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 occurswhen 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.(2) ← book

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

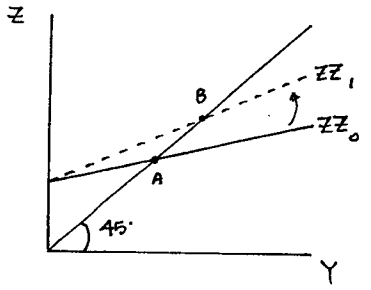
Uncertain (graph 3-2)

Goods Market: $Z = C + I + G$

$Z = C_0 + C_1(Y - T) + I + G$

C_1: slope; I: part of intercept

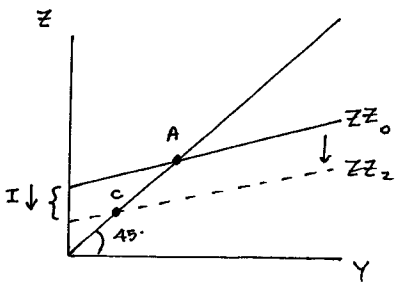
mpc: marginal propensity to consume (C_1)



C_1 = slope of ZZ

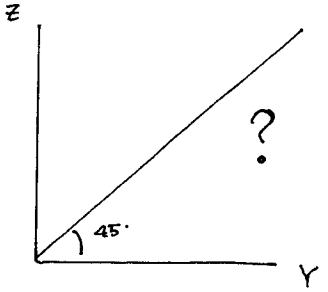
$C_1 \uparrow$ makes ZZ steeper

So, $Y \uparrow$



$I \downarrow \rightarrow ZZ$ shifts down

So $Y \downarrow$



Depends on how much ΔI & ΔC_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.

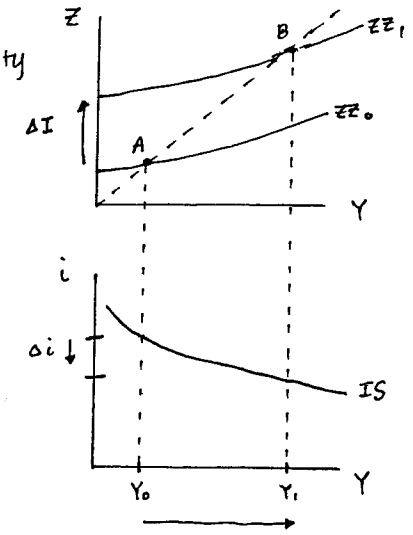
False. When investment is really sensitive to changes in the interest rate, then IS is flatter but fiscal policy is **less** effective. This is because there will be more crowding out of investment, and therefore an increase in government spending will be less effective.

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

$I = b_0 - b_1 i$

↳ investment sensitivity to Δi

let b_1 be large.



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

b_1 large means for a given Δi, ΔI is large and thus ΔY 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

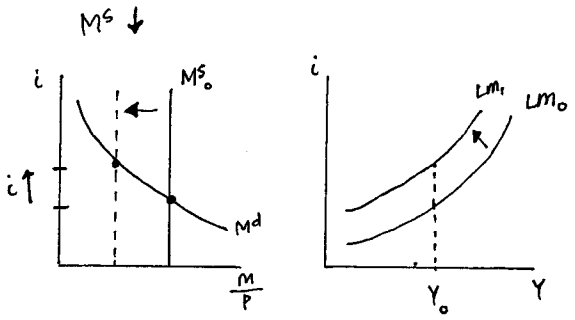
$i \downarrow \rightarrow P_B \uparrow$
$i \uparrow \rightarrow P_B \downarrow$

* 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.

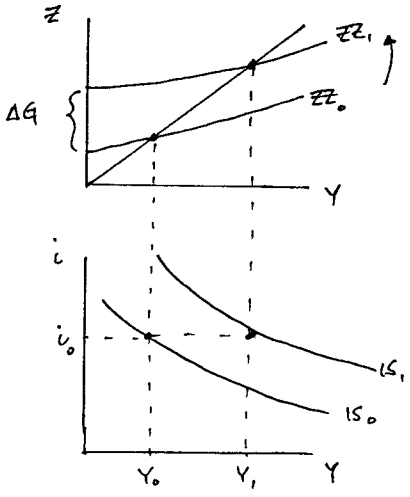
Uncertain $i \uparrow$ but ΔY uncertain (chapter 5)

