

6. The IS-LM and Its Application

EE212 2/2016 Section 464001 - A. Sicha

Case & Fair, ch. 10-11; LCR, ch. 27-29, Froyen p.335-339

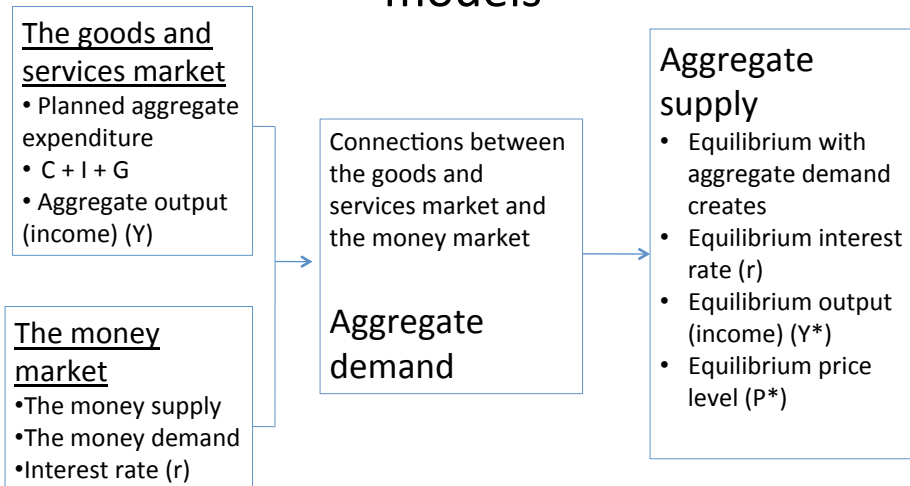
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1 Introduction

The overview of basic macroeconomic models



- Remember our earlier depiction of the interactions between goods and money markets.
- In fact, we can depict the interaction between the two markets via mapping their equilibriums.
- And this is what led to the IS (goods market equilibrium) and LM (money market equilibrium) model
- The “interest rate” provides the link between the money market (what its equilibrium determines) and the goods market (interest rate determines investment).
 - The “interest rate”, therefore, will be the key variable in IS-LM model. We want to plot the relationship between “interest rate” and “output” that arises from the equilibriums in each of the market.

2 The Goods Market and the IS Curve

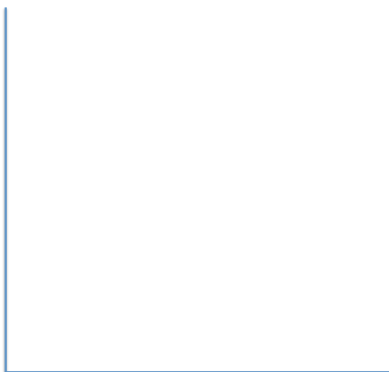
2.1 IS (Investment and Saving) curve : meaning

- Represents what is going on in the market for goods and services.
- Remember our “Keynesian Cross” model (DAE and Output equilibrium)
- IS (Investment and Saving) curve

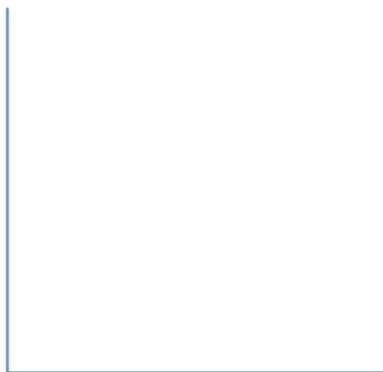
2.2 Plotting the IS curve

- We will be plotting the IS curve from the relationship between the interest rate and equilibrium output in the goods market.
- The derivation can be achieved through plotting what happens to the DAE & Y equilibrium when the interest rate changes.

DAE



IS Curve



2.3 Slope of the IS curve

- $r \uparrow \Rightarrow I \downarrow \Rightarrow DAE \downarrow \Rightarrow Y \downarrow$
- slope of the IS curve depends on MPC and interest elasticity of investment
 - IS is steep ; $\left| \frac{\Delta r}{\Delta Y} \right|$ is high. Big change in interest rate, small change in Y in the opposite direction
 - IS is flat ; $\left| \frac{\Delta r}{\Delta Y} \right|$ is low. change in interest rate, change in Y in the opposite direction
- 1. MPC ;
 - high MPC ; DAE is ; income multiplier
 - $r \uparrow \Rightarrow I \downarrow \Rightarrow DAE \downarrow \Rightarrow Y \downarrow$
 - high MPC, IS is
- 2. Interest elasticity of investment
 - high interest elasticity of investment (investment is very sensitive to change in interest rate)
; interest rate increases by a little, investment decreases a lot.
 - $r \uparrow \Rightarrow I \downarrow \dots \Rightarrow DAE \downarrow \Rightarrow Y \downarrow$
 - high interest elasticity of investment, IS is

