# 14.02 Principles of Macroeconomics
# Problem Set 2 *Solution*
# Fall 2004

**Part I. True/False/Uncertain**
Justify your answer with a short argument.

1. Paradox of saving occurs when the attempts by people to save more lead to a decline in output & an increase in saving.

False. $Y \downarrow$ $S$ (no change) (page 60)

Private saving:
$S \equiv Y_D - C$
$S \equiv Y - T - C$

Eqm. condition:
$Y = Z$
$Y = C + I + G$

$S = I + G - T$

* Consumers' decision to save more can't affect $I$, $G$ nor $T$. (by assumption)
∴ We know $S$ did not change

Why $Y \downarrow$ ?
$S = Y - T - C$
$S = -C_0 + (1 - C_1)(Y - T)$

When $C_0 \downarrow$
① $[-C_0] \uparrow \rightarrow S \uparrow$
② $C_0 \downarrow \rightarrow C \downarrow \rightarrow Z \downarrow \xrightarrow{\text{eqm}} Y \downarrow \rightarrow S \downarrow$

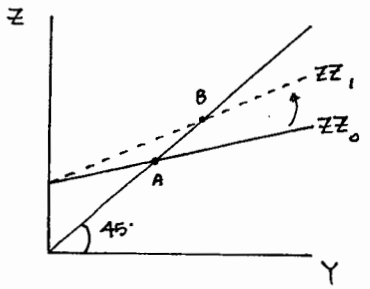
* $S$ does not change.
(see eqn 3.12) ← book

2. When mpc increases and investment decreases, goods market equilibrium output increases.

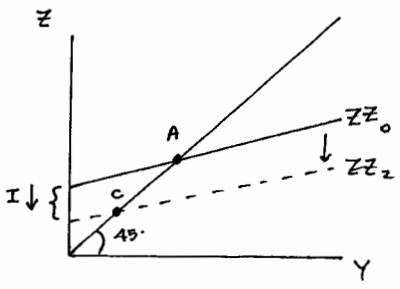
Uncertain (graph 3-2)

Goods Market: $Z = C + I + G$
$Z = C_0 + C_1(Y - T) + I + G$
($C_1$: slope; $I$: part of intercept)

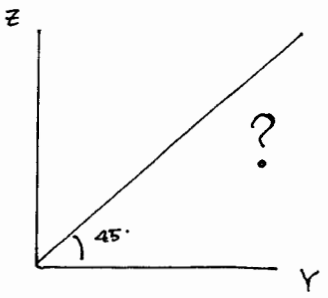
mpc: marginal propensity to consume ($C_1$)




$C_1$ = slope of ZZ
$C_1 \uparrow$ makes ZZ steeper
So, $Y \uparrow$




$I \downarrow \rightarrow$ ZZ shifts down
So $Y \downarrow$




Depends on how much $\Delta I$ & $\Delta C_1$

3. If investment is really sensitive to changes in the interest rate ($b_1$ large), then IS is flatter and fiscal policy is more effective.

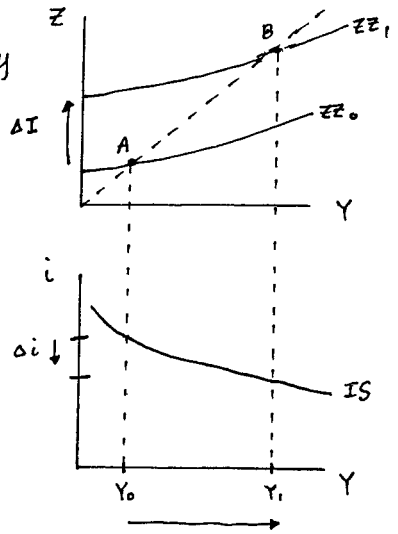
**False.** When investment is really sensitive to changes in the interest rate, then IS is flatter but fiscal policy is **less** effective. This is because there will be more crowding out of investment, and therefore an increase in government spending will be less effective.

