14.02 Quiz 1

3/16

Closed econ = savings = investment

Wages + Profits = GDP

$GDP = \sum_j a_j \times P_j$

Real = adj. for inflation - use base year prices

$Y = C + I + G + NX$ (exports)

$C = C(Y_D) = C(Y-T)$

$= c_0 + c_1(Y-T) + \bar{I} + \bar{G}$

hedonic pricing - take advances in value not just price drop

$GDP = \frac{\text{Nominal GDP}}{\text{Real GDP}} = \frac{\$Y_t}{Y_t}$

CPI - measures inflation

inflation - generally rising prices

$Y = Z$ output = income

$Y = \frac{1}{1-c_1}[c_0 + \bar{I} + \bar{G} - c_1 T]$

multiplier $= 1 + c_1 + c_1^2 + c_1^3 + \dots$

Private savings $= S = Y_D - C$

$= Y - T - C$

Public savings $= T - G$

$M^d = \$Y\,L(i)$ (−)

M^s = set by central bank

higher income shifts curve out

Bonds - alt to currency $\$P_B = \frac{100}{1+i}$

Central gov buys/sells

when buys prices ↑ i ↓

Checkable deposits

LM: Liabilities - Money

Demand for Money:

$M^d = \$Y\,L(i)$ (−)

$CU^d = c\,M^d$ (c = proportion held in currency)

$D^d = (1-c)\,M^d$ checkable deposits

Demand for Reserves:

$R = \theta D$ (θ = reserve ratio)

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

Demand Central Bank Money:

$H^R = CU^d + R^d$

$= c M^d + \theta(1-c)M^d$

$= [c + \theta(1-c)]M^d$

$= [c + \theta(1-c)]\$Y\,L(i)$

Determination:

$H^{\text{supply}} = H^d$

$= [c + \theta(1-c)]\$Y\,L(i)$

Wealth < Currency, Bonds < Money, Deposits — HHs

$YL(i)$

Money (M^D) ⇄ Currency (c) / Deposits (1−c) → Reserves (θ) → (central bank) Money

Demand = Z or Z^t

$Y - T - C = S = \bar{I} + \bar{G} - T$ ① IS

$S^P + S^G = \bar{I}$ savings = investment

$C = C(Y-T)$ LS

↑ Can be any function

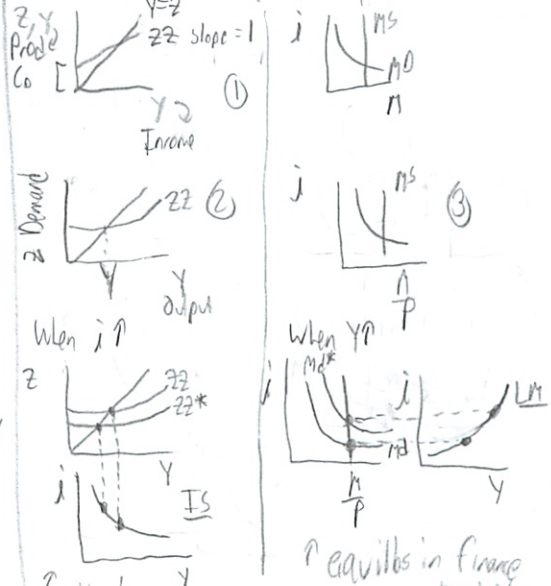
$I = I(Y, r)$ ⊃ assume inflation = 0

$Y = C(Y-T) + I(\overset{\oplus}{Y}, \overset{\ominus}{i}) + \bar{G}$ ②

$\frac{M^d}{P} = Y \cdot L(\overset{\ominus}{i})$ ③

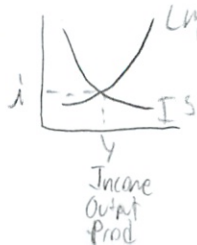
2 eq 2 unknowns

$Z = (c_0 + I + G - c_1 T) + c_1 Y$ Z = demand



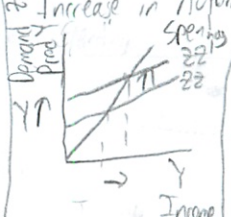
↑ equilbs in finance markets

↑ equilbs in good markets



Shifts when Exog. Changes

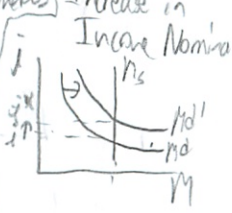
↑ Increase in Autonomous Spending



Exog I, G, T

End C, Y, Z, Y_D

↑ Increase in Income Nominal



Exog #P, M

End M^S, M^d, i

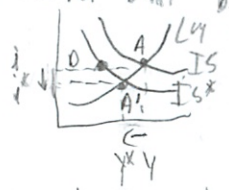
Fiscal Contraction (Gov ↑ Taxes)

lower output/sales = ↓ investment

but ↑ i = ↑ investment

IS curve shifts - since Exog to that

LM does not shift - but shift along



↑ increase in taxes → lower disposable income → lower consumption → so output ↓ → so income ↓ (through multiplier) to D

Also ↓ in income → ↓ demand for money

↓ i rate

offsets effects of higher taxes on demand — shifts to A_1

Monetary Expansion

Gov ↑ M^S by buying bonds

So lower i → I ↑ So demand + output ↑

income ↑ w/ taxes unchanged, so ↓I, C ↑ so I ↑

What	IS	LM	Output	i
↑T	←	—	↓	↓
↓T	→	—	↑	↑
↑G	→	—	↑	↑
↓G	←	—	↓	↓
↑M	—	↓	↑	↓
↓M	—	↑	↓	↑

Labor

Pop - Non Inst civilian < In Labor Force < Emp / Unemp; Out LF

$u = \frac{U}{L}$ ← Labor Force

$W = P^e F(u, z)$

↑ nominal

$Y = A \cdot E^{\alpha} \cdot k^{1-\alpha}$ → $Y = A \cdot E \to Y = E$

↑ prod. E_2

$P = W(1+\mu)$

$\frac{W}{P} = F(U, \frac{\Theta}{Z})$ Wage setting

$\frac{W}{P} = \frac{1}{1+\mu}$ Price setting

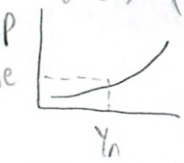
Set = to Find U_n

Then translate for $N_n = L(1-U_n)$

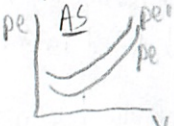
AS don't assume $P = P^e$ take WS, PS above

$P = P^e(1+\mu)F(U,z)$

$= P^e(1+\mu)F(1-\frac{Y}{L}, z)$ ∈



Expected price becomes actual - wage Setters set expected, compare, must raise prices to meet, comes true



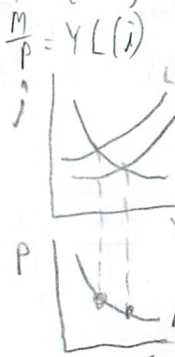
$P^{e\prime} > P^e$

exog P^e, z, μ, U end w, P, Y

AD take IS, LM inputs

IS $Y = C(Y-T) + I(Y,i) + G$

LM $\frac{M}{P} = YL(i)$

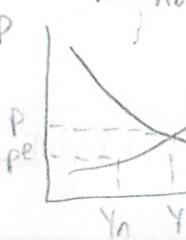


So adds another layer

$Y = Y(\overset{\oplus}{\frac{M}{P}}, \overset{\oplus}{G}, \overset{\ominus}{T})$ ∈

SR take P^e as given

for given P^e (AS), M, G, T (AD) find Y, P



no reason for $Y = Y_n$ can be more →

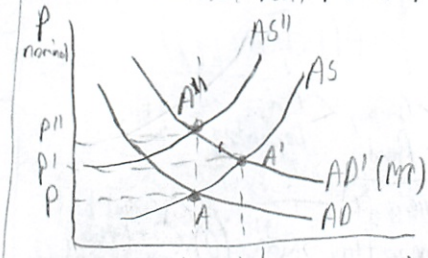
MR Price expectations start to come into play

Say gov ↑MS For given P, MP so $\frac{M}{P}$ ↑, so YP

AD shifts right AD' (SR Econ A → A') YP from Y_n to Y' so P↑ from P to P'

Over time P^e into play, when $Y > Y_n$, the $P > P^e$, so wage setters ↑P^e, so AS shifts ↑ to AS'' (Econ moves along AD' to A'') Stops when $Y = Y_n$

Arrived at medium run, P now P''



Behind Scenes In SR the ↑P partially offsets effect of ↑ in M (from LM'' to LM') from B

letters match!

Don't know I since ↓Y = I↓ but U_t ↑ ↑I

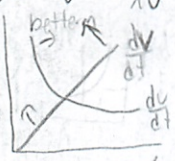
Diamond Labor U = unemp V = vac h = hires s = seps

$h = m\sqrt{vu}$ matching

$w = \beta b(1-\beta)y + \frac{V}{U}$ wage ↑ who controls surplus

$x = w - \beta b + (1-\beta)y$

to get $V^{ss} = xU^{ss}$



$\frac{V}{U}$ = market tightness

$U_{t+1} - U_t = s(1-U_t) - h_t$

$h^{ss} = s^{ss}(1-U^{ss})$

$V_{t+1} - V_t = \frac{U_t}{U_t} - \frac{1}{x}$

$s_{V^{ss}} = xU^{ss}$

Phillips Curve Start w/ AS, adds expectation π^e

$\pi = \pi^e + (\mu + z) - \alpha U$

early version $\pi^e = 0$

so $\pi_t = (\mu + z) - \alpha U_t$

wage-price spiral up to 1960s

	exog	end
AS	P^e, μ, Y_n, z	P
AD	M, P, G, T	Y
AS/AD	μ, N, z, G, T	P, Y

M

By then in 1970s $\pi^e_t = \theta\pi_{t-1}$

$\pi_t = \theta\pi_{t-1} + (\mu + z) - \alpha U_t$

AS $\theta \to 1$ then Phillips Curve about $\Delta\pi$

Natural rate of unemp = so that $P = P^e$, $\pi = \pi^e$

So $U_n = \frac{\mu + z}{\alpha}$

AS'' So $\pi_t - \pi_{t-1} = -\alpha(U_t - U_n)$

Now some have COLAs λ = proportion with

$\pi_t = [\lambda\pi_t + (1-\lambda)\pi_t^e] - \alpha(U_t - U_n)$

Assume $\pi_t^e = \pi_{t-1}$

$\pi_t = [\lambda\pi_t + (1-\lambda)\pi_{t-1}] - \alpha(U_t - U_n)$

when $\lambda \uparrow$ ↓ small change unemp → large change unemp

---

Okun's Law Production Function

$U_t - U_{t-1} = -g_{yt}$

In USA $U_t - U_{t-1} = -.4(g_{yt} - .03)$

In general $U_t - U_{t-1} = -\beta(g_{yt} - \bar{g}_y)$ ∈

Phillips Curve

$\pi_t = \pi^e_t - \alpha(U_t - U_n)$

$\pi_t - \pi_{t-1} = -\alpha(U_t - U_n)$ ∈

AD

$Y_t = Y(\frac{M_t}{P_t}, G, T)$

$g_{yt} = g_{mt} - \pi_t$ ∈

Solve Simultaneously

MR $g_y = \bar{g}_y$

$\pi = \bar{g}_m - g_y$ $\pi_t - \pi_{t-1} = 0$

$U = U_n$

Lucas Critique on creditability

Autonomous spending $C_0 - C_1 T + \bar{I} + G$

14.02 Exam Review Quiz 1

3/16

Oh no Maya is teaching after SB
Should I drop?
Or write letter?
- perhaps over SB

Closed econ = Savings = investment

Hedonic pricing = taking into account benefits
like the value of PC
not just ↓ price

Still don't get how LS-IM comes together.
Then is now all adjustments

In HS called this AS-AD
↑ISLM

But AD $Y = Y_d\left(\frac{M}{P}, G, \overline{T}\right)$

$Y = Y_t^S\left(\frac{W}{P}, \frac{P}{P^e}\right)$ ← later in chap

---

What is the ZZ curve anyway?
Demand
Oh - just IS!!! not IS-LM
that's why I was so confused!
Every makes so much more sense now!

(2)

So ~~that~~ i makes up IS
- must be end. - check
- well actually nowhere in formula - well asks for I
  - which is $I(r,i)$
    - what is the function normaly behind here

I think this book normally ignores
which is confusing

Why exactly do you do that - change i
- why not something else?

IS actually shifts w/ changes in exog I, G, T

Going to ignore some of the finer dynamics in IS-LM
just what book covered

So AD adds another layer to IS/LM

Also going to skip over AS-AD behind scenes
- Perhaps read once
- Often just asked to do - not explain

I should do a derivation from very begining
- might confuse me more!

(3)

So AD changes first in both models?

- did not realize

Don't know investment's direction

Hope I remember this too! (w/o cheat sheet)

Diamond Labor Model was division that could be on exam

I always have trouble on the s/l/m solve p-set qu

- I don't think of strategy

Need to in future

Phillips curve makes more sense now

Understand some deviations

3/16

Review Sheet From Internet
I downloaded on own

Macro Preparation Camp Handout 6: The IS-LM Model

CDE, Williams College

August 2009

Why is this handout useful?

This handout will describe a well known closed economy model that will provide you with intuition, concepts and tools useful for improving your understanding of open economy models that you'll study in your first macro course.

How to study the handout

Before coming to Williams town: Read the document carefully

During your first week in Williamson: 1) Make sure you work the math at least once (there is not much math here), 2) Work all the graphic examples by hand!

If you don't feel comfortable working with graphs: read the appendix.

If you don't feel comfortable working with basic macro concepts: read handout 5.

If you are not able to come to the preparation camp...

...1) Read the document carefully, 2) work all the math and graphic derivations by hand.

Very helpful!

The IS-LM Model

This handout is based on Blanchard (2003) Chapters 4 and 5.

