\Delta Y = \frac{1}{1-b} \Delta G$

We want Y to decrease from 2500 to 2000, which means $\Delta Y = -500$. Plug this, and $b = MPC = 0.8$, in to get:

$$-500 = \frac{1}{1-0.8} \times \Delta G \Rightarrow \Delta G = (0.2)(-500) = -100$$

Here, we need government spending to decrease by 100. Thus, this is a contractionary policy.

TA Note 9 - Apr 26

Review

So far in this class, we learned:

real-life
1) Definitions + how to calculate output, unemployment, inflation from real-life data

theories
2) Government's tools to adjust the economy through Fiscal policies (setting government spending, tax, transfer, etc.)
Finding equilibrium output (Y) after such policy, using:

$$Y = TE = C + I + G + NX$$

3) FED's tools to stabilize prices & target full employments through Monetary policies:
- Discount rate (FED to members)
- Required reserve ratio ("r")
- Open Market Operation (OMO)
- Interest rate on Excess reserve (ER = Deposit − Reserve)

How would FED's action affect Money supply (Ms) and eventually Y ?
Path:

$$\text{OMP} \xrightarrow{①} \text{Ms} \xrightarrow{②} i \text{ (interest rate)} \xrightarrow{③} I \text{ (investment)} \xrightarrow{④} TE \xrightarrow{⑤} Y$$

Today I'll break down the mechanism for each step!

1 OMP → ΔMs

Assume FED "pumps" some money to the market through OMP
What's the change in Money supply ?

$$\text{Max } \Delta Ms = \underbrace{\text{OMP}}_{\Delta \text{ currency}} + \underbrace{\frac{1}{r} \times \Delta ER_{\text{1st bank holding required reserve}}}_{\Delta \text{ Checkable deposits}}$$

Or we can use

$$\text{Max } \Delta Ms = \frac{1}{r} \times \text{OMP}$$

(Note: It's "Max" because irl, changes can be smaller due to individuals holding currency and banks holding excess reserves) eg1: FED pumps \$ 100 into the market. Required reserve ratio is $r = 5\%$. What's maximum change in Ms ?

Solution:

Method 1: Max. increase in currency = ΔCurrency = OMP = \$100

$$\text{Max. } \Delta \text{excess reserve } (\Delta ER) = \underbrace{\$100}_{\text{initial deposit}} - \underbrace{5\% \times \$100}_{\text{required reserve}} = \$95$$

$$\text{Max. increase in C.D.} = \frac{1}{5\%} \times \Delta ER = \frac{1}{0.05} \times \$95 = \$1900$$

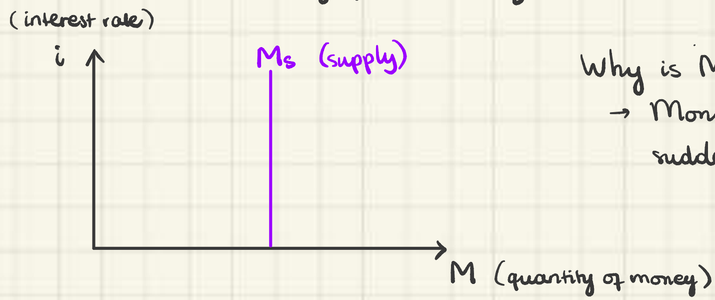
$$\Rightarrow \text{Max } \Delta Ms = \text{Max } \Delta\text{Currency} + \text{Max } \Delta CD$$
$$= \$100 + \$1900 = \$2000$$

Method 2:

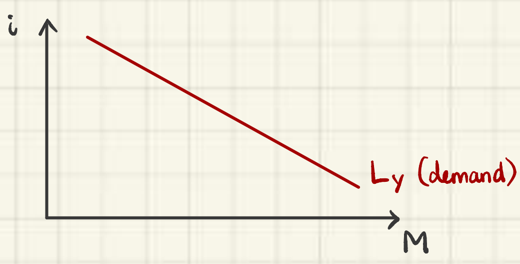
$$\text{Max } \Delta Ms = \frac{1}{r} \times OMP = \frac{1}{5\%} \times OMP = \frac{1}{0.05} \times \$100 = \$2000$$

② $\Delta MS \longrightarrow \Delta i$

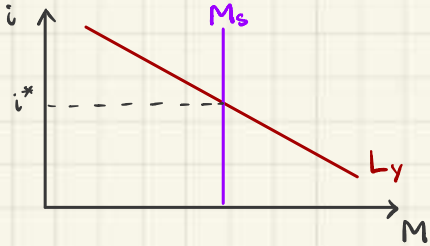
We'll now use a new graph: Money market (demand vs supply of money)



Why is Ms vertical ?
→ Money supply does not suddenly change



Ly is demand for money for exchange purposes.
Why is it sloping down ?
Higher interest rate
→ I'll want less money for exchange, and save the rest at banks

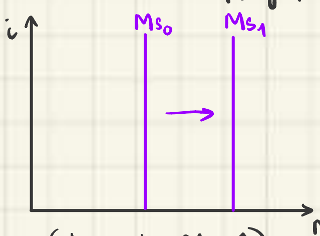


Combining public's demand for money (L_Y) and supply from FED (M_S), we get an equilibrium interest rate i^*

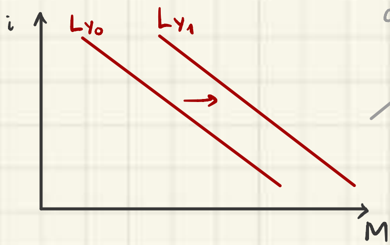
Now, what if money supply changes?