Monetary Contraction



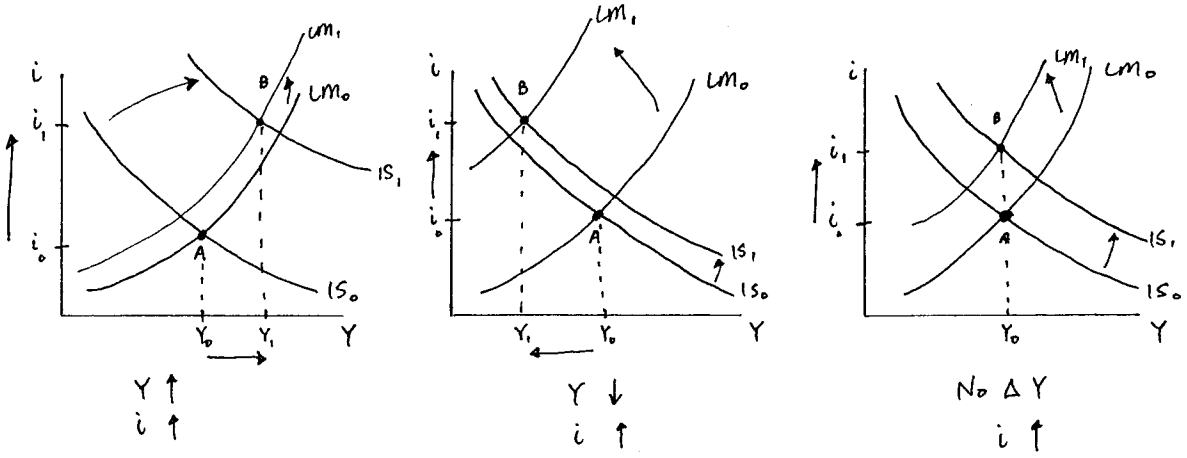
When the Fed $M^S \downarrow$, $i \uparrow$.
Given a level of Y, i is higher so LM shifts up and left

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.

$0 < \Theta < 1$
Θ = 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))

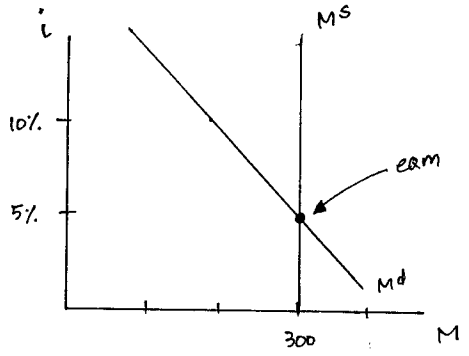
3. Graph M^s and M^d.

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

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

$i = 0.05$

$\boxed{i = 5\%}$



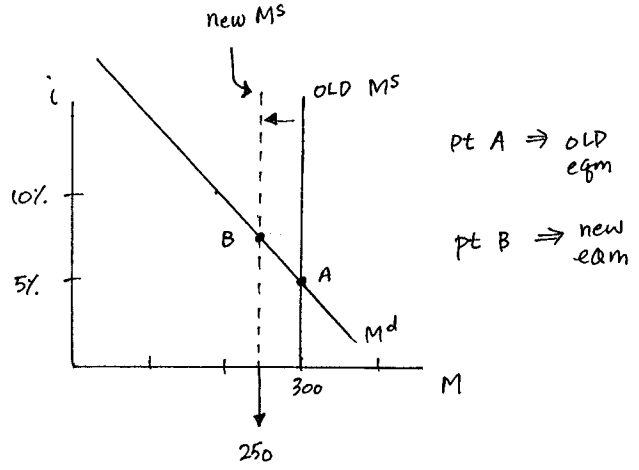
4. Alan Greenspan decreases M^s by 50.
What happens to money market equilibrium? (solve & graph)

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

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

$i = 0.075$

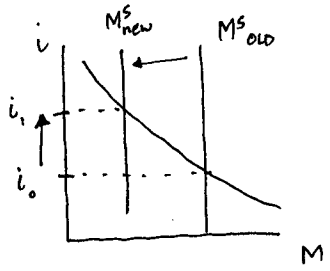
$\boxed{i = 7.5\%}$



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: $\theta = 0.2$

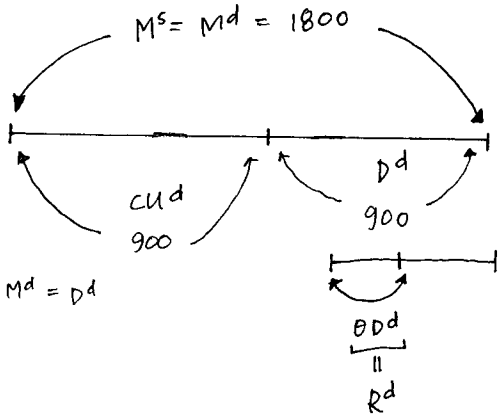
$$\left(\frac{cu^d}{M^d}\right) = c = 0.5$$