1 The Goods Market

1.1 The Demand for Goods

- The economy produces only one good that can be used by households for consumption, by firms for investment or by the government for public consumption.
- The firms are willing to supply as many units of the good as demanded by households, the government and other firms. They supply the good at a price P.
- The economy is closed.
- Denote the total demand for goods by Z. From the composition of GDP for a closed economy, we can write Z as:

$$Z = C + I + G \tag{1}$$

Consumption

- Consumption (C) depends positively on disposable income (Yd) (C goes up when Yd goes up). Disposable income is defined as income minus net taxes ($Yd = Y - T$).

$$C = C(Yd^{+}) \tag{2}$$

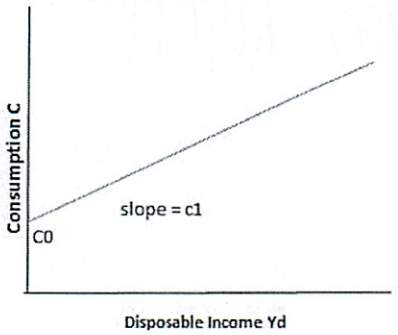
- Sometimes it is useful to give a functional form to $C = C(Yd^{+})$. Let's assume that the relationship between consumption and disposable income is linear (you may want to go over the appendix in order to refresh some concepts about straight lines and their properties)

$$C = c_0 + c_1 Yd \tag{3}$$

$$C = c_0 + c_1(Y - T) \tag{4}$$

- The parameter $c_1$is called the marginal propensity to consume. It gives the effect of an additional unit of disposable income on consumption. A natural restriction on $c_1$is that is has to be between 0 and 1: people are likely to consume only part of any increase in disposable income and save the rest.
- The parameter $c_0$is what people would consume if their disposable income is zero.
- Graph 1 depicts the linear consumption function.

Graph 1: Consumption Function



Investment

- For the moment we'll assume that investment in exogenous

$$I = \bar{I} \tag{5}$$

Government Spending (G)

- We'll treat G as an exogenous policy variable.

1.2 The Determination of Equilibrium Output

- Replacing C and I from (4) and (5) in (1):

$$Z = c_0 + c_1(Y - T) + \bar{I} + G \tag{6}$$

- Equilibrium in the goods market requires that production Y be equal to demand Z.

$$Y = Z \tag{7}$$

- Replacing (7) in (6):

$$Y = c_0 + c_1(Y - T) + \bar{I} + G \tag{8}$$

- In equilibrium production, Y (the left hand side of 8), is equal to demand (the right hand side of 8). Demand in turn depends on income, Y, which is itself equal to production.

Characterizing Equilibrium Graphically

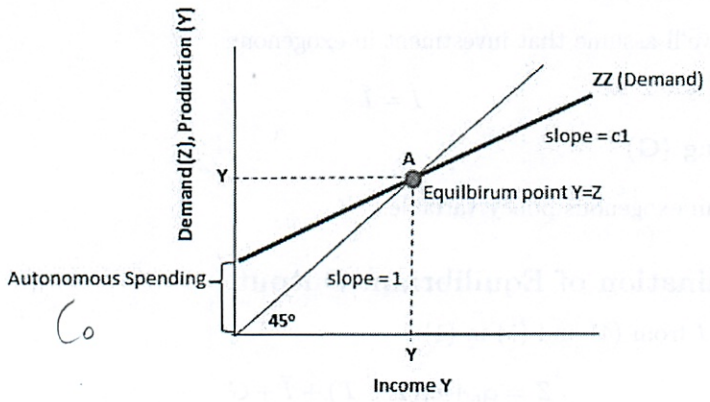
- First plot production as a function of income. Graph 2 measures production on the vertical axis and income on the horizontal axis.
- Recall that production and income are always equal. Then, the relation between these two variables is the 45-degree line (why? because any point on the 45-degree line has the same value for the vertical-axis variable and for the horizontal-axis variable).
- Second, plot demand as a function of income. Notice that (6) can be rewritten as:

$$Z = (c_0 + \bar{I} + G - c_1 T) + c_1 Y \tag{9}$$

so that is just for IS - ahh!

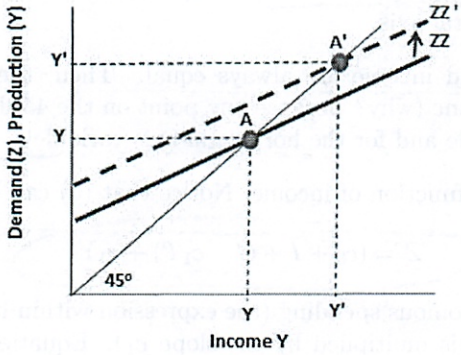
- Demand depends on autonomous spending (the expression within brackets; this is the intercept) and on income (Y, which is multiplied by the slope c_1). Equation (9) is drawn as ZZ in the graph.
- Equilibrium output, Y, is given by the intersection of the 45-degree line and the demand relation at point A. To the left of A, demand exceeds production. To the right of A, production exceeds demand.

Graph 2: Equilibirum in the Goods Market



- Now suppose that c_0, one of the elements of autonomous consumption, increases to $c_0' > c_0$. The ZZ relation will shift upwards in a distance equal to $(c_0' - c_0)$, this is the change in the intercept. The new level of equilibrium output (Y') is found at the intersection of the 45-degree line and the new demand relation (point A').

Graph 3: Effect of an Increase in Autonomous Spending



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2 The Financial Market

2.1 The Demand for Money

- Denote the amount of money people want to hold (the demand for money) by M^d. The economy's total demand for money depends on the overall level of transactions (proxied by nominal income) and on the interest rate. Nominal income is defined as PY, [if Y is real income (in units of the good) and P is the dollar price of one unit of the good, then PY is income in nominal terms (i.e. dollar terms)].

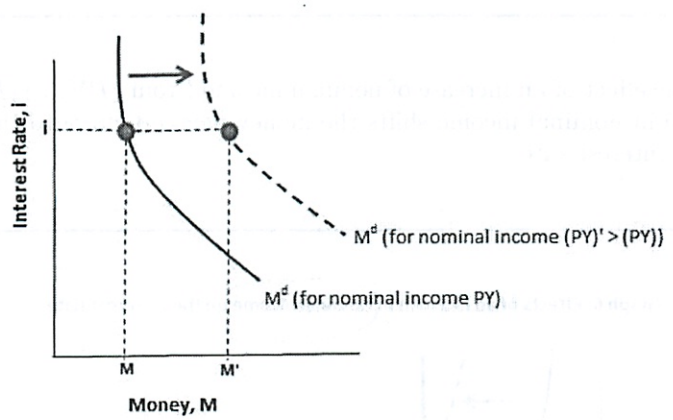
- The minus sign above i captures the fact that the interest rate has a negative effect on money demand: an increase in the interest rate decreases money demand. We don't know the exact expression of the relation between i and M^d, so we write it just as a function $L(i)$.

$$M^d = PYL(\bar{i}) \tag{10}$$

- Graph 4 shows the relation between money demanded (measured in the horizontal axis) and the interest rate (vertical axis).

- How does money depend on nominal income? Suppose that nominal income increases from (PY) to $(PY)'$. This will shift the money demand curve to the right.

Graph 4: The Demand for Money



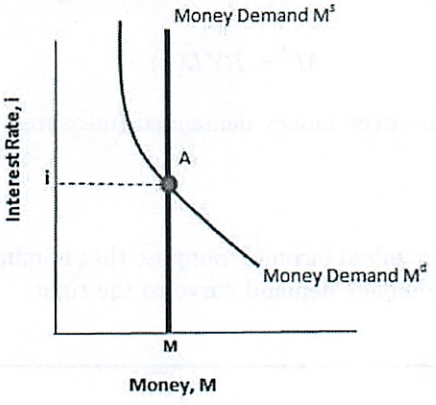
2.2 Money Demand, Money Supply and the Equilibrium Interest Rate

- Suppose the Central Bank decides to supply and amount of money equal to M, so $M^s = M$.
- Equilibrium in the financial market requires that money supply $(M^s = M)$ be equal to money demand (M^d):

$$M = PYL(\bar{i}) \tag{11}$$

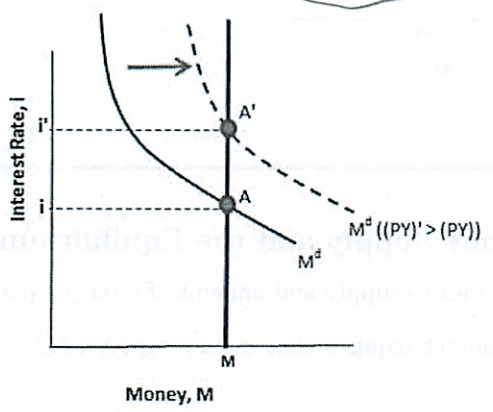
- Graphically:

Graph 5: Determination of the Intsrest Rate



- Now we explore the effect of an increase of nominal income (from (PY) to $(PY)'$) on the interest rate. The increase in nominal income shifts the money demand curve to the right and leads to an increase in the interest rate.

Graph 6: Effects of an Increase in Nominal Income on the Interest Rate



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3 The Goods Market and the IS Relation

- **Consumption:** We won't work with the linear functional form for consumption used in Section 1, but we will assume the general form $C(Yd)$ or $C(Y-T)$.
- **Investment:** Investment won't be exogenous as in Section 1. We assume that a firm that faces increasing sales needs to increase production and to do so it may need to buy new equipment. We also assume that a firm may need to borrow resources in order to finance its investment, therefore

it is more likely that the firm will do so when the interest rate is low than when the interest rate is high. Investment, therefore, is a function of the level of production and the interest rate: $I = I(\overset{+}{Y}, \overset{-}{i})$.

- **Government Spending:** As in Section 1.

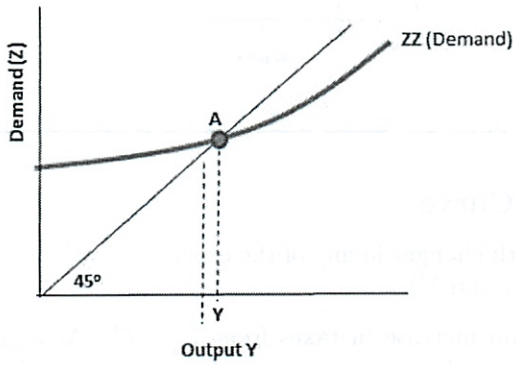
3.1 The Determination of Output

- Taking into account the general forms for consumption and investment, $C(Y-T)$ and $I = I(\overset{+}{Y}, \overset{-}{i})$, the condition for equilibrium in the goods market becomes:

$$Y = C(Y - T) + I(Y, i) + G \tag{12}$$

As in Section 1, the goods market equilibrium ca be expressed graphically as the intersection between the 45-degree line and the demand relation:

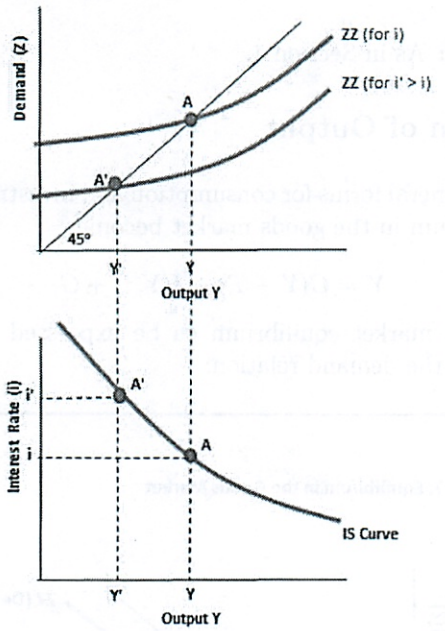
Graph 7: Equilibirum in the Goods Market



3.2 Deriving the IS Curve

- The ZZ relation in Graph 7 was drawn for a given value of the interest rate. Let's now ask what happens when the interest rate changes.
- Suppose that, in Graph 7, the demand curve is given by ZZ, and the initial equilibrium is point A. Suppose now that the interest rate increase from i to i'. At any level of output, a higher interest rate implies a decrease in investment and therefore a decrease in demand. The demand curve ZZ shifts downwards to ZZ' and the new equilibrium is found at point A'. This process is shown in the top panel of Graph 8.
- The bottom panel shows the two goods market equilibrium points A and A' in (i, Y) space. These two points correspond to two equilibrium combinations of i and Y in the goods market. If we repeat the exercise for every possible value of i and then connect all the equilibrium points in (i, Y) space, we obtain the downward-sloping IS Curve.

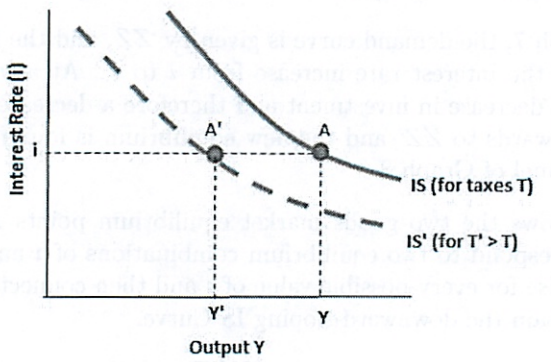
Graph 8: Equilibirum in the Goods Market



3.3 Shifts of the IS Curve

- The IS curves shifts with changes in any of the exogenous variables in the demand relation (that is, any variable except i and Y).
- Consider for example an increase in taxes from T to T'. At a given interest rate, disposable income decreases and therefore consumption goes down. This leads to a decrease in output. Graphically, the IS curve shifts to the left: At any interest rate, the equilibrium level of output is lower than it was before the increase in taxes.

Graph 9: A Shift in the IS Curve



4 The Financial Market and the LM Relation

4.1 Real Money, Real Income and the Interest Rate

- Define real money balances as M/P. Then we can re-express equation (11) as:

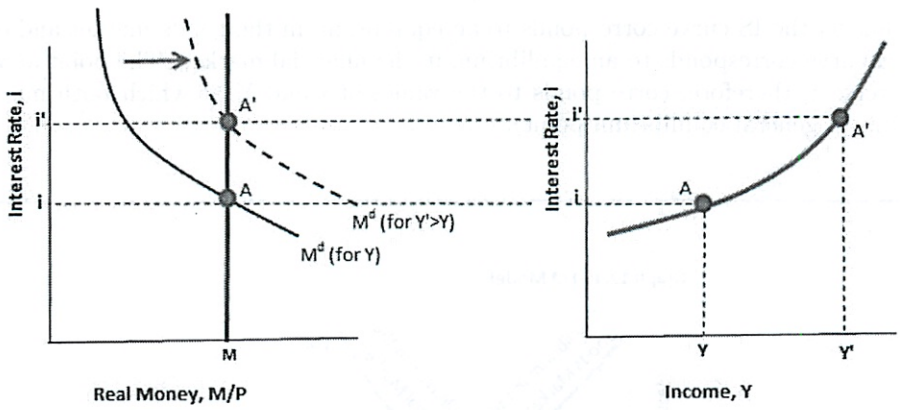
$$\frac{M}{P} = YL(\bar{i}) \tag{13}$$

- This is the equilibrium relation in the financial market.