$I = I(\overset{+}{Y}, \overset{-}{i})$

$I = b_0 - b_1 i$

↳ investment sensitivity to $\Delta i$

let $b_1$ be large.




Start at A.
let $i \downarrow$
If $b_1$ is large, then $I \uparrow\uparrow\uparrow$.
$I \uparrow\uparrow\uparrow \rightarrow Z \uparrow\uparrow\uparrow \xrightarrow{\text{cam}} Y \uparrow\uparrow\uparrow$

$b_1$ large means for a given $\Delta i$, $\Delta I$ is large and thus $\Delta Y$ is large.

⇓ IS is Flatter

4. The price of bonds increases when the interest rate rises.

False (page 74-75)

Price of Bonds $= \frac{\$100}{1+i}$

if \$100 was the face value of a bond

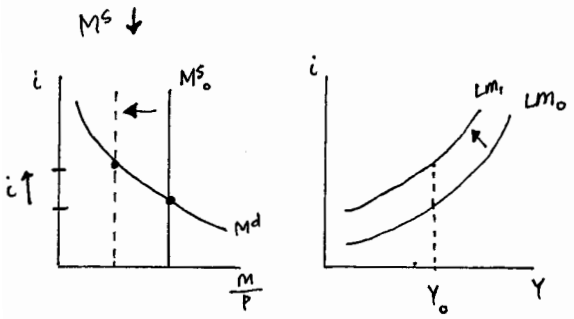
$i \downarrow \rightarrow P_B \uparrow$
$i \uparrow \rightarrow P_B \downarrow$

* If a bond promises to pay \$100 in a year, its face value is \$100 & $P_B \leq 100$ if $i \geq 0$.

5. Monetary contraction and fiscal expansion increase equilibrium output and interest rate.

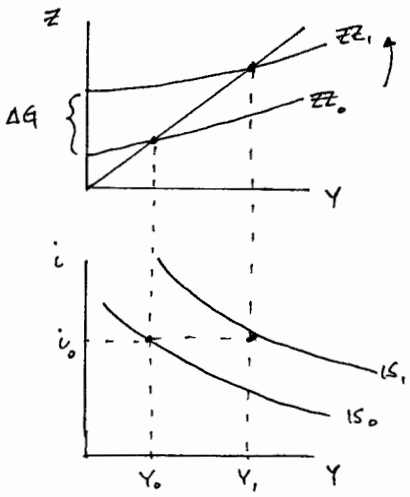
**Uncertain** i ↑ but ΔY uncertain (chapter 5)