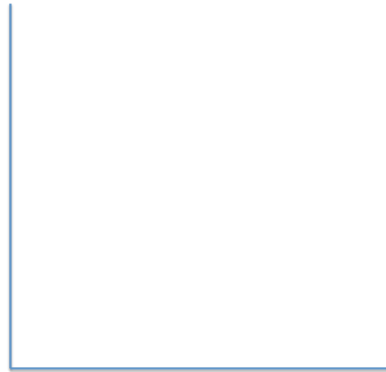
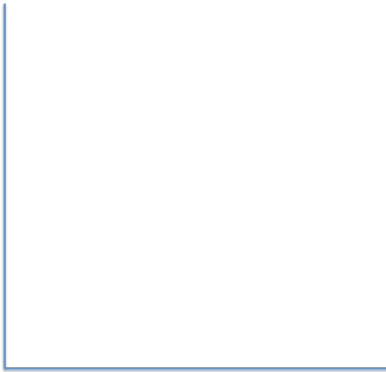
2.4 Shiftness of IS curve:

- IS curve shifts to the left can be caused by
- IS curve shifts to the right can be caused by
- How fiscal policy shifts the IS curve ? Expansionary fiscal policy, Contractionary Fiscal policy

2.4.1 IS shift to the right : Expansionary Fiscal Policy

DAE

IS curve



2.4.2 IS shift to the left : Contractionary Fiscal Policy

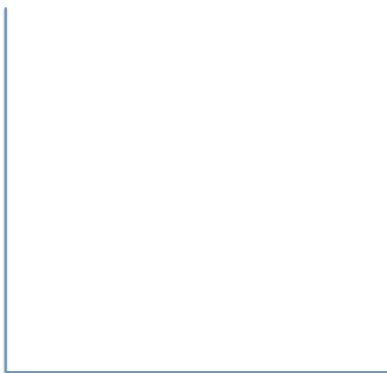
DAE

IS curve



2.4.3 Size of IS shift

- (horizontally measure = holding r constant) : How does fiscal policy affect IS Curve?



Size of IS shift (horizontally measure = holding r constant) : How does fiscal policy affect IS Curve?

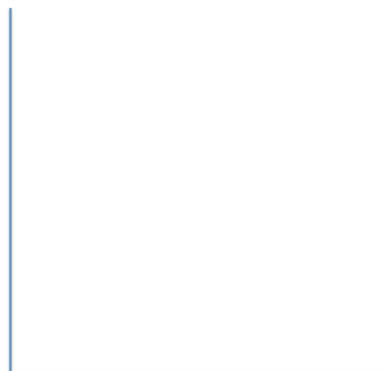
- Suppose G increases for 1 unit, how does IS shift? to what direction and by how much?
- Suppose T increases for 1 unit, how does IS shift? to what direction and by how much?
- Suppose BB increases for 1 unit, how does IS shift? to what direction and by how much?

3 The Money Market and the LM Curve

3.1 LM curve : meaning

- LM (Liquidity and Money) Curve
- Remember the equilibrium between money supply and money demand
- Hold the price constant.
- With there's a change in output, money demand will shift, and the equilibrium interest rate will change accordingly.
- The LM curve simply summarizes what happen.