4.2 Deriving the LM Curve

- The graphic representation of (13) is very similar to Graph 5, we just change nominal money balances (M) for real money balances ($\frac{M}{P}$) in the horizontal axis.
- Now consider an increase in income from Y to Y', which shifts the money demand curve to the right. This will increase the interest rate from i to i'(left panel in Graph 10). Equilibrium will change from point A to point A'.
- Now we can find the equilibrium points in (i, Y) space. Point A in the right panel corresponds to point A in the left panel and point A' in the right panel corresponds to point A' in the left panel.
- If we repeat the exercise for all the possible values of Y we obtain the upward-sloping LM curve.

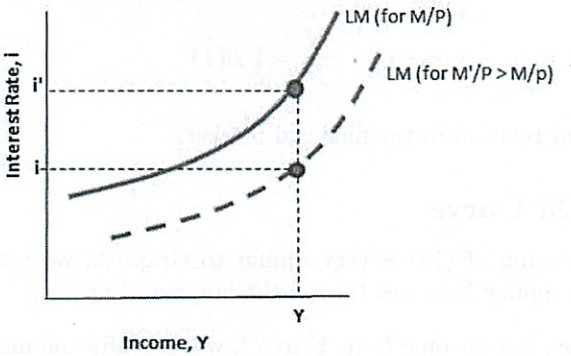
Graph 10: Derivation of the LM Curve



4.3 Shifts of the LM Curve

- We have derived the LM curve taking M and P as given. The LM curve will shift with any of these variables. Consider for example an increase in the nominal money supply, from M to M'. This will shift the money supply vertical line to the right, decreasing the interest rate. Output remains fixed in the exercise implying that we should end up having a lower interest rate for any given level of output. The LM curve, therefore, shifts downwards.

Graph 11: Shifts in the LM Curve



5 Putting the IS and LM Relations Together

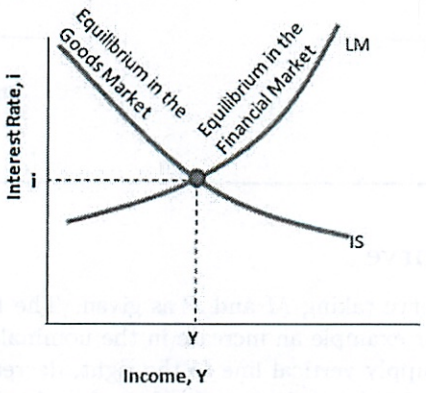
- We now put the IS and LM relations together.

$$IS : Y = C(Y - T) + I(Y, i) + G \tag{14}$$

$$LM : \frac{M}{P} = YL(i) \tag{15}$$

- Every point on the IS curve corresponds to an equilibrium in the goods market and every point in the LM curve corresponds to an equilibrium in the financial market. The point at which both curves intersect, therefore, corresponds to the values of i and Y at which both markets are in equilibrium (a general equilibrium point).

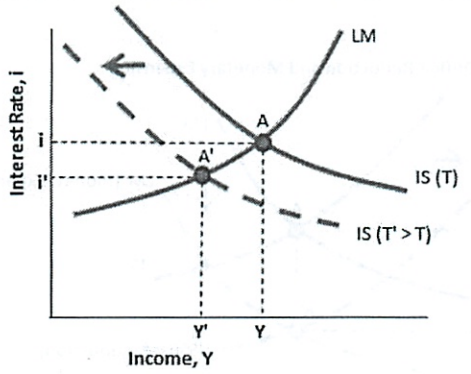
Graph 12: IS-LM Model



5.1 Fiscal Policy, Output and the Interest Rate

- The IS-LM framework is a useful tool for policy analysis. Consider for example the effect of an increase in taxes. As we just saw this will shift the IS curve to the left. Since the policy does not affect the financial market, the LM curve will not shift. The new equilibrium will be at point A' in Graph 13 and the final effect of the policy will be a lower level of production and a lower interest rate.

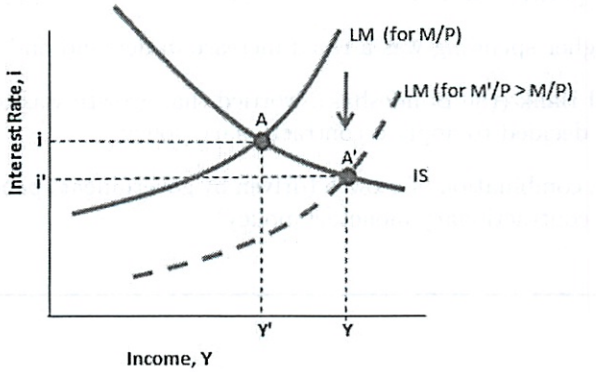
Graph 13: An Increase in taxes



5.2 Monetary Policy, Output and the Interest Rate

- A similar analysis can be made for the monetary policy case. Consider a money expansion from M to M'. As we saw above this will shift the LM curve to the right. No change occurs on the IS curve and therefore equilibrium changes from point A to point A' in Graph 14. The expansionary monetary policy causes higher output and lower interest rates.

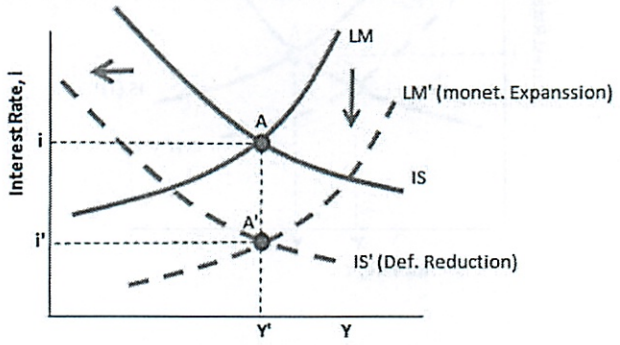
Graph 14: A Monetary Expansion



5.3 Policy Mix 1

- Suppose that the government wants to reduce its fiscal deficit by increasing taxes (it could also do it by reducing G), but knows that the effect of such policy would be lower output and lower interest rates (because the policy would shift the IS curve to the left). If the government wants to reduce its deficit without reducing output, then the fiscal policy could be complemented with a monetary policy: a monetary expansion in a magnitude such that the shift in the LM curve will be enough to keep output unchanged. The final result will be only a decrease in the nominal interest rate.

Graph 15: Deficit Reduction and Monetary Expansion

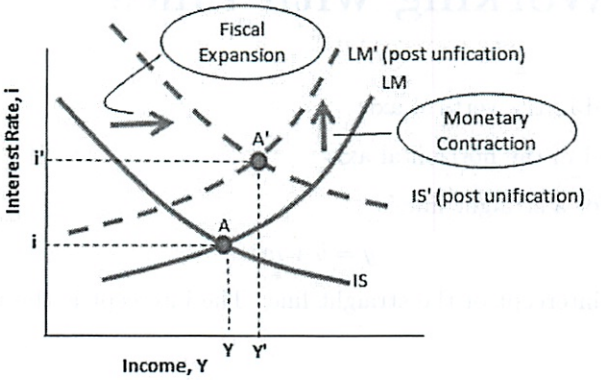


5.4 Policy Mix 2

- Blanchard gives the following account of the German unification in 1990:

1. Upon unification the government had to increase its deficit $(T - G)$ because of the large need of resources demanded by the unification process (this spending was related with things like new infrastructure, cleaning up environmental damage, unemployment benefits and government subsidies to non competitive firms).
2. The result of this higher spending was a rapid increase in demand and production.
3. The German Central Bank (the Bundesbak), worried that growth was too strong (this may have effects on inflation), decided to apply a contractionary policy.
4. The final effect was a combination of growth (driven by government spending) and higher interest rates (driven by the contractionary monetary policy).

Graph 16: Post-Unification Policy Mix



Appendix: Working with Lines

Straight lines

- y= variable measured in the vertical axis
- x= variable measured in the horizontal axis
- The basic equation for a straight line is

$$y = b + mx \tag{16}$$

- What is b? b is the intercept of the straight line. The intercept is the value that y takes when x=0.

- What is m? m is the slope of the straight line.
- The slope of a curve is the change in the vertical variable that corresponds to a change in the horizontal variable.

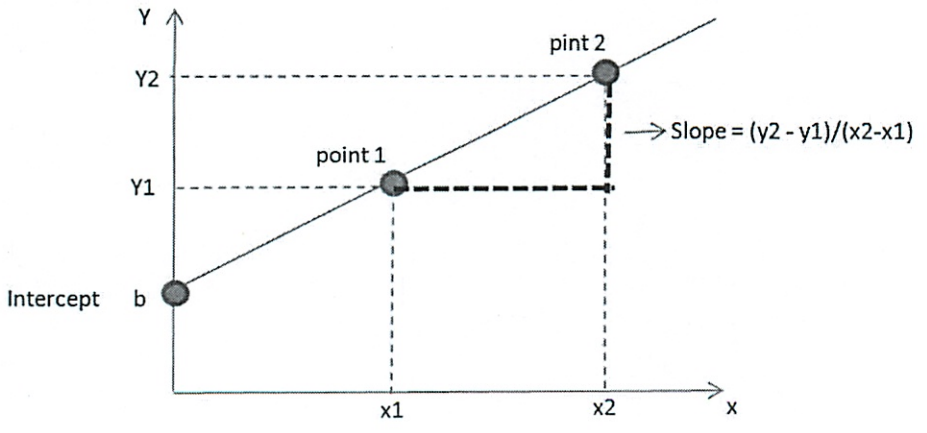
$$slope = \frac{change\ vertical\ variable}{change\ horizontal\ variable} \tag{17}$$

- The sign of the slope tells whether the curve slopes up or down.
- When a curve slopes down m is negative
- When a curve slopes up m is positive
- The size of m tells us how steep of flat the curve is.
- The higher (in absolute value) m is the steeper the line is.
- The lower (in absolute value) m is the flatter the line is.
- If you have two points on a line ($x1$,$y1$) and ($x2$,$y2$), you can find the line's slope using the following formula

$$slope = \frac{y2 - y1}{x2 - x1} \tag{18}$$

- A straight line has the same slope in every point.

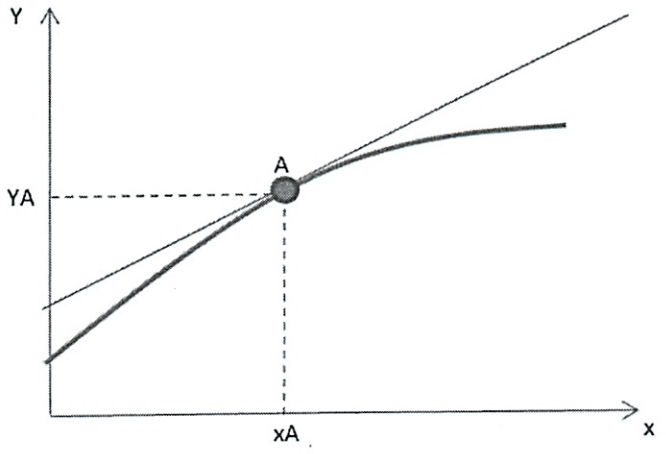
Graph 1



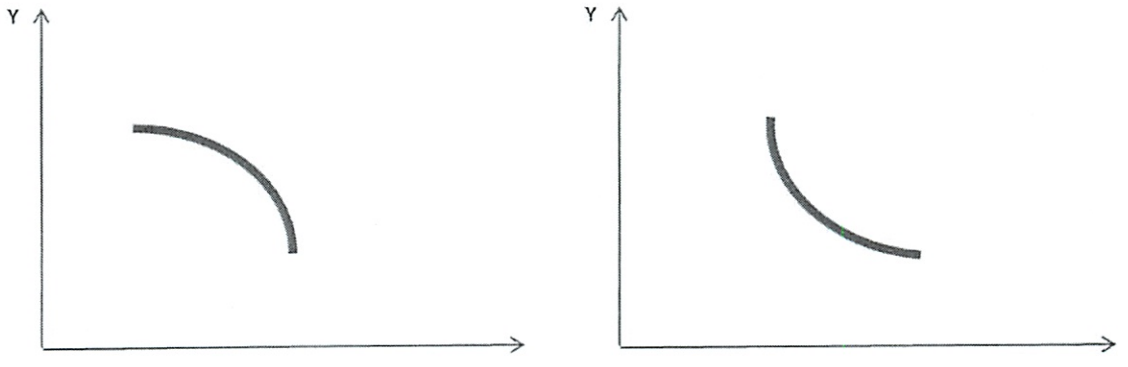
Curved lines

- A curved line has a different slope at every point.
- Let's say you want to find the slope of the curved line at point A in Graph 2. Then you first need to find a straight line that touches the curved line exactly at point A (this is called a tangent line – a line that touches the curve at just one point). Then apply formula (18) to two points in the straight line and you'll obtain the slope of the curved line at point A.
- When the curvature of the curved line aims to the origin the curve is said to be "convex"
- When the curvature of the curved line aims to the opposite direction the curve is said to be "concave"

Graph 2



Graph 3



Concave Convex

References

[1] Blanchard, Olivier (2003). Macroeconomics. 3th ed. Prentice Hall.

14.02 Quiz 1

No cheat-sheet

Spring 2010

1 Short questions (30 points)

Each of these is worth 6 points.

1. Suppose we introduce commercial banks in the economy. The money multiplier (the impact of a unit increase in the monetary base on the money supply)

   (a) does not change

   (b) decreases

   (c) increases from 1 to a number greater than 1

2. Suppose a bond pays \$1000 in one year. If the price of the bond is \$750, we know that the interest rate on the bond is:

   15.4%

   (a) 33%

   (b) 25%

   (c) 15%

   $750 = \frac{1000}{(1+r)^1}$ $750 + 750r = 1000$ $250 = 750r$ $\frac{1}{3} = r$

3. When the nominal interest rate falls to zero

   (a) the central bank can increase M and push i below zero

   (b) the central bank cannot increase M

(c) the central bank can increase M but i will not change

4. The natural level of output depends on

   (a) government spending G, net taxes T and nominal money M ← C ino

   (b) the markup variable μ and the catch-all variable modelling factors that influence wages other than unemployment, z

   (c) all of the above

u_{emp} $\frac{1+\mu}{\alpha}$;

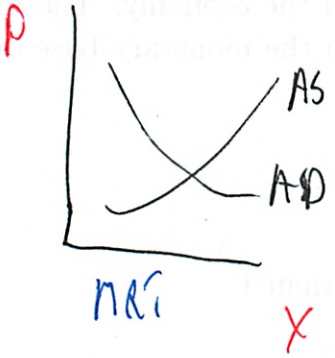
5. Consider the impact of a monetary expansion on output in the IS-LM and in the short-run of the AS-AD model. The change in output is

guessing (a) the same in the two models

(b) smaller in the IS/LM model

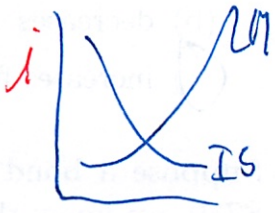
(c) smaller in the short-run of the AS-AD model

Lable



i don't really remember how to draw IS-LM!!!

just



;; same thing

b/c of price adjustment ; has not happened yet vs instantenous ;;

2 Long question 1: the IS/LM model (27)

Consider the following specification of the IS-LM model:

$$\begin{array}{ll} C: & C = c_0 + c_1 Y - c_1 T \\ I: & I = \bar{I} + d_1 Y - d_2 i \\ M^d: & \frac{M^d}{P} = Y - i \text{ for } 0 \leq i < Y \\ M^s: & M^s = M \end{array}$$

need to really remember formulas!