Monetary Contraction



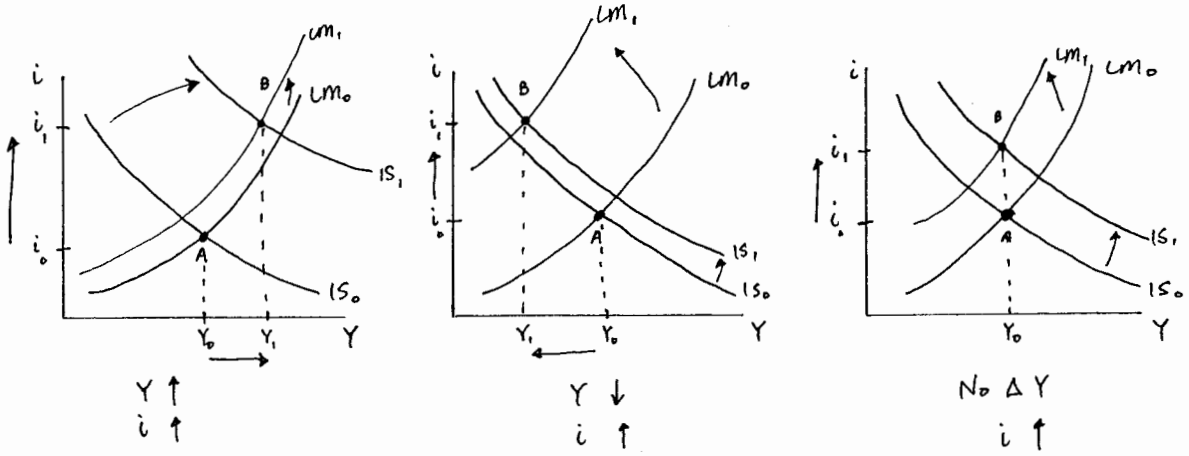

When the Fed $M^S \downarrow$, i ↑.
Given a level of Y, i is higher so LM shifts up and left

Fiscal Expansion




When G ↑ → Z ↑ → Y ↑
at a given i, higher Y
So IS shifts up and right
(Because at a higher i people demand less money)

* 3 possible outcomes...



6. The money multiplier is always less than 1.

**False.**

$0 < \Theta < 1$
$\Theta$ = reserve ratio

$0 < c < 1$
c = some constant
c is the proportion of $M^d$ (money demand) people hold as $CU^d$ (currency). Since people hold both $CU^d$ (currency) and $D^d$ (deposits), c is between 0 and 1.

Because $0 < \Theta < 1$ and $0 < c < 1$, money multiplier ($\frac{1}{c + \theta(1-c)}$) is always greater than 1.

(see chapter 4)

**Part II. THE MONEY MARKET**
(all units are trillions of US $)

Money Demand: $M^d = \$Y\,(0.2 - i)$
Nominal Income: $\$Y = 2000$
Money Supply: $M^s = 300$

1. Find $M^d$ for i = 10% and i = 5%.

$i = 10\% \longrightarrow M^d = 200 = 2000\,(0.2 - 0.1)$

$i = 5\% \longrightarrow M^d = 300 = 2000\,(0.2 - 0.05)$

2. What is the relationship between i and $M^d$.

a negative relationship between $i$ and $M^d$ $\longrightarrow$ $M^d = M^d(\overset{+}{Y}, \overset{-}{i})$

$i \uparrow \longleftrightarrow M^d \downarrow$ (higher $i$ → higher opportunity cost of holding money → people demand less money (hold less))

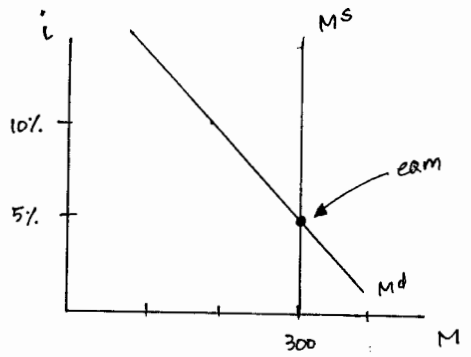
3. Graph $M^s$ and $M^d$.