3.2 Plotting the LM curve



3.3 Slope of the LM curve

- slope of the LM curve depends on money demand elasticity of income
 - LM is steep ; $\frac{\Delta r}{\Delta Y}$ is high, small change in Y , big change in r ; in the same direction
 - LM is flat ; $\frac{\Delta r}{\Delta Y}$ is low, change in Y , change in r ; in the same direction
- $Y \uparrow \Rightarrow M^d \uparrow \Rightarrow r \uparrow$
- Money demand is highly sensitive to income change
 - $Y \uparrow$ a little $\Rightarrow M^d \uparrow$ $\Rightarrow r \uparrow$
 - LM is
- Money demand is lowly sensitive to income change
 - $Y \uparrow$ a lot $\Rightarrow M^d \uparrow$ $\Rightarrow r \uparrow$
 - LM is
- Money demand is highly sensitive to interest rate change
 - $Y \uparrow \Rightarrow M^d \uparrow$ but MS $\Rightarrow$ then, r to make M^d (offsetting the previous increase in M^d to make money market in equilibrium again.).
 - It requires a increase in r to make money market in equilibrium again.
 - LM is
- Money demand is lowly sensitive to interest rate change
 - $Y \uparrow \Rightarrow M^d \uparrow$ but MS $\Rightarrow$ then, r to make M^d (offsetting the previous increase in M^d to make money market in equilibrium again.).
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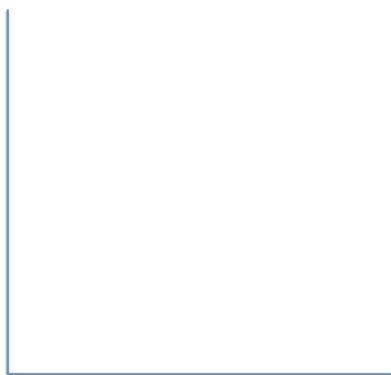
3.4 Shiftness of the LM curve

- LM curve shifts to the left can be caused by
- LM curve shifts to the right can be caused by

3.4.1 LM shifts to the right : Expansionary Monetary Policy

Money Market

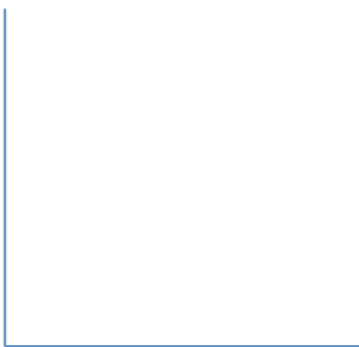
LM curve



3.4.2 LM shifts to the left : Contractionary Monetary Policy

Money Market

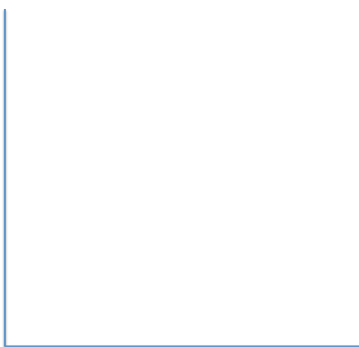
LM Curve



3.4.3 Change in Money Demand : Money demand increases for all levels of interest rate (r) and (y).

Money Market

LM Curve

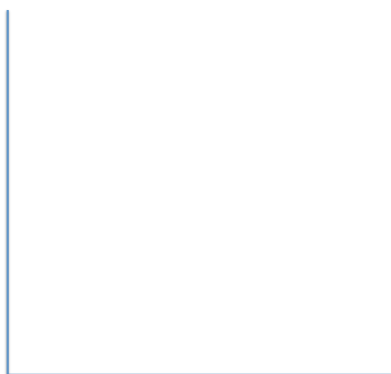


IS	LM
Derivation Equilibrium in the goods market $r \uparrow \Rightarrow I \dots \Rightarrow DAE \dots \Rightarrow Y \dots$ r and Y has relationship IS has slope	Derivation Equilibrium in the money market $Y \uparrow \Rightarrow M^d \dots \Rightarrow r \dots$ r and Y has relationship LM has slope
Slope of IS depends on 1. MPC - high MPC ; DAE is ; income multiplier $r \uparrow \Rightarrow I \downarrow \Rightarrow DAE \downarrow \Rightarrow Y \downarrow \dots$ - high MPC, IS is 2. Interest elasticity of investment - high interest elasticity of investment (investment is very sensitive to change in interest rate) ; interest rate increases by a little, investment decreases a lot. $r \uparrow \Rightarrow I \downarrow \dots \Rightarrow DAE \downarrow \Rightarrow Y \downarrow \dots$ - high interest elasticity of investment, IS is flat IS ; MPC ϵ_I^r	Slope of LM depends on 1. Money demand elasticity of income - Money demand is highly sensitive to income change $Y \uparrow \text{ a little } \Rightarrow M^d \uparrow \dots \Rightarrow r \uparrow \dots$ - LM is 2 Money Demand Elasticity of interest - Money demand is highly sensitive to interest rate change $Y \uparrow \Rightarrow M^d \uparrow$.but MS..... $\Rightarrow$ then, r must..... (a) to make M^d (offsetting the previous increase in M^d to make money market in equilibrium again.) - LM is flat LM ; $\epsilon_{M^d}^Y$ $\epsilon_{M^d}^r$
Shift in IS $G \uparrow \Rightarrow IS$ shifts to the $T \uparrow \Rightarrow IS$ shifts to the $G \uparrow$ by equal amount as $T \uparrow \Rightarrow IS$ shifts to the..... C or $I \uparrow$ for all levels of r and Y $\Rightarrow IS$ shifts to the	Shift in LM $M^s \uparrow \Rightarrow LM$ shifts to the $M^s \downarrow \Rightarrow LM$ shifts to the $M^d \uparrow$ for all levels of r and Y $\Rightarrow LM$ shifts to the $P \uparrow \Rightarrow LM$ shifts to the