As usual, we assume that the economy is closed so the trade balance is zero. Public spending is denoted by G.

1. derive the IS curve. Express it as giving Y as a function of i [2 points]

goods market

$$Y = C + I + G$$

$$= c_0 + c_1 Y - c_1 T + \bar{I} + d_1 Y - d_2 i + G$$

$$Y - c_1 Y - d_1 Y = c_0 - c_1 T + \bar{I} - d_2 i + G$$

$$Y = \frac{c_0 - c_1 T + \bar{I} - d_2 i + G}{1 - c_1 - d_1}$$

Then seperate out I why?

$$\frac{1}{1-c_1-d_1}(c_0 - c_1 T + \bar{I} + G) - \frac{d_2}{1-c_1-d_1} i$$

(a) Write down the good market multiplier [1/2 point]? Name it m. Write down autonomous spending [1/2 point]? Name it A. Rewrite the IS curve using m and A .

$$\frac{1}{1-c_1-d_1} = m \quad \checkmark$$

$$c_0 = A \quad \text{no A includes } c_0 - c_1 T + \bar{I} + G$$

$$Y = (A - c_1 T + \bar{I} - d_2 i + G)(m)$$

as I defined m

$$= mA - d_2 m i$$

2. Derive the LM curve. Express it as giving i as a function of Y, using m and A as defined above [3 points].

   (a) Make sure you identify the range of values of Y for which $i = 0$ [1 point]

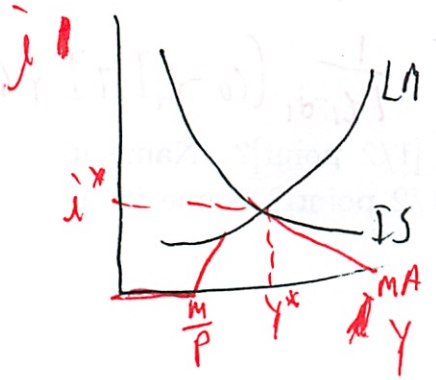
$$\frac{M'}{P} = Y - i \qquad 0 \le i < Y$$

$$\frac{M}{P} = Y \qquad i \le 0$$

otherwise

$$i = \begin{cases} Y - \frac{M}{P} & Y > \frac{M}{P} \\ 0 & Y \le \frac{M}{P} \end{cases}$$

3. Assume $mA > M/P$ throughout this long question. Draw the IS/LM graph [2 points]. ↑ just normal



4. compute the equilibrium i.e. solve for (i^*, Y^*) [2 points]

Solve simultaneously

$$Y = m(A - c_1 T + \bar{I} - d_2 i + G)$$

$$\frac{M}{P} = Y - i$$

$$Y = \frac{M}{P} + i = m(A - c_1 T + \bar{I} - d_2 i + G)$$

$$Y^* = \frac{mA}{1+md_2} + \frac{md_2}{1+md_2}\frac{M}{P}$$ need to practice this

$$i^* = \frac{mA}{1+md_2} - \frac{1}{1+md_2}\frac{M}{P}$$

This is a good to practice

(a) Is the economy in a liquidity trap? Explain [3 points].

i I need to learn what this means again

No, since not below $i=0$

WP: when econ unable to stimulate an econ (↓ i or ↑ M)

✓ yes since $mA > \frac{M}{P}$

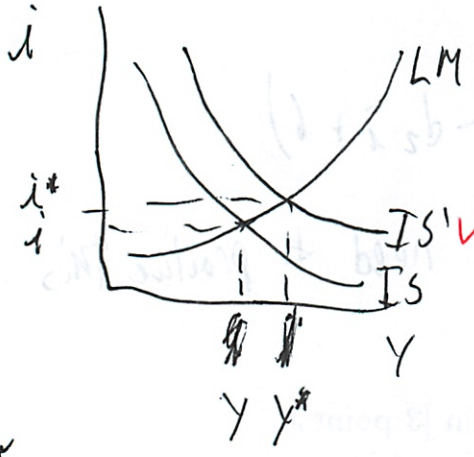
$i^* > 0$

Now suppose public spending increases by $\Delta G > 0$ (fiscal expansion).

5. Compute [1 points] and show graphically [1 point] the resulting change in the equilibrium i.e. $(\Delta i^*, \Delta Y^*)$.
   Describe intuitively [2 points].

Just IS changes

table graph



AD ↑
Y ↑ output
Y ↑ income
MD ↑
i ↑
Say

After ans review to here

Well G is inside A

So A↑ to A' $(A' > A)$

$$Y' = \frac{mA'}{1+md_2} + \frac{md_2}{1+md_2}\frac{M}{P}$$

↑ Unchanged

↑ numerator ↑ so increases

$$i = \frac{MA'}{1+md_2} - \frac{1}{1+md_2}\frac{M}{P}$$

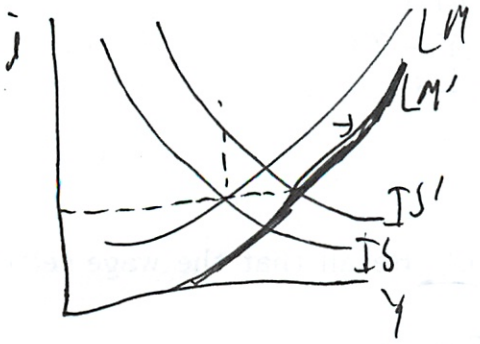
↑ numerator ↑ ↑ Unchanged

So ↑ entire thing

$\Delta Y^* = \Delta i^* = \frac{M}{1+md_2}$ ✓✓6 Oh show amount of shift read carefully!

(central Bank

6. Now suppose that following this increase in G, the CB wants to keep interest rates at the original level.
Show graphically what it would need to do [1 point].
Then compute by how much should M change in order to achieve this [1 point].
Describe intuitively [2 points].



Wrong dir
↓ i by buying bonds
(↑ price of bonds)
so M ↑ ?

Wants to ↓ opp cost of holding $
↑ supply M
As M price M↓, i↑, AD↑, Y↑

Move LM out to this point
How to represent algebraically

$$i'' = i = \frac{m'A'}{1+md_2} - \frac{1}{1+md_2}\frac{M'}{P}$$

terms w/ all their modifiers must ↑ = amt to offset

$$\frac{1}{1+md_2}\frac{1}{P}\Delta M = \frac{m}{1+md_2}\Delta G \qquad \Delta M = mP\Delta G$$

7. what happens to consumption, private savings (S), total saving (private saving S plus public saving $(T-G)$) and investment as a result of this policy mix? Fill in the table [4 points] and describe intuitively [1 point]. Use + for a positive change, − for a negative change and ? for an ambiguous change.

both

ΔC	ΔS	$\Delta(S+(T-G))$	ΔI
+	+	~~0~~ ?; +	+

− +
↙ duh this increased! (was I counting − sign twice?)

also rises with same i since sales ↑

Y ↑ + Higher outcome = higher income = more savings

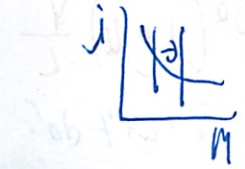
Sure I goes ↑ when i ↑

i back to normal; ~~savings rate does not change~~; ~~don't learn it changes in MS~~;

$I = S + T - G$

Investment = savings

↑ MS = ↓ i



As CB buys bonds, demand bonds ↑, P_{Bonds} ↑
Expands money supply → ↓ i (what I said)
But that ↓ opp cost of M so I ↑

Investment – interest rate
Sales –) can move in similar or diff dir

3 Long question 2: the AS/AD model (43 points)

Consider the AS/AD model that we saw in class:

$$\begin{aligned} Y: &\quad Y = N \\ PS: &\quad P = (1+\mu) W \\ C: &\quad C = c_0 + c_1 (Y - T) \\ I: &\quad I = d_1 Y - i \\ M^d: &\quad \frac{M^d}{P} = Y - i. \\ M^o: &\quad M \end{aligned}$$

with government spending denoted by G. Recall that the wage setting equation is given by

$$WS: \quad W = P^e F(u, z)$$

We assume that $F(u, z)$ is linear in u and z

function

$$F(u, z) = 1 - u + \beta z$$

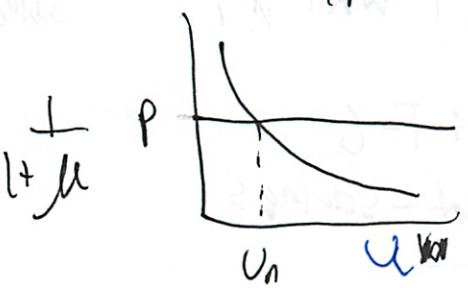
with $\beta = 0$. So the wage-setting relation becomes

$$W = P^e (1 - u)$$

Finally, let L denote the labour force of this economy.

1. Under these assumptions, derive the equation describing the set of points in (P, Y) space that are consistent with labour market equilibrium. This is the AS curve. Do this analytically first [2 points] and then draw a graph [2 points]

Wage / price curve



$P = (1+\mu) W$

$W = P^e (1-u)$

Pratice my solving skm.

$P = (1+\mu) P^e (1-u)$

$= P^e (1+\mu)(1-u) = P^e (1+\mu) \frac{Y}{L}$

emp

$Y = N = L(1-u)$

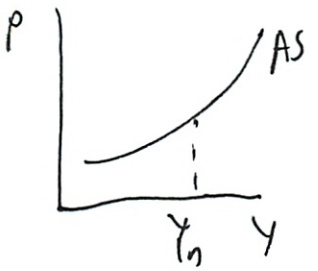
$\frac{N}{L} = emp$

where does this come from?

~~$W = (1+\mu)$~~ don't need to do i can't do?

2. Write down the natural level of output in this economy (1 point) as well as the natural rate of unemployment [1 point] as functions of parameters.
Mark Y_n on your graph [1 point)]

Y_n is when $P = P^e$



So set = to

$$\sigma = (1+\mu)\frac{Y_n}{L}$$

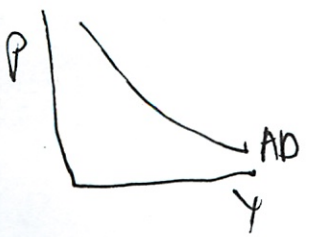
$$-(1+\mu) = \frac{Y_n}{L}$$

$$-L(1+\mu) = Y_n$$

$$Y_n = \frac{L}{1+\mu}$$ ← where went wrong on division

$$\mu_n = \frac{\mu}{1+\mu}$$

3. Under these assumptions, derive the quations describing the IS curve [2 points] and the LM curve [2 points].
To make your algebra easier, once you've done your calculations use A to denote autonomous spending and m to denote the good market multiplier. Draw the IS-LM graph [2 points] .
Use your IS and LM curves to derive the equation describing the set of points in (P, Y) space that are consistent with good and money market equilibrium. This is the AD curve [3 points].



Look back to previous ~~pbm~~ qu

$$Y = C_0 + C_1(Y-T) + d_1 Y - i + G$$

$$Y = \frac{C_0 - C_1 T - i + G}{1 - C_1 - d_1}$$

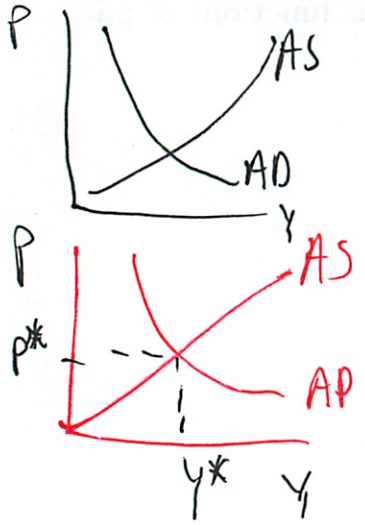
$$\frac{M}{P} = Y - i$$

$$i = Y - \frac{M}{P}$$ ✓

Solve by plugging in

↓ "i normal" - not at 0 point?

4. Assume that $\frac{mA}{1+m} < \frac{L}{1+\mu}$. Draw the AD curve on your graph [1 point].



5. Show the MR equilibrium of this economy on both your graphs (2 points per graph for a total of 4).

So equilibrium

Now supppose that the government decides to embark on a policy to increase saving. We are going to model this as a decrease in the marginal propensity to consume c_1, given by $\Delta c_1 = c_1' - c_1 < 0$.

7. Show graphically the first SR equilibrium (i.e. the equilibrium that the economy moves to when c_1 *decreases*) in both (P, Y) and (i, Y) space [1 point].
We apologise for not catching the typo in the exam. You should have consistently been asked to work under the assumption that the marginal propensity to consume decreases. Here we give you the solutions for a decrease in c_1, but you will get full credit if you answered correctly considering a change in either direction.

In General know how to solve and if needed work out derivatives by hand

   (a) Figure out the response of (Y, P, i, C, I, P^e) (without doing any maths) [3 points] and fill the table below (use + for a positive change, − for a negative change and ? for an ambiguous change).

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e

(b) Describe intuitively [4 points].

8. Show graphically the new MR equilibrium in both (P, Y) and (i, Y) space [1 point].

(a) Figure out the response of (Y, P, i, C, I, P^e) (without doing any maths) and fill the table below (use + for a positive change, − for a negative change and ? for an ambiguous change) [3 points].

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e
−	0	−			−

? equilibrium

Why is it?

(b) Compare the change in P and i going from the old MR equilibrium to the first SR equilibrium to the change in P and i going from the old MR to the new MR equilibrium. What do you observe? Why? [1 points].

Prices adjust

(c) What condition on prices and output holds in the MR? [1/2 point each]

9. How does the economy adjust from the first SR equilibrium (i.e. the equilibrium that the economy moves to when c_1 decreases) to the new MR equilibrium? Describe intuitively. Make sure you track what's happening in all three markets [8 points].
   We apologise for not catching the typo in the exam. You should have consistently been asked to work under the assumption that the marginal propensity to consume decreases. Here we give you the solutions for a decrease in c_1, but you will get full credit if you answered correctly considering a change in either direction.