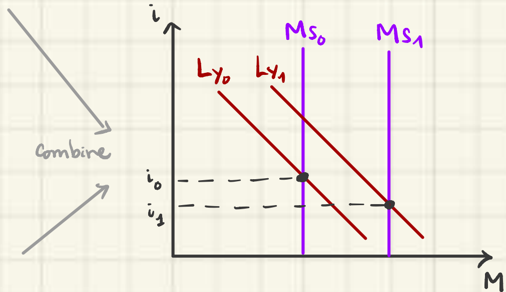
→ Both supply and demand for money change !!!

eg2: Increase in supply from an OMP ⇒ $i \downarrow$



(due to $M_S \uparrow$)

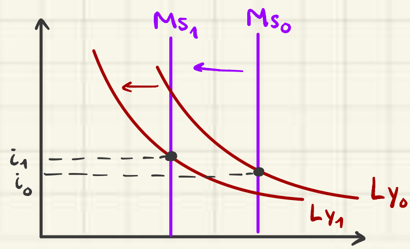




(due to $M_S\uparrow \rightarrow i\downarrow \rightarrow I\uparrow \rightarrow TE\uparrow \rightarrow Y\uparrow \rightarrow L\uparrow$)

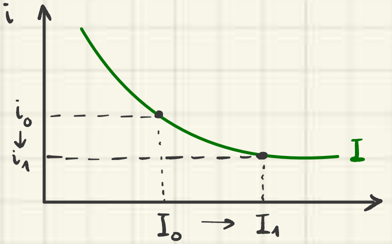
eg3: Decrease in M_S

⇒ $i \uparrow$



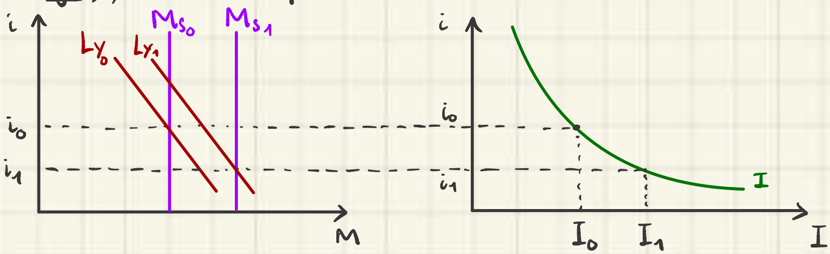
③ $\Delta i \rightarrow \Delta I$

We'll now use the ==Investment market== graph :



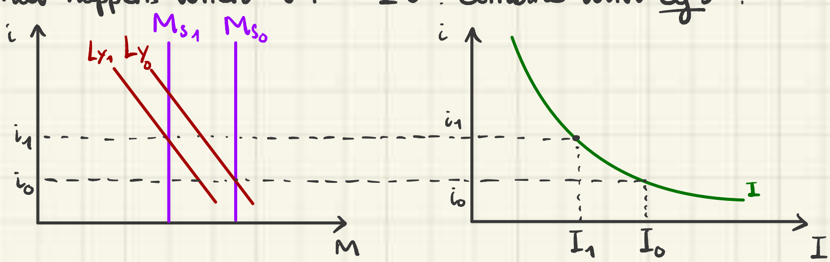
Why is investment downward sloping?
When interest is too high, investors are discouraged to borrow and invest!

eg4: What happens when $i \downarrow$? $I \uparrow$. Combine with previous graph when $Ms \uparrow$ (in eg2), since both of them share the same vertical axis :



$Ms \uparrow \rightarrow i \downarrow$ $\qquad$ $i \downarrow \rightarrow I \uparrow$

eg5: What happens when $i \uparrow$? $I \downarrow$. Combine with eg 3 :



$Ms \downarrow \rightarrow i \uparrow$ $\qquad$ $i \uparrow \rightarrow I \downarrow$