Eqm $\longrightarrow$ $M^s = M^d$

$300 = 2000\,(0.2 - i)$

$i = 0.05$

$\boxed{i = 5\%}$



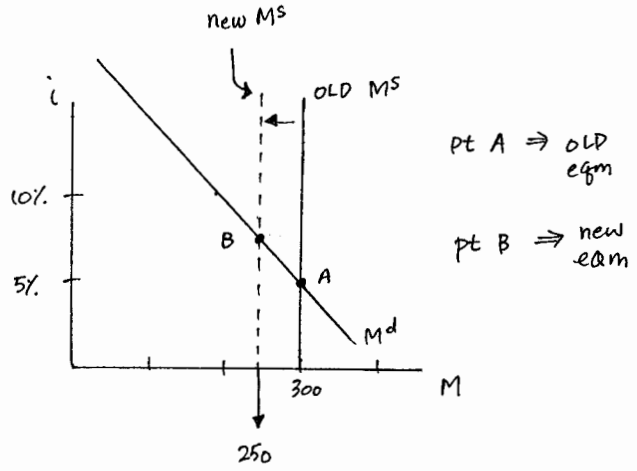

4. Alan Greenspan decreases $M^s$ by 50.
What happens to money market equilibrium? (solve & graph)

Eqm $\longrightarrow$ $M^s = M^d$

$250 = 2000\,(0.2 - i)$

$i = 0.075$

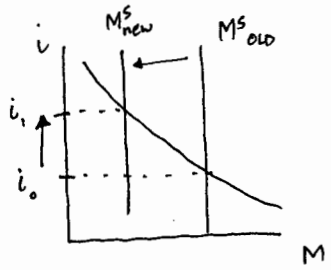
$\boxed{i = 7.5\%}$



5. Describe how the Fed changes $i$ in the U.S.

The Fed can ↑ $i$ by ↓ $M^s$ (money supply).

The Fed can ↓ $i$ by ↑ $M^s$.




$i$ ↑ ⇔ $M^s$ ↓

**Part III. Money Multiplier**

Checkable deposits: $D^d$ = \$900 billion
Total money supply: $M^s$ = \$1800 billion
Reserve ratio: $\theta = 0.2$

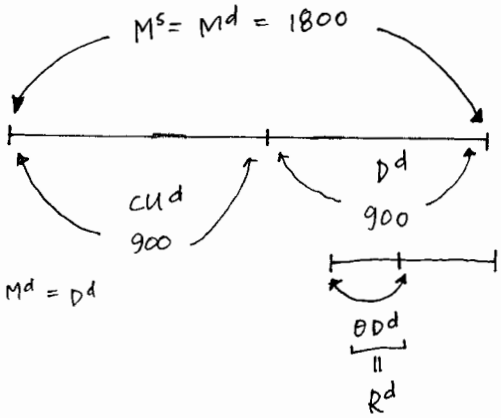
$\left(\frac{cu^d}{M^d}\right) = c = 0.5$

1. Find $CU^d$, $R^d$ and $D^d$ in equilibrium.

$M^d = cu^d + D^d$
$M^s = M^d$ (in eqm) → $1800 = cu^d + 900$
$\boxed{cu^d = 900}$

$R^d = \theta D^d \rightarrow R^d = 0.2(900)$
$\boxed{R^d = 180}$

$D^d = D^d$
$\boxed{D^d = 900}$




note: $(1-c)M^d = D^d$

2. Find the money multiplier.

$H^d = cu^d + R^d$
$H^d = cM^d + \theta(1-c)M^d$
$H^d = [c + \theta(1-c)]M^d$
$H^d \left[\frac{1}{c+\theta(1-c)}\right] = M^d$

note: $R^d = \theta D^d$
$D^d = (1-c)M^d$

$mm = \frac{1}{c+\theta(1-c)} = \frac{1}{0.5 + 0.2(0.5)}$

money multiplier

$\boxed{mm = 1.67}$

* when the Fed ↑ $M^s$ by \$100, the overall $m^s$ ↑ by \$167
(see page 82 & 83)

3. Describe 2 different ways the Fed can decrease money supply.

(1) The Fed can sell bonds thru open market operations.
This ↓ $M^s$ (This decreases the Ms and increases i)

(2) ↑ θ (The Fed can raise reserve ratio)

4. If the Fed wants to decrease the money supply by $500 million (in order to raise i), what amount of bonds would it have to sell/buy?

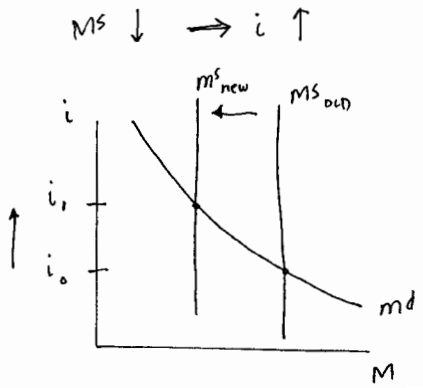
mm = 1.67 (from part 2) (mm = money multiplier)

If the Fed wants the over all money supply to ↓ by 500, it initially needs to ↓ $M^s$ (by selling bonds) by less than 500 due to the money multiplier.