2-4.

Algebra Pratice

$Y = mA - d_2 m i$ ← Start off in right form

$i = Y - \frac{m}{p}$

So need to get the other w/ the form

$Y = mA - d_2 m \left(Y - \frac{M}{p}\right)$

$Y = mA - d_2 m Y + d_2 m \frac{M}{p}$

$Y + d_2 m Y = mA + d_2 m \frac{M}{p}$

$Y = \frac{mA + d_2 m \frac{m}{p}}{1 + d_2 m}$

~~I guess thats what they had~~ ✓ yes

$\dot{i} = mA - d_2 m i - \frac{m}{p}$

$\dot{i} + d_2 m i = mA - \frac{M}{p}$

$\dot{i} = \frac{mA - \frac{M}{p}}{1 + d_2 m}$

Now do just solve in terms of other stuff

3-2.

~~I forgot the d_1 term for~~ no

$$Y = \frac{C_0 - C_1 T - Y - \frac{M}{P} + G}{1 - C_1 - d_1}$$

Solve for Y again!

Oh shortcut

$$m = \frac{1}{1 - C_1 - d_1} \qquad Y = m(A - i)$$

$$A = C_0 - C_1 T + G$$

$$Y = m\left(A - Y - \frac{M}{P}\right)$$

$$Y = mA - mY - \frac{mM}{P}$$

$$Y = \frac{mA - \frac{mM}{P}}{1 + m}$$ ← just need

$$i = m(A - i) - \frac{M}{P}$$

$$i = mA - mi - \frac{M}{P}$$

$$i = \frac{mA - \frac{M}{P}}{1 + m}$$

IS $Y = mA - mi$ ✓ had it.

LM $i = Y - \frac{M}{P}$ ✓ had

AD

$$P = \frac{M}{Y - i} = \frac{M}{Y + \frac{Y - mA}{m}} = \frac{M}{\frac{1+m}{m} Y - A}$$

14.02 Quiz 1

Spring 2010

1 Short questions (30 points)

Each of these is worth 6 points.

1. Suppose we introduce commercial banks in the economy. The money multiplier (the impact of a unit increase in the monetary base on the money supply)

   (a) does not change

   (b) decreases

   (c) increases from 1 to a number greater than 1

   ANS: (c)

2. Suppose a bond pays \$1000 in one year. If the price of the bond is \$750, we know that the interest rate on the bond is:

   (a) 33%

   (b) 25%

   (c) 15%

   ANS: (a)

3. When the nominal interest rate falls to zero

   (a) the central bank can increase M and push i below zero

   (b) the central bank cannot increase M

(c) the central bank can increase M but i will not change
ANS: (c)

4. The natural level of output depends on

   (a) government spending G, net taxes T and nominal money M

   (b) the markup variable μ and the catch-all variable modelling factors that influence wages other than unemployment, z

   (c) all of the above
   ANS (b)

5. Consider the impact of a monetary expansion on output in the IS-LM and in the short-run of the AS-AD model. The change in output is

   (a) the same in the two models

   (b) smaller in the IS/LM model

   (c) smaller in the short-run of the AS-AD model
   ANS: (c) because of price adjustment

2 Long question 1: the IS/LM model (27)

Consider the following specification of the IS-LM model:

$$\begin{array}{ll} C: & C = c_0 + c_1 Y - c_1 T \\ I: & I = \bar{I} + d_1 Y - d_2 i \\ M^d: & \frac{M^d}{P} = Y - i \text{ for } 0 \leq i < Y \\ M^s: & M^s = M \end{array}$$

As usual, we assume that the economy is closed so the trade balance is zero. Public spending is denoted by G.

1. derive the IS curve. Express it as giving Y as a function of i [2 points]
   ANS:

$$Y = \frac{1}{1 - c_1 - d_1}\left(c_0 - c_1 T + \bar{I} + G\right) - \frac{d_2}{1 - c_1 - d_1} i$$

(a) Write down the good market multiplier [1/2 point]? Name it m. Write down autonomous spending [1/2 point]? Name it A. Rewrite the IS curve using m and A .
ANS

$$\begin{aligned} m &\equiv \frac{1}{1-c_1-d_1} \\ A &\equiv c_0 - c_1 T + \bar{I} + G \\ Y &= mA - d_2 mi \end{aligned}$$

2. Derive the LM curve. Express it as giving i as a function of Y, using m and A as defined above [3 points].

   (a) Make sure you identify the range of values of Y for which $i = 0$ [1 point]

ANS

$$LM: \quad i = \begin{cases} Y - \frac{M}{P} & Y > \frac{M}{P} \\ 0 & Y \leq \frac{M}{P} \end{cases}$$

3. Assume $mA > M/P$ throughout this long question. Draw the IS/LM graph [2 points].

4. compute the equilibrium i.e. solve for (i^*, Y^*) [2 points]
   ANS:

$$\begin{aligned} Y^* &= \frac{mA}{1+md_2} + \frac{md_2}{1+md_2}\frac{M}{P} \\ i^* &= \frac{mA}{1+md_2} - \frac{1}{1+md_2}\frac{M}{P} \end{aligned}$$

   (a) Is the economy in a liquidity trap? Explain [3 points].
   ANS: the liquidity trap is a situation where the equilibrium of the economy lies on the flat portion of the LM curve. In this region, the central bank cannot bring interest rates down by doing expansionary monetary policy. Since $mA > M/P$, our equilibrium rate $i^* > 0$, so the economy is not in a liquidity trap.

Now suppose public spending increases by $\Delta G > 0$ (fiscal expansion).

5. Compute [1 points] and show graphically [1 point] the resulting change in the equilibrium i.e. $(\Delta i^*, \Delta Y^*)$.
   Describe intuitively [2 points].
   ANS:

$$\Delta Y^* = \Delta i^* = \frac{m}{1 + md_2} \Delta G$$

   An increase in G result in an outward shift of the IS curve, since at any value of the interest rate the good market now clears at a higher level of output. As G increases, aggregate demand rises driving output up. As income increases, money demand also increases, thereby driving interest rates up. Hence, both output and interest rates are higher in the new equilibrium. .

6. Now suppose that following this increase in G, the CB wants to keep interest rates at the original level.
   Show graphically what it would need to do [1 point].
   Then compute by how much should M change in order to achieve this [1 point].
   Describe intuitively [2 points].
   ANS

$$\begin{aligned} \frac{1}{1 + md_2} \frac{1}{P} \Delta M &= \frac{m}{1 + md_2} \Delta G \\ \Delta M &= mP\Delta G \end{aligned}$$

   The central bank aims to decrease the opportunity cost of holding money. Since the central bank does not control money demand, it needs to increase supply to reduce the price of money. As the price of money decreases, investment increases, thereby driving aggregate demand up. Since demand is now higher, output must increase

7. what happens to consumption, private savings (S), total saving (private saving S plus public saving $(T - G)$) and investment as a result of this policy mix? Fill in the table [4 points] and describe intuitively [1 point]. Use + for a positive change, − for a negative change and ? for an ambiguous change.

ΔC	ΔS	$\Delta (S + (T - G))$	ΔI

ANS

ΔC	ΔS	$\Delta(S+(T-G))$	ΔI
+	+	+	+

As a result of the policy mix, output increases relative to the old equilibrium and interest rates stay the same. Higher output means higher income, so higher consumption and higher private saving. Higher output also implies higher sales, so investment rises, given that interest rates are the same as in the original equilibrium. Since $I = S+(T-G)$, it follows that total saving increases.

3 Long question 2: the AS/AD model (43 points)

Consider the AS/AD model that we saw in class:

$$\begin{array}{ll} Y: & Y = N \\ PS: & P = (1+\mu)W \\ C: & C = c_0 + c_1(Y-T) \\ I: & I = d_1 Y - i \\ M^d: & \frac{M^d}{P} = Y - i. \\ M^s: & M \end{array}$$

with government spending denoted by G. Recall that the wage setting equation is given by

$$WS: \quad W = P^e F(u, z)$$

We assume that $F(u,z)$ is linear in u and z

$$F(u,z) = 1 - u + \beta z$$

with $\beta = 0$. So the wage-setting relation becomes

$$W = P^e(1-u)$$

Finally, let L denote the labour force of this economy.

1. Under these assumptions, derive the equation describing the set of points in (P, Y) space that are consistent with labour market equilibrium. This is the AS curve. Do this analytically first [2 points] and then draw a graph [2 points]
   ANS:.
   $$P = P^e (1 + \mu) \frac{Y}{L}$$
2. Write down the natural level of output in this economy (1 point) as well as the natural rate of unemployment [1 point] as functions of parameters.
   Mark Y_n on your graph [1 point)]
   ANS
   $$\begin{aligned} Y_n &= \frac{L}{1+\mu} \\ u_n &= \frac{\mu}{1+\mu} \end{aligned}$$
3. Under these assumptions, derive the quations describing the IS curve [2 points] and the LM curve [2 points].
   To make your algebra easier, once you've done your calculations use A to denote autonomous spending and m to denote the good market multiplier. Draw the IS-LM graph [2 points] .
   Use your IS and LM curves to derive the equation describing the set of points in (P, Y) space that are consistent with good and money market equilibrium. This is the AD curve [3 points].
   ANS
   $$\begin{array}{ll} IS & Y = mA - mi \\ LM & i = Y - \frac{M}{P} \\ AD & P = \frac{M}{Y-i} = \frac{M}{Y+\frac{Y-mA}{m}} = \frac{M}{\frac{1+m}{m}Y-A} \end{array}$$
4. Assume that $\frac{mA}{1+m} < \frac{L}{1+\mu}$. Draw the AD curve on your graph [1 point].
5. Show the MR equilibrium of this economy on both your graphs (2 points per graph for a total of 4).

Now supppose that the government decides to embark on a policy to increase saving. We are going to model this as a decrease in the marginal propensity to consume, c_1, given by $\Delta c_1 = c_1' - c_1 < 0$.

7. Show graphically the first SR equilibrium (i.e. the equilibrium that the economy moves to when c_1 *decreases*) in both (P, Y) and (i, Y) space [1 point].
We apologise for not catching the typo in the exam. You should have consistently been asked to work under the assumption that the marginal propensity to consume decreases. Here we give you the solutions for a decrease in c_1, but you will get full credit if you answered correctly considering a change in either direction.

   (a) Figure out the response of (Y, P, i, C, I, P^e) (without doing any maths) [3 points] and fill the table below (use + for a positive change, − for a negative change and ? for an ambiguous change).

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e

   ANS:

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e
-	-	-	-	?	0

   (b) Describe intuitively [4 points].
   ANS
   An increase in the marginal propensity to save decreases aggregate demand at any value of the interest rate. As a result, output falls (the IS moves inward). Since income is lower, consumption decreases. As for prices, the decrease in production means that fewer workers are required, so the unemployment rate rises. As a result, nominal wages fall, and prices decrease. This causes real money balances to increase (the LM shifts out). This increase in the supply of money lowers interest rates. The effect on investment is therefore ambiguous. On the one hand, interest rates decrease so investing should be cheaper. On the other hand, sales drop, so the incentives to invest are weaker. Finally, price expectations don't change, because they are given from the time when workers last negotiated wages.

8. Show graphically the new MR equilibrium in both (P, Y) and (i, Y) space [1 point].

(a) Figure out the response of (Y, P, i, C, I, P^e) (without doing any maths) and fill the table below (use $+$ for a positive change, $-$ for a negative change and ? for an ambiguous change) [3 points].

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e

ANS

ΔP	ΔY	Δi	ΔC	ΔI	ΔP^e
-	0	-	-	+	-

In the MR, the economy is in equilibrium at the natural level of output. Prices, expectations and interest rates are all lower.

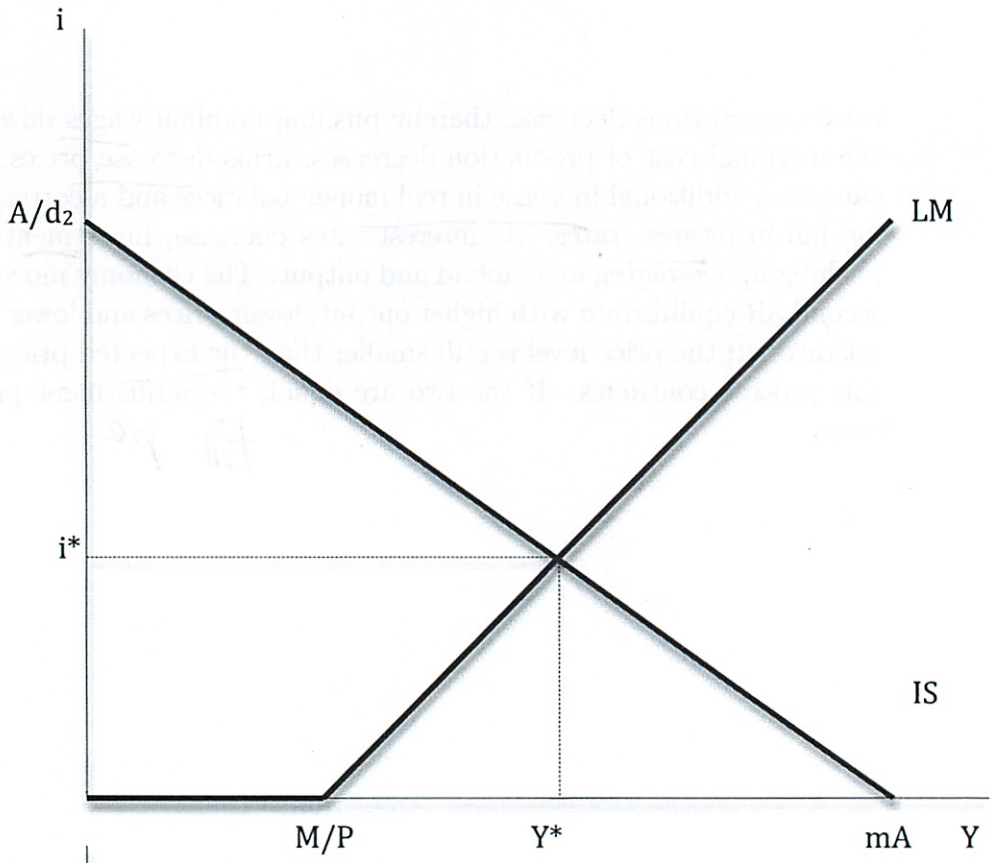
(b) Compare the change in P and i going from the old MR equilibrium to the first SR equilibrium to the change in P and i going from the old MR to the new MR equilibrium. What do you observe? Why? [1 points].
ANS:
The change in prices and interest rates are greater in the MR than in the SR, because prices adjust.