4 The Equilibrium between IS-LM

4.1 Simultaneous Equilibrium

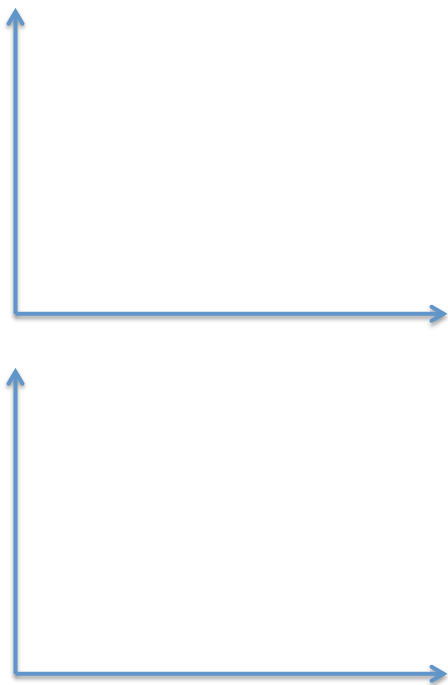
- Putting the IS curve and LM curve together, we get the simultaneous equilibrium of the goods market and the money market.
- Note that what we will know will be the equilibrium interest rate and the equilibrium output.
- And also note that this is the short-run depiction.



At the equilibrium,

- (Y^E, r^E) is on both IS and LM ; both goods market and money market are in equilibrium
- other points is not on both IS and LM ; either of the two markets is not in equilibrium or both market is not in equilibrium
- there will be adjustment to equilibrium

4.2 Adjustment to IS curve;



adjustment to IS curve in the goods market

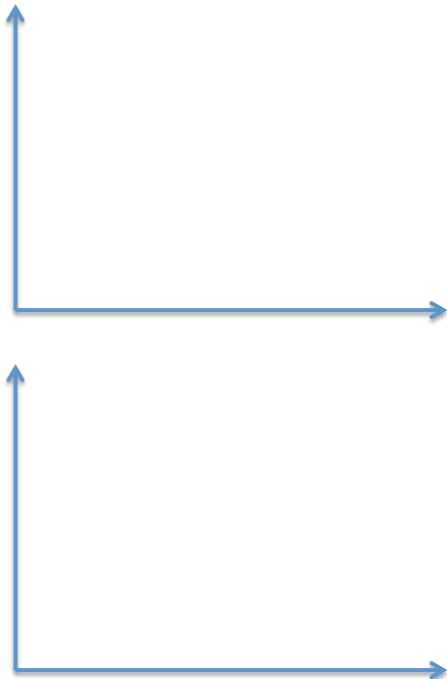
1. A point above IS curve ; $Y > Y^E$ DAE

- Actual Δ inventory.....
Planned Δ inventory
- inventory
- producers will produce
- $Y < Y^E$

2. A point below IS curve ; $Y < Y^E$ DAE

- Actual Δ inventory.....
Planned Δ inventory
- inventory
- producers will produce
- $Y > Y^E$

4.3 Adjustment to LM curve



adjustment to LM curve in the money market

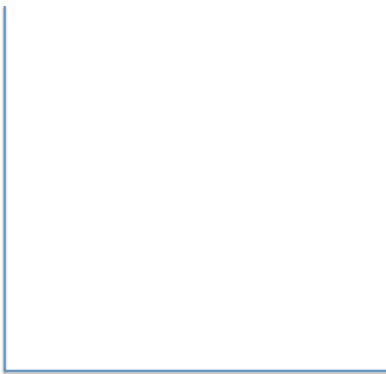
1. A point above LM curve ;