Initially, the Fed will sell about $300 million worth of bonds.

$300 * mm = $300 * 1.67 ≅ $500 million.

* Make sure you can explain how the money multiplier works. (page 82-83)



**Part IV. IS - LM**
(All units are millions of US dollars)

$C = 200 + (0.25)Y_D$
$I = 150 + 0.25Y - 1000\,i$
$T = 200$
$G = 250$
$(M/P)^s = 1600$
$(M/P)^d = 2Y - 8000\,i$

1. Find the equation for aggregate demand (Z)

$$Z = C + I + G$$
$$= 200 + (0.25)Y_D + 150 + 0.25Y - 1000i + 250$$
$$= 600 + 0.25(Y - 200) + 0.25Y - 1000\,i$$
$$= 550 + 0.5Y - 1000i$$

$$\boxed{Z = 550 + 0.5Y - 1000i}$$

2. Derive the IS equation.

IS eqn $\longleftrightarrow$ Goods market eqm $\longleftrightarrow$ $Y = Z$

$$Y = Z$$
$$= 550 + 0.5Y - 1000i$$
$$0.5Y = 550 - 1000i$$

$$\boxed{\begin{aligned} Y &= 1100 - 2000i \\ i &= (1100 - Y)\left(\frac{1}{2000}\right) \end{aligned}}$$

3. Derive the LM equation.

LM eqn $\longleftrightarrow$ money (financial) market eqm $\longleftrightarrow$ $M^s = M^d$

$$M^s = M^d$$
$$\left(\frac{M}{P}\right)^s = \left(\frac{M}{P}\right)^d$$
$$1600 = 2Y - 8000\,i$$
$$2Y = +1600 + 8000\,i$$

$$\boxed{\begin{aligned} Y &= +800 + 4000\,i \\ i &= \frac{Y}{4000} - \frac{1}{5} \end{aligned}}$$

4. Solve for equilibrium real output, $i$, $I$, & $C$.

eqm ⟷ where IS & LM intersect

IS: $Y = 1100 - 2000i$

LM: $Y = +800 + 4000i$

$1100 - 2000i = +800 + 4000i$

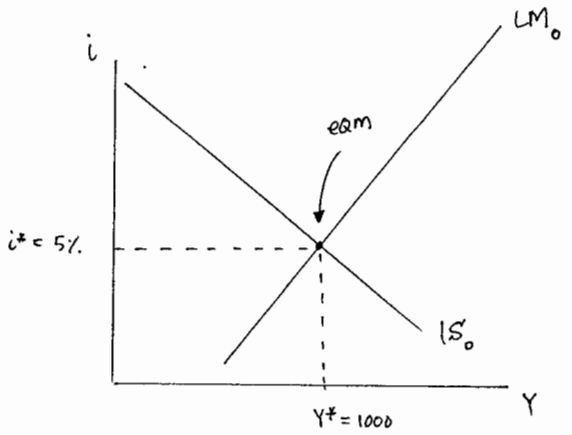
$300 = 6000i$

$0.05 = i$

$Y = 1100 - 2000(0.05) = 1000$

| |
|---|
| $Y^* = 1000$ |
| $i^* = 5\%$ |
| $C = 400$ |
| $I = 350$ |

5. Graph IS-LM of above with correct labels.




when graphing be sure to always have correct axis labels!

6. Monetary expansion:
Let $M^s$ (nominal money supply) increase to 1840. Find equilibrium Y, i, C and I. What happens to Y, i, C and I when the Fed increases money supply thru open market operations?