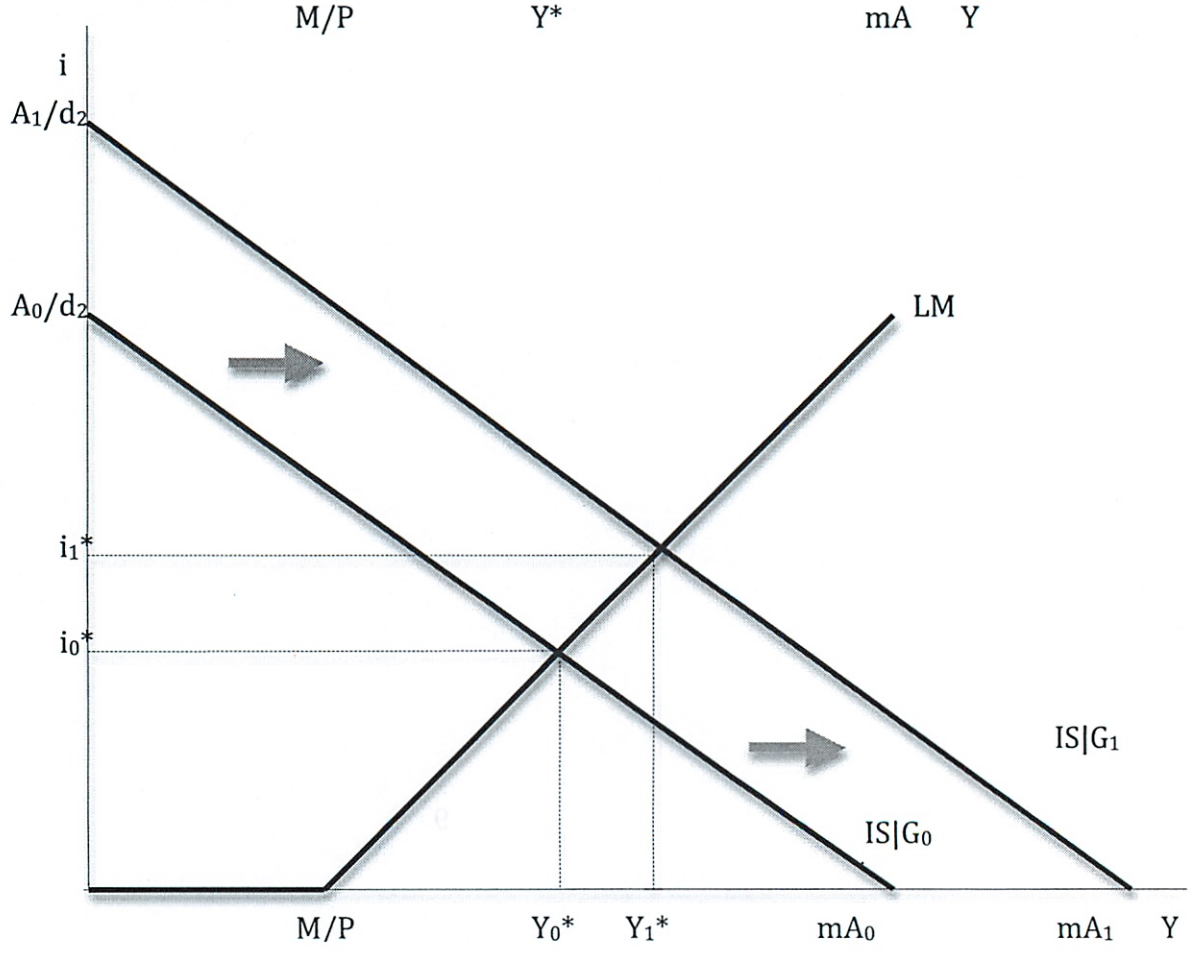
(c) What condition on prices and output holds in the MR? [1/2 point each]
ANS
The condition that needs to hold is $P = P^e$ and $Y = Y_n$.

9. How does the economy adjust from the first SR equilibrium (i.e. the equilibrium that the economy moves to when c_1 decreases) to the new MR equilibrium? Describe intuitively. Make sure you track what's happening in all three markets [8 points].
We apologise for not catching the typo in the exam. You should have consistently been asked to work under the assumption that the marginal propensity to consume decreases. Here we give you the solutions for a decrease in c_1, but you will get full credit if you answered correctly considering a change in either direction.
ANS:
The adjustment happens through price expectations P^e. In the first SR equilibrium, prices are lower relative to the original MR equilibrium but expectations are unchanged, so $P_1^{SR} < P_1^{eMR}$. As a result,

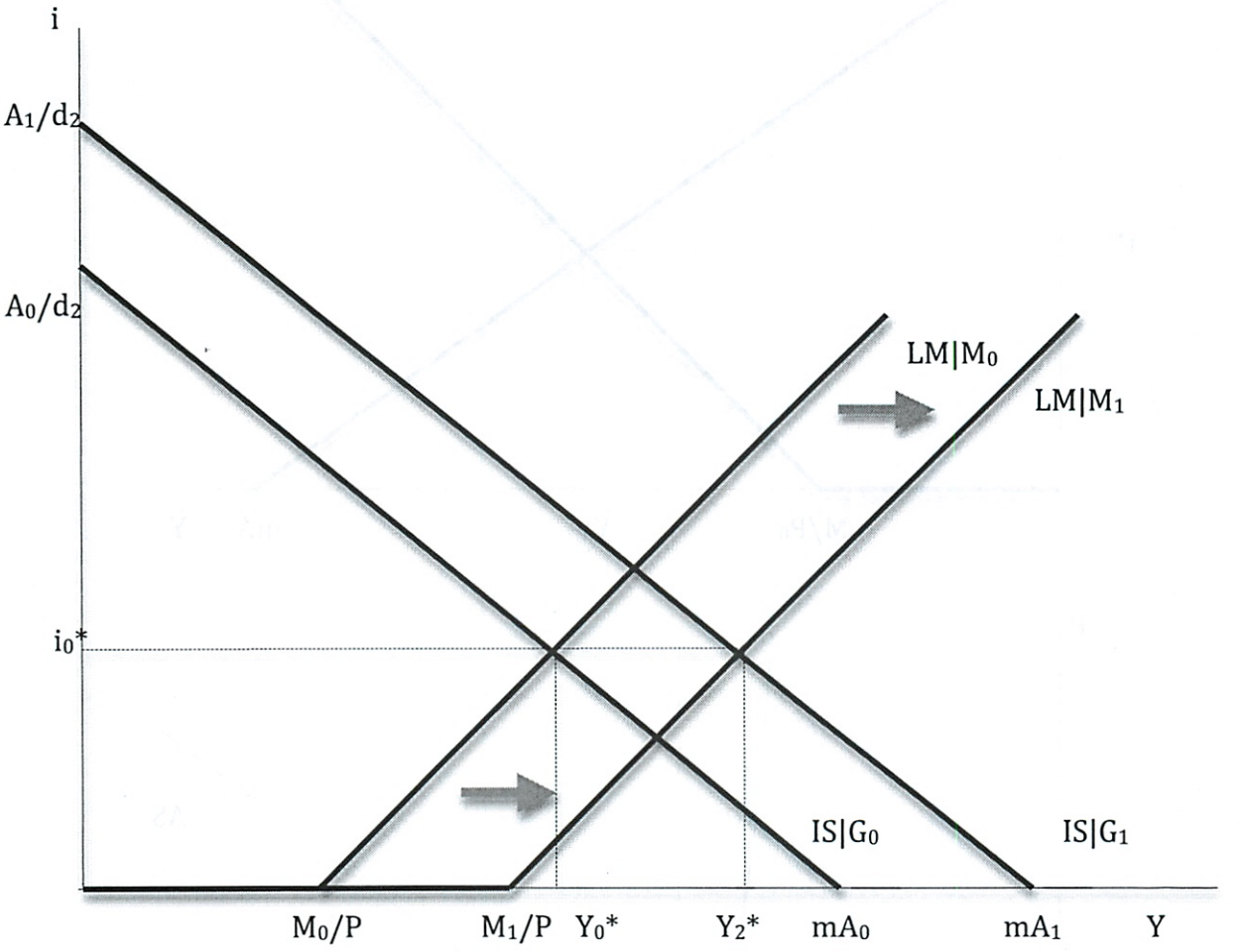
price expectations decrease, thereby pushing nominal wages down. As the marginal cost of production decreases, firms decrease prices. This causes an additional increase in real money balances and a corresponding fall in interest rates. As interest rates decrease, investment rises, pushing up aggregegregate demand and output. The economy moves to a second SR equilibrium with higher output, lower prices and lower interest rates. If the price level is still smaller than the expected price level, this process continues. If the two are equal, the adjustment process stops.

Long question 1 – sub-questions 3 and 5
IS/LM graph and results of fiscal expansion