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

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

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

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



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

money multiplier

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

$\boxed{mm = 1.67}$

* 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)

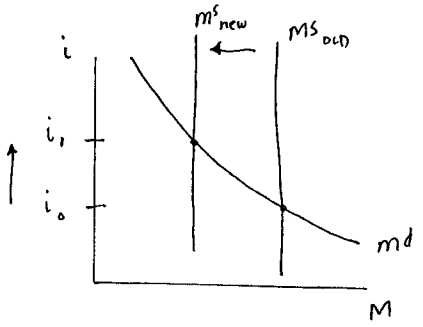
If the Fed wants the over all money supply to ↓ by 500, it initially needs to ↓ M^s (by selling bonds) by less than 500 due to the money multiplier.

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)

M^s ↓ → i ↑



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)

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

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

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 $\longleftrightarrow$ $M^s = M^d$

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

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

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

eqm ⟷ where IS & LM intersect

IS: $Y = 1100 - 2000i$

LM: $Y = +800 + 4000i$

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

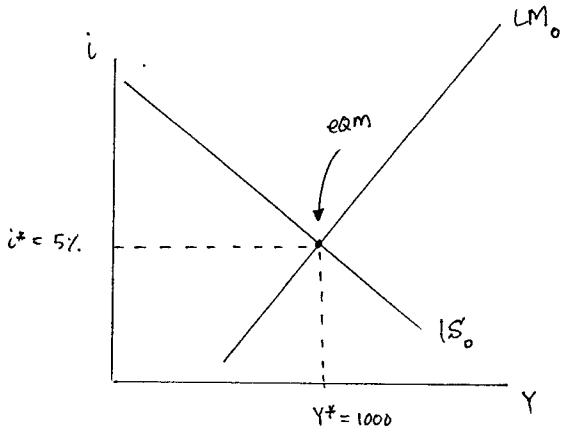
$300 = 6000i$

$0.05 = i$

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

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

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 → $920 + 4000i = 1100 - 2000i$

$6000i = 180$

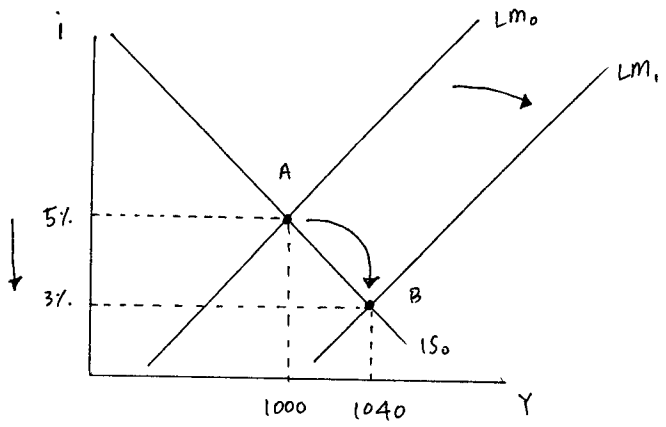
$i = 3\%$

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

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 → $1400 - 2000i = 800 + 4000i$

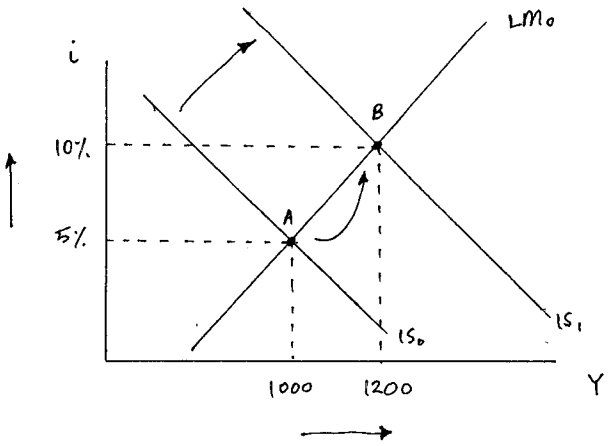
$600 = 6000i$

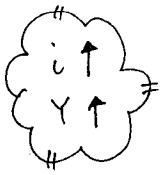
$10\% = i$

$i = 10\%$	↑
$Y = 1200$	↑
$C = 450$	↑
$I = 350$	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 $\downarrow T \rightarrow Y_d \uparrow \rightarrow C \uparrow \rightarrow Z \uparrow \rightarrow Y \uparrow$