Money mkt eqm → $M^s = M^d$

$1840 = 2Y - 8000i$

$2Y = 1840 + 8000i$

$Y = 920 + 4000i$ (new LM)

IS-LM eqm → $920 + 4000i = 1100 - 2000i$

$6000i = 180$

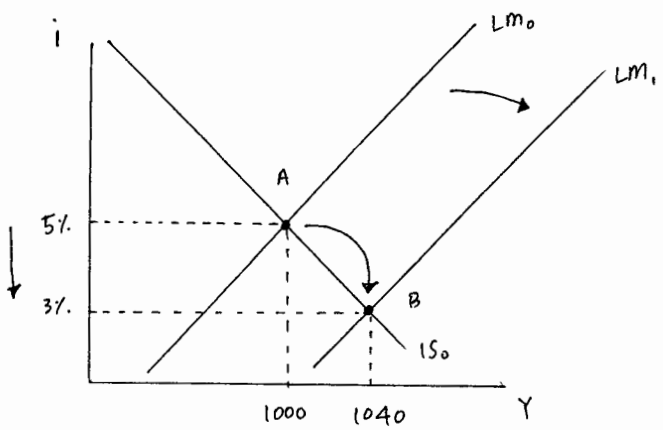
$i = 3\%$

| | |
|---|---|
| $i = 3\%$ | ↓ |
| $Y = 1040$ | ↑ |
| $C = 410$ | ↑ |
| $I = 380$ | ↑ |

Expansionary monetary policy reduces $i$, increases $Y$, $C$, & $I$.

* notice that IS stayed the same.
only LM eqn changed & shifted.

7. Graph part 6 (a new graph starting from part 5).




Expansionary Monetary policy

A = old equilibrium

B = new equilibrium


8. Fiscal expansion: (Continue from part 5)
Let G increase to 400. Find equilibrium Y, i, C and I. What happens to equilibrium Y, i, C and I when government spending increases?

Goods mkt equilibrium → $Y = Z$

$Y = 1400 - 2000i$ new IS

IS - LM → $1400 - 2000i = 800 + 4000i$

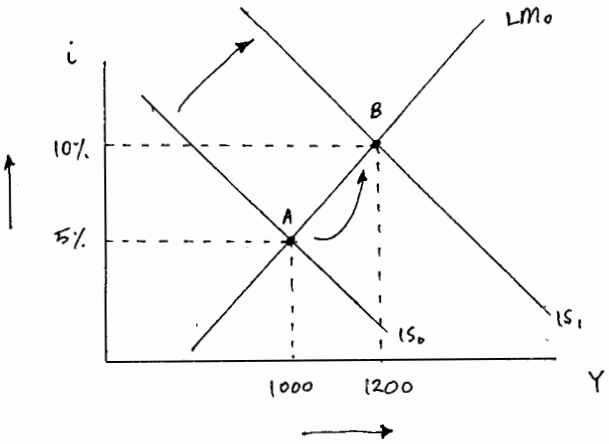
$600 = 6000i$

$10\% = i$

| | |
|---|---|
| $i = 10\%$ | ↑ |
| $Y = 1200$ | ↑ |
| $C = 450$ | ↑ |
| $I = 350$ | no change |

*note: with fiscal expansion, nothing is happening to LM.

9. Graph part 8 (a new graph starting from part 5).




10. There is a sudden drop in consumer confidence and $c_0$ drops from 200 to 100. How can the government counterbalance the drop in GDP using government spending as a policy instrument?

$c_0 \downarrow \rightarrow C \downarrow \rightarrow Z \downarrow Y \downarrow \rightarrow$ IS shifts down and to the left

The government can $\uparrow Z$ by ① $\uparrow G$ by 100 $\rightarrow Z \uparrow \rightarrow Y \uparrow$

② $\downarrow T \rightarrow Y_d \uparrow \rightarrow C \uparrow \rightarrow Z \uparrow \rightarrow Y \uparrow$