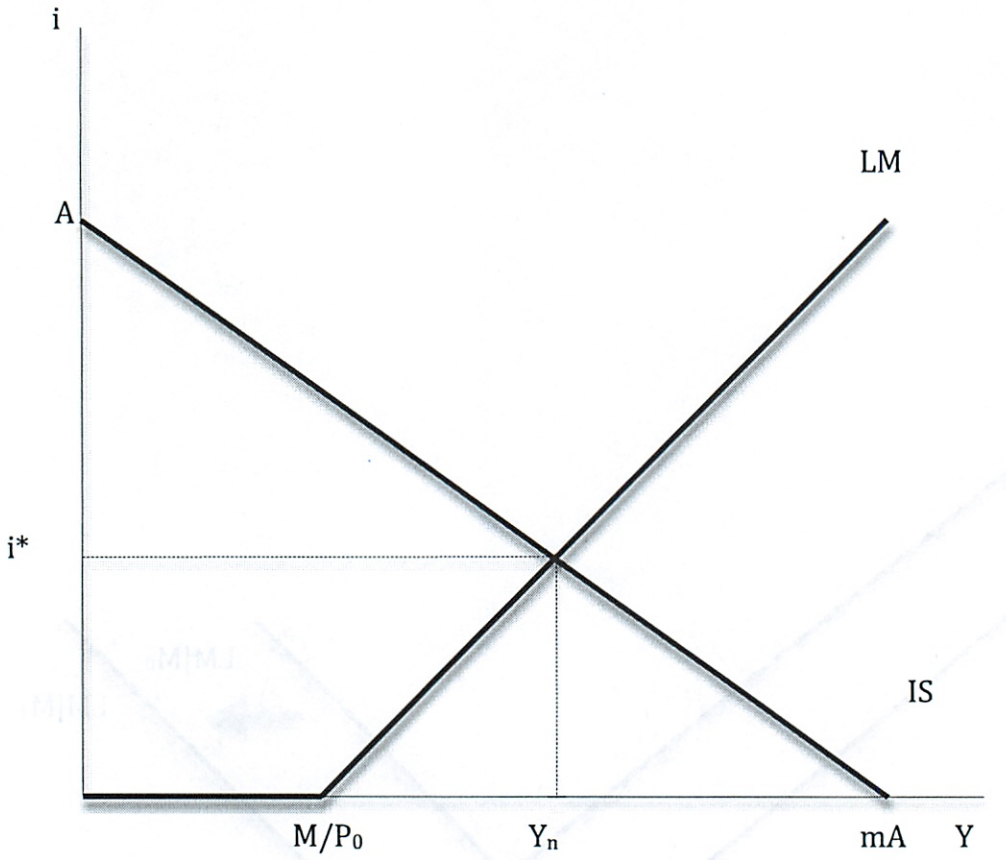


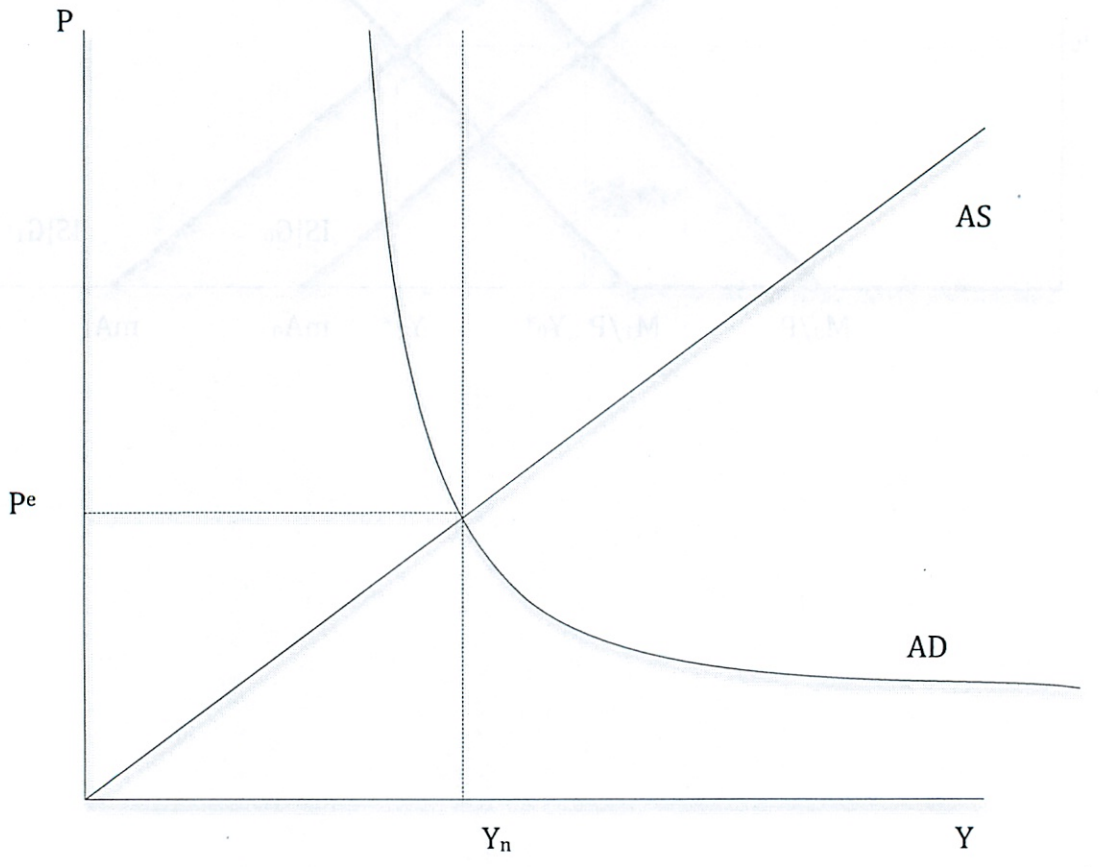


Long question 1 – sub-question 6
Results of monetary expansion

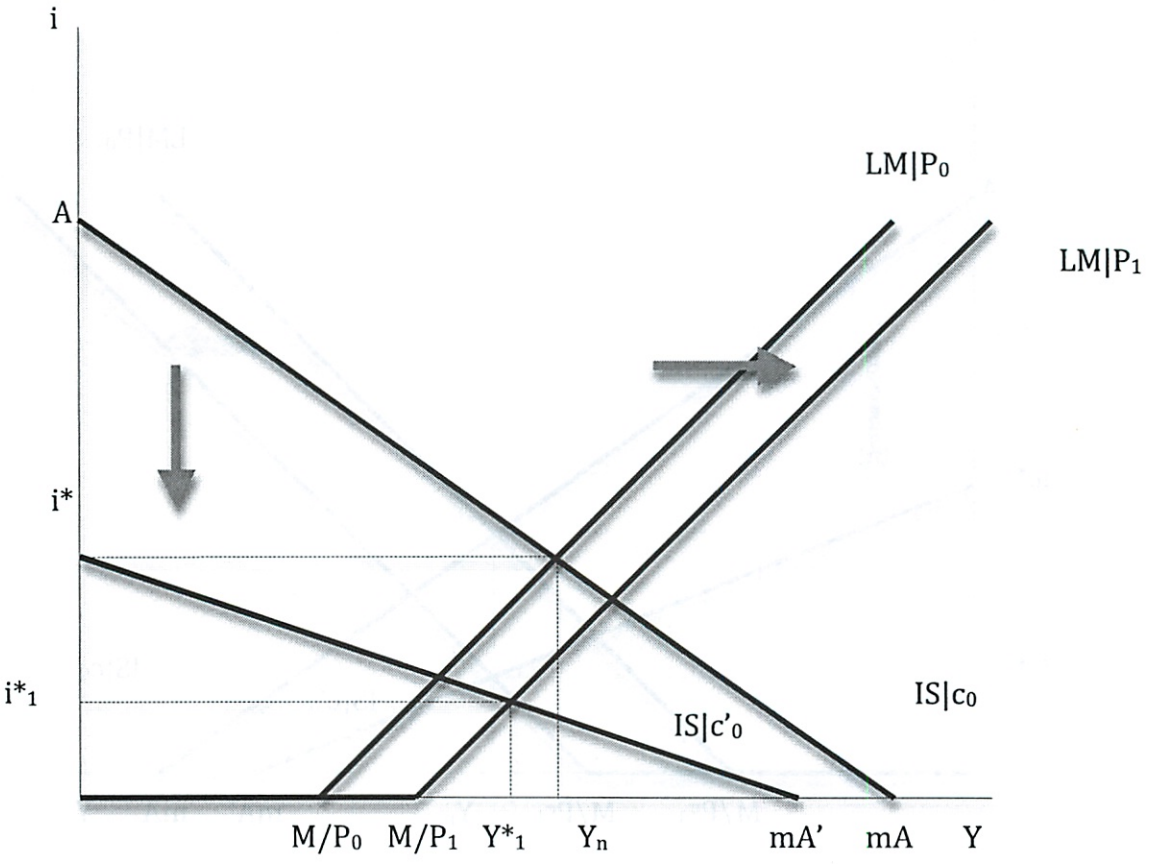


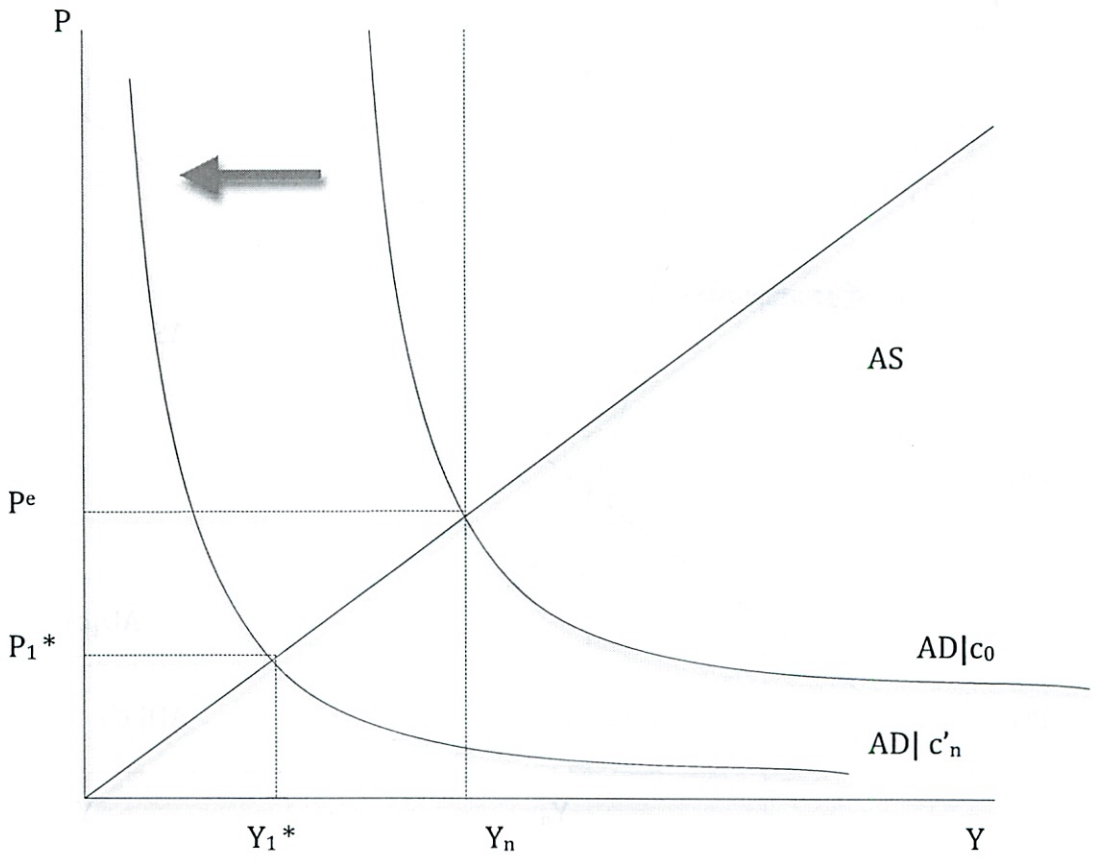
Long question 2 – Sub-questions 3 and 5
IS/LM and AS/AD graphs



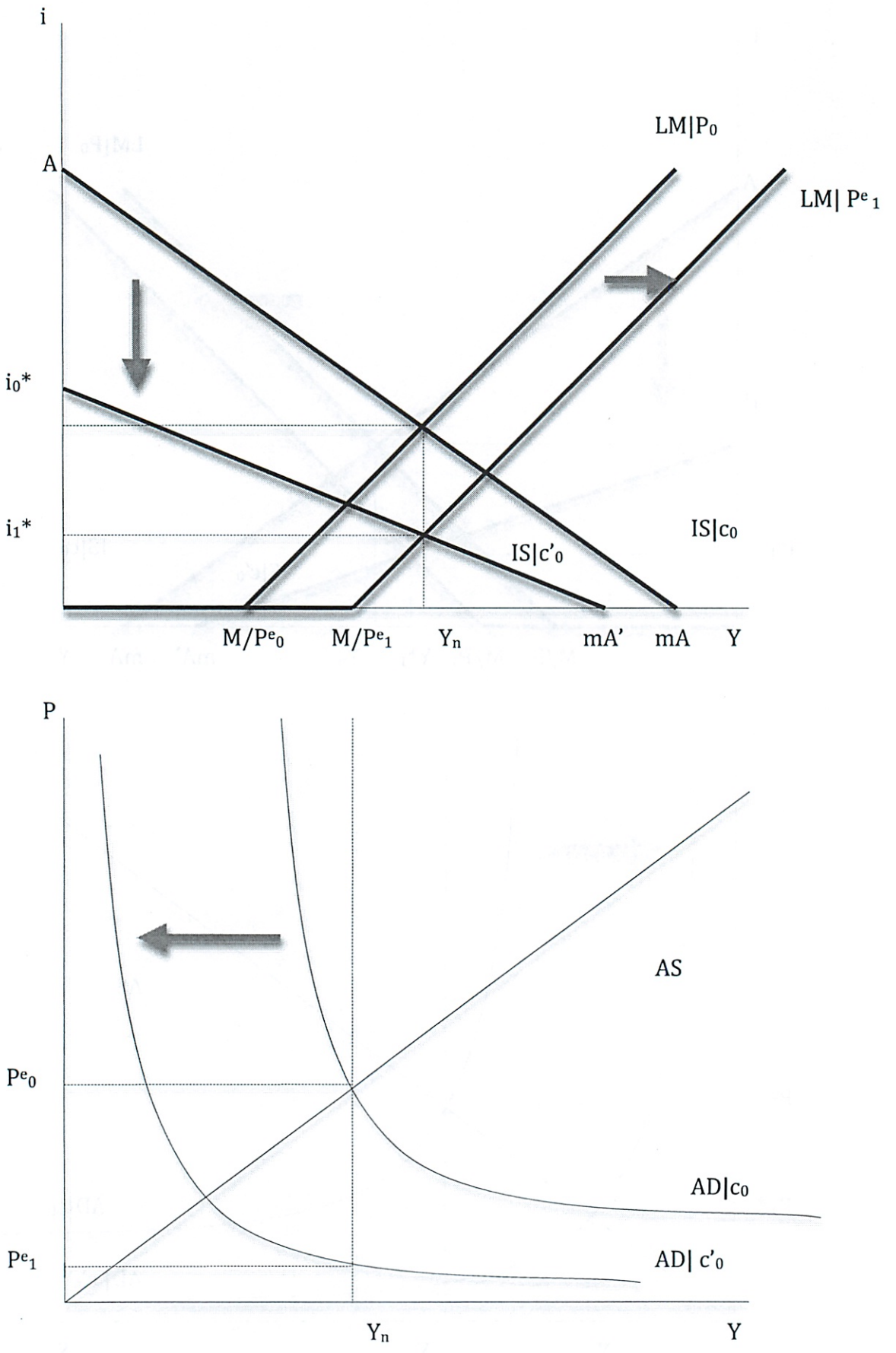


Long question 2 – Sub-question 7
The First SR Equilibrium





Long question 2 – Sub-question 8
The new MR equilibrium



14.02 Principles of Macroeconomics
Spring 2009

Quiz 1
Thursday, March 5
7:30 PM – 9 PM

1 Multiple Choice (30 points, 6 points each)

Choose only one answer per question.

1. An increase in taxes (at an unchanged level of government spending and money supply)

   (a) reduces private investment

   (b) stimulates private investment

   (c) has an ambiguous effect on private investment

2. Consider an economy with 2 goods and compute the real GDP growth rate between years t and t+1 using the chain index. Data are

   Good 1

   $p_t^1 = 1.0$

   $y_t^1 = 1.0$

   $p_{t+1}^1 = 1.0$

   $y_{t+1}^1 = 1.1$

   Good 2

   $p_t^2 = 1.0$

   $y_t^2 = 1.0$

   $p_{t+1}^2 = 1.4$

   $y_{t+1}^2 = 1.2$

   The correct answer is

   (a) 16.3%

   (b) 15.4%

   (c) 15.0%

3. When the central bank has brought the interest rate to zero, an open market purchase of bonds

   (a) raises investment but has no effect on consumption

   (b) raises investment and consumption

(c) leaves investment and consumption unchanged

4. (Use the Goods Market Model to answer this question.) The Congressional Budget Office estimates that over the coming two years the US economy will lose about 3 trillion (3000 billion) US dollars worth of output. The stimulus package is about 800 billion, 2/3 in the form of higher G and 1/3 in the form of lower T. How large should the multiplier on government spending be for the stimulus package to make up exactly for the output loss?

   (a) 3.75

   (b) 4.08

   (c) 5.68

5. If taxes increase and the Central Bank is following a fixed interest rate rule, it will

   (a) decrease money supply

   (b) keep money supply unchanged

   (c) increase money supply

2 IS-LM (40 points)

Consider the following IS-LM model:

$$\begin{aligned} C &= \frac{1}{2} + \frac{1}{3}(Y - T) \\ I &= \frac{1}{2} + \frac{1}{3}Y - i \\ G &= \bar{G} \\ \frac{M^d}{P} &= \frac{1}{3}Y - i \\ M^s &= M \end{aligned}$$

1. State the exogenous variables. (3 points)

2. Consider the **goods market** equilibrium. Solve for production as a function of the interest rate and the other exogenous variables (the IS relation). What is the multiplier at unchanged i? (just state a number) (4 points)

3. Consider the **financial market** equilibrium. Why is the money demand decreasing in the interest rate? (2 lines maximum). State the equilibrium condition and solve for the LM relation. (3 points)

Solution:

4. Find the equilibrium interest rate (i^*) and output (Y^*) in this economy. (5 points)

5. Consider an expansion in Government spending. Show graphically the change in the IS and LM curves and the effect on (Y^*, i^*). What is the effect on equilibrium output of an extra dollar spent? Is this number greater or smaller than the multiplier found in point 2 (when we were looking at the goods market exclusively)? How would your answers change for a flat LM? (5 points)

6. It turns out that the money demand function you had at the beginning of the exercise is appropriate only when the interest rate is higher than 0. From **now until the end of this question**, we will assume that the money demand is given by the following:

$$\begin{aligned} \frac{M^d}{P} &= \frac{1}{3}Y - i, \text{for } i > 0 \\ \frac{M^d}{P} \epsilon [\frac{1}{3}Y, \infty), \text{for } i &= 0 \end{aligned}$$

That is, when the interest rate is greater than 0, the money demand is as before but when the interest rate is 0, people will be willing to demand any amount of money as long as it is greater than $\frac{1}{3}Y$. Draw the new LM curve in a graph, labelling the intersection point with the horizontal axis. (5 points)

7. Find the equilibrium values of Y and i for the values of M^s, P, G and T given below (use the money demand function given in 6). (5 points)

$$\begin{aligned} G &= 5 \\ T &= 3 \\ M^s &= 10 \\ P &= 2 \end{aligned}$$

8. What happens when the Central Bank doubles the money supply ($M^s = 20$)? Draw a graph and find the new values of Y and i. (5 points)

9. The money supply is at the initial level ($M^s = 10$). What happens when the government increases expenditure such that $G = 7$? Draw a graph and find the new values of Y and i.(5 points)

3 Expansionary government spending (30 points)

1. Consider an economy in which taxes are proportional to the income level $T = \tau Y$. Consumption is increasing in disposable income $C = c_0 + c_1 (Y - T)$ .Assume investment and government spending are exogenous.