④ $\Delta I \rightarrow \Delta TE$

: $TE = C + G + I + NX$

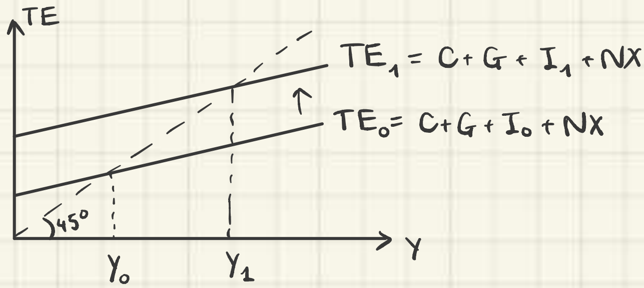
$\uparrow$ $\qquad$ $\uparrow$

$\downarrow$ $\qquad$ $\downarrow$

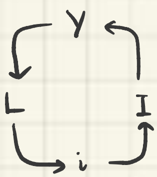
⑤ ΔTE → ΔY

Now we go back to multiplier effect : $\Delta I \rightarrow \Delta Y$ & Graph

eg6 : When $I \uparrow$:



Recap :



where Y = income , or output

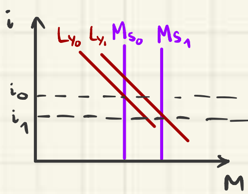
L = liquidity preference, or money demand

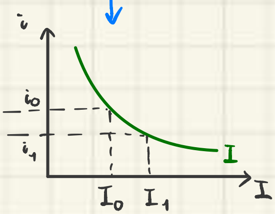
i = interest rate

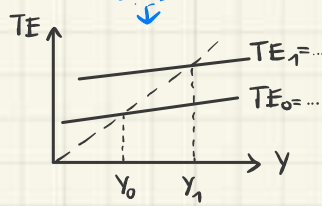
I = investment

OMO ($\Delta M_S > 0$) → $M_S \uparrow$ → $i \downarrow$ → $I \uparrow$ → $TE \uparrow$ → $Y \uparrow$

Max ΔM_s = $\frac{1}{r} \times$ OMP

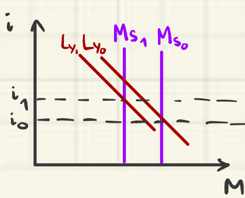


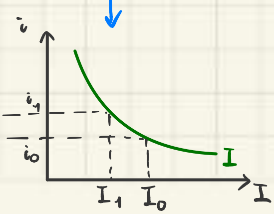


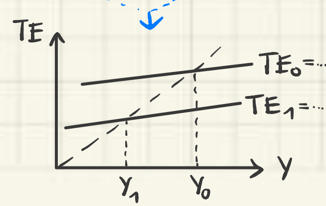


OMO ($\Delta M_S < 0$) → $M_S \downarrow$ → $i \uparrow$ → $I \downarrow$ → $TE \downarrow$ → $Y \downarrow$

Max ΔM_s = $\frac{1}{r} \times$ (−OMS)



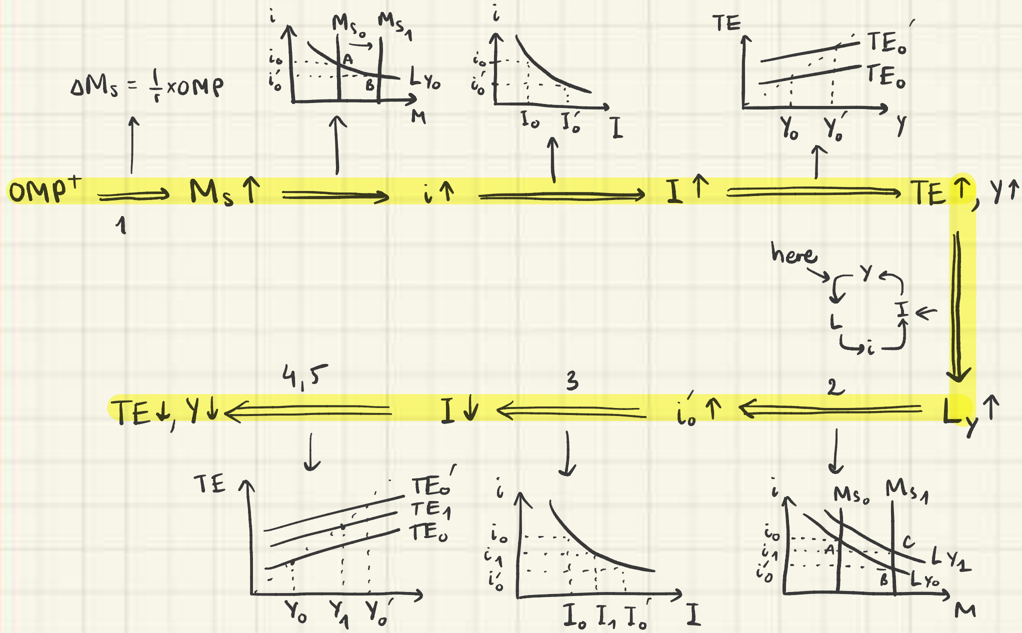




<Money market> <Investment market> <Output equilibrium>

Supplement: Explaining the A, B, C in money market graph (in class)

- What I showed is the simplified ver, ignoring intermediate steps
- In class ver:



Overall: $OMP^+ \rightarrow M_s \uparrow \rightarrow \dots \rightarrow Y \uparrow$ (note that $Y_1 > Y_0$)