   (a) If $c_1 = 0.8$ and $\tau = 0.2$, what is the effect on GDP of a \$1 trillion fiscal stimulus plan? (5 points)

   (b) How does the effect of government spending on output depend on the marginal tax rate? (5 points)

2. Now instead of what was assumed in part (1), assume the government launches a stimulus plan while committed to sustain budget balance ($T = G$). Assume investment is exogenous and consumption is $C = c_0 + c_1(Y - T)$. What is the effect on output of a one dollar increase in G? Explain your result in words. (10 points)

3. A prominent economist wrote on his blog...

   '*In a context of increased uncertainty, those with high current income plus liquid assets can more easily bear the effects of the uncertainty and would change their consumption less. But if consumption is depressed more at lower levels than at higher levels, then the marginal propensity to consume has gone up for the entire economy. In other words, uncertainty raises the marginal propensity to consume.*'

   According to this prominent economist, what can you say about the effect of an expansionary government spending program in times of uncertainty? (10 points)

14.02 Principles of Macroeconomics
Spring 2009

Quiz 1
Thursday, March 5
7:30 PM – 9 PM

Please, answer the following questions. Write your answers directly on the quiz. You can achieve a total of 100 points. There are five multiple choice questions and two long questions. The quiz is nine pages long. There will be no questions allowed during the quiz.

Good Luck!

NAME: _____

TA: _____

CLASS TIME: _____

EMAIL: _____

(Table is for corrector use only)

	1	2	3	4	5	6	7	8	9	Total
Short Questions										
Long Question 1										
Long Question 2										
Total										

1 Multiple Choice (30 points, 6 points each)

Choose only one answer per question.

1. An increase in taxes (at an unchanged level of government spending and money supply)

   (a) reduces private investment

   (b) stimulates private investment

   (c) has an ambiguous effect on private investment

   Solution: c. Investment increases because of the decrease in the interest rate but decreases because of the lower income.

2. Consider an economy with 2 goods and compute the real GDP growth rate between years t and t+1 using the chain index. Data are

   Good 1

   $p_t^1 = 1.0$

   $y_t^1 = 1.0$

   $p_{t+1}^1 = 1.0$

   $y_{t+1}^1 = 1.1$

   Good 2

   $p_t^2 = 1.0$

   $y_t^2 = 1.0$

   $p_{t+1}^2 = 1.4$

   $y_{t+1}^2 = 1.2$

   The correct answer is

   (a) 16.3%

   (b) 15.4%

   (c) 15.0%

   Solution: b

$$\begin{aligned} & \frac{1}{2}\left[\frac{p_{t+1}^1 y_{t+1}^1 + p_{t+1}^2 y_{t+1}^2}{p_{t+1}^1 y_t^1 + p_{t+1}^2 y_t^2} + \frac{p_t^1 y_{t+1}^1 + p_t^2 y_{t+1}^2}{p_t^1 y_t^1 + p_t^2 y_t^2}\right] - 1 \\ = & \frac{1}{2}(1.15833 + 1.15) - 1 = 15.4\% \end{aligned}$$

3. When the central bank has brought the interest rate to zero, an open market purchase of bonds

   (a) raises investment but has no effect on consumption

   (b) raises investment and consumption

(c) leaves investment and consumption unchanged

Solution: c. When the interest rate is zero, an expansionary monetary policy cannot lower the interest rate further, given that it is already zero. Hence, it cannot change investment, consumption, or output.

4. (Use the Goods Market Model to answer this question.) The Congressional Budget Office estimates that over the coming two years the US economy will lose about 3 trillion (3000 billion) US dollars worth of output. The stimulus package is about 800 billion, 2/3 in the form of higher G and 1/3 in the form of lower T. How large should the multiplier on government spending be for the stimulus package to make up exactly for the output loss?

   (a) 3.75

   (b) 4.08

   (c) 5.68

   Solution. b

$$\begin{aligned} \Delta Y &= \frac{1}{1-c}\Delta G - \frac{c}{1-c}\Delta T \\ 3000 &= \frac{1}{1-c}533.33 + \frac{c}{1-c}266.67 \\ c &= \frac{3000-533.33}{3000+266.67} = 0.755 \\ multiplier &= \frac{1}{1-c} = 4.08 \end{aligned}$$

5. If taxes increase and the Central Bank is following a fixed interest rate rule, it will

   (a) decrease money supply

   (b) keep money supply unchanged

   (c) increase money supply

   Solution: a. An increase in taxes shifts the IS to the left, in order to maintain the interest rate at its original level we need a shift to the left of the LM which is generated by a decrease in money supply.

2 IS-LM (40 points)

Consider the following IS-LM model:

$$\begin{aligned} C &= \frac{1}{2} + \frac{1}{3}(Y-T) \\ I &= \frac{1}{2} + \frac{1}{3}Y - i \\ G &= \bar{G} \\ \frac{M^d}{P} &= \frac{1}{3}Y - i \\ M^s &= M \end{aligned}$$

1. State the exogenous variables. (3 points)

   Solution. $\overline{G}$, T, M^s and P.

2. Consider the **goods market** equilibrium. Solve for production as a function of the interest rate and the other exogenous variables (the IS relation). What is the multiplier at unchanged i? (just state a number) (4 points)

   Solution.

$$\begin{aligned} Y &= \frac{1}{2}+\frac{1}{3}(Y-T)+\frac{1}{2}+\frac{1}{3}Y-i+G \\ Y &= 1+\frac{2}{3}Y-\frac{1}{3}T-i+G \\ Y &= 3-T-3i+3G \end{aligned}$$

   The multiplier is 3 (think of the effect on Y of a 1 dollar increase in G). Alternatively, the IS is

$$i = 1-\frac{1}{3}T+G-\frac{1}{3}Y$$

3. Consider the **financial market** equilibrium. Why is the money demand decreasing in the interest rate? (2 lines maximum). State the equilibrium condition and solve for the LM relation. (3 points)

   Solution.

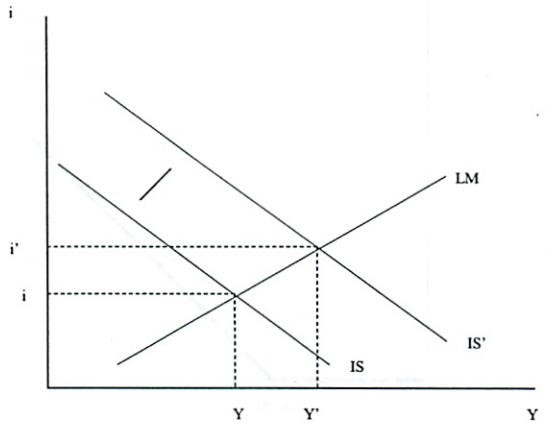
$$\begin{aligned} \frac{M}{P} &= \frac{1}{3}Y-i \\ i &= \frac{1}{3}Y-\frac{M}{P} \end{aligned}$$

4. Find the equilibrium interest rate (i^*) and output (Y^*) in this economy. (5 points)

$$\begin{aligned} 1-\frac{1}{3}T+G-\frac{1}{3}Y &= \frac{1}{3}Y-\frac{M}{P} \\ Y^* &= \frac{3}{2}-\frac{1}{2}T+\frac{3}{2}G+\frac{3}{2}\frac{M}{P} \\ i^* &= \frac{1}{2}-\frac{1}{6}T+\frac{1}{2}G-\frac{1}{2}\frac{M}{P} \end{aligned}$$

5. Consider an expansion in Government spending. Show graphically the change in the IS and LM curves and the effect on (Y^*, i^*). What is the effect on equilibrium output of an extra dollar spent? Is this number greater or smaller than the multiplier found in point 2 (when we were looking at the goods market exclusively)? How would your answers change for a flat LM? (5 points)

   Solution. The graph is the usual one, with the IS shifting to the right, so that both equilibrium output and interest rate are higher. The effect of a \$1 increase in G is 3/2 which is less than the multiplier found in part 2 above. This is because the LM is upward slopping. If it was flat, the effect would equal the multiplier, 3.

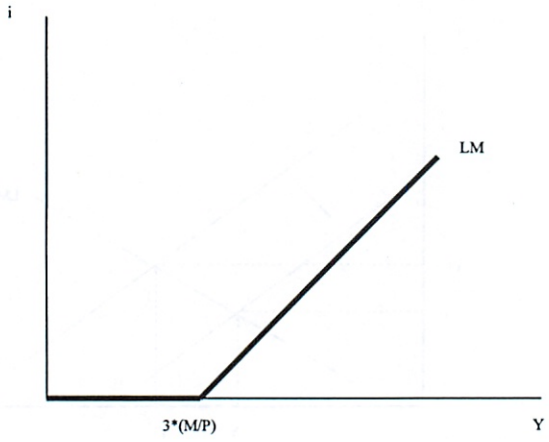


6. It turns out that the money demand function you had at the beginning of the exercise is appropriate only when the interest rate is higher than 0. From **now until the end of this question**, we will assume that the money demand is given by the following:

$$\begin{aligned} \frac{M^d}{P} &= \frac{1}{3}Y - i, \text{for } i > 0 \\ \frac{M^d}{P} \epsilon [\frac{1}{3}Y, \infty), \text{for } i &= 0 \end{aligned}$$

That is, when the interest rate is greater than 0, the money demand is as before but when the interest rate is 0, people will be willing to demand any amount of money as long as it is greater than $\frac{1}{3}Y$. Draw the new LM curve in a graph, labelling the intersection point with the horizontal axis. (5 points)

Solution.



7. Find the equilibrium values of Y and i for the values of M^s, P, G and T given below (use the money demand function given in 6). (5 points)

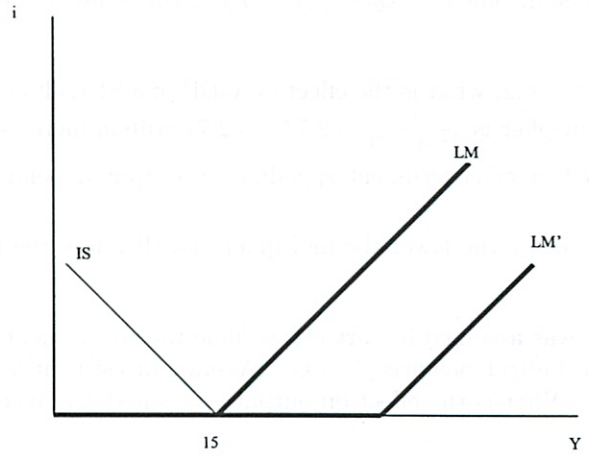
$$\begin{aligned} G &= 5 \\ T &= 3 \\ M^s &= 10 \\ P &= 2 \end{aligned}$$

Solution.

$$\begin{aligned} i^* &= \frac{1}{2} - \frac{1}{6}3 + \frac{1}{2}5 - \frac{1}{2}\frac{10}{2} = 0 \\ Y^* &= 3 - 3 - 3i^* + 3 \times 5 = 15 \end{aligned}$$

8. What happens when the Central Bank doubles the money supply ($M^s = 20$)? Draw a graph and find the new values of Y and i. (5 points)

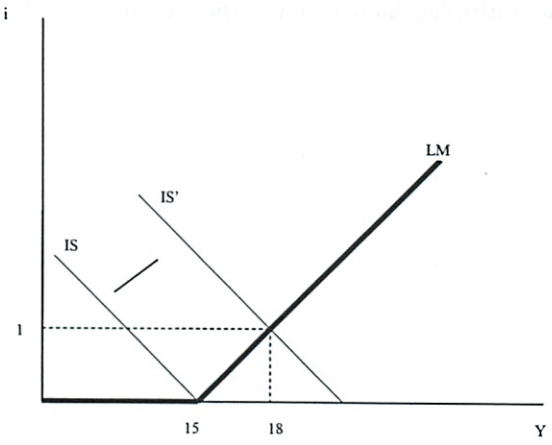
Solution. Y and i don't change. The expansionary monetary policy can't reduce the interest rate, because it is already 0, and therefore doesn't have any impact on Y



9. The money supply is at the initial level ($M^s = 10$). What happens when the government increases expenditure such that $G = 7$? Draw a graph and find the new values of Y and i.(5 points)

Solution.

$$\begin{aligned} i^* &= \frac{1}{2} - \frac{1}{6}3 + \frac{1}{2}7 - \frac{1}{2}\frac{10}{2} = 1 \\ Y^* &= 3 - 3 - 3 \times 1 + 3 \times 7 = 18 \end{aligned}$$



3 Expansionary government spending (30 points)

1. Consider an economy in which taxes are proportional to the income level $T = \tau Y$. Consumption is increasing in disposable income $C = c_0 + c_1 (Y - T)$ .Assume investment and government spending are exogenous.

   (a) If $c_1 = 0.8$ and $\tau = 0.2$, what is the effect on GDP of a \$1 trillion fiscal stimulus plan? (5 points)
   Answer: the multiplier is $\frac{1}{1-c(1-\tau)} = 2.77$. So 2.77 trillion increase in GDP.

   (b) How does the effect of government spending on output depend on the marginal tax rate? (5 points)
   Answer: The higher τ the lower the multiplier and therefore the less effective the fiscal stimulus plan.

2. Now instead of what was assumed in part (1), assume the government launches a stimulus plan while committed to sustain budget balance ($T = G$). Assume investment is exogenous and consumption is $C = c_0 + c_1(Y - T)$. What is the effect on output of a one dollar increase in G? Explain your result in words. (10 points)

   Answer: An increase in G of one dollar increases output by one dollar. The multiplier of government expenditure is 1, not larger than 1 as we are used to. the reason is that budget balance requires to raise taxes to pay for the increase in expenditures. The expansionary effect of higher G is dampened by the higher taxes required to pay for it.

3. A prominent economist wrote on his blog...

   '*In a context of increased uncertainty, those with high current income plus liquid assets can more easily bear the effects of the uncertainty and would change their consumption less. But if consumption is depressed more at lower levels than at higher levels, then the marginal propensity to consume has gone up for the entire economy. In other words, uncertainty raises the marginal propensity to consume.*'

   According to this prominent economist, what can you say about the effect of an expansionary government spending program in times of uncertainty? (10 points)

   Answer: according to this economist, in times of uncertainty the marginal propensity to consume increases, therefore the multiplier increases and the stimulus plan is more effective.