- for the level of Y , interest rate is equilibrium r
- There is excess money
- People will bonds , bond price
- interest rate

2. A point below LM curve ;

- for the level of Y , interest rate is equilibrium r
- There is excess money
- People will bonds , bond price
- interest rate

4.4 Adjustment to equilibrium



- any point not on IS or LM or both will adjust until it falls to both IS and LM
- adjustment will take place in goods market or money market or both
- equilibrium is at the intersection between IS and LM

5 Application of IS-LM to explain policies

5.1 How fiscal policy shifts the IS curve and the equilibrium in the IS-LM model.

5.1.1 Expansionary Fiscal Policy



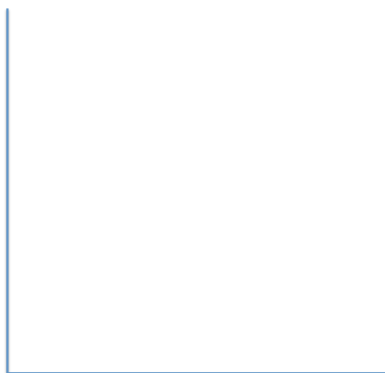
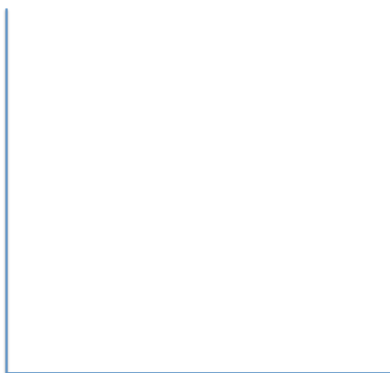
- $G \dots$
- $T \dots$
- Balance budget change ; $G \dots T \dots$ by equal amount

1. Expansionary Fiscal Policy $\Rightarrow DAE \uparrow \Rightarrow Y \dots$ for all levels of r .

If r remained constant, $Y \dots$ from $\dots$ to $\dots$

2. $Y \uparrow \Rightarrow M^d \dots \Rightarrow r \dots \Rightarrow I \dots \Rightarrow DAE \dots \Rightarrow Y \dots$ from $\dots$ to $\dots$

For the case $G \uparrow$; $G \uparrow \Rightarrow r \uparrow \Rightarrow I \downarrow$ is called “**crowding out effect**”.



5.1.2 Contractionary Fiscal Policy

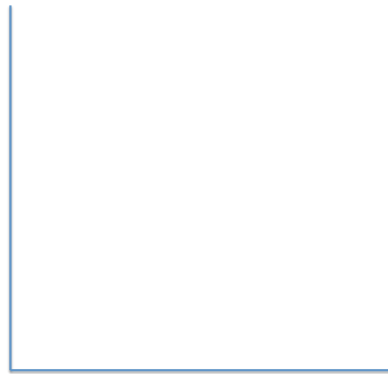
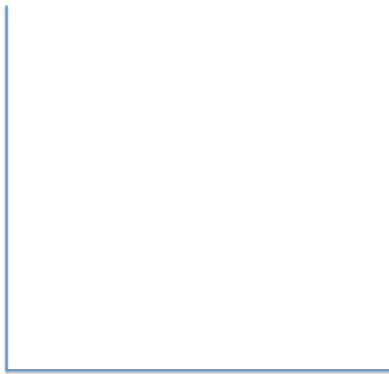


- $G \dots$
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1. Contractionary Fiscal Policy $\Rightarrow DAE \uparrow \Rightarrow Y \dots$ for all levels of r .

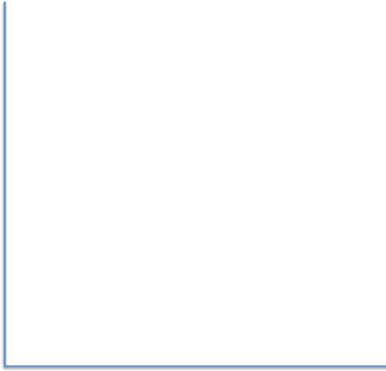
If r remained constant, $Y \dots$ from $\dots$ to $\dots$

2. $Y \uparrow \Rightarrow M^d \dots \Rightarrow r \dots \Rightarrow I \dots \Rightarrow DAE \dots \Rightarrow Y \dots$ from $\dots$ to $\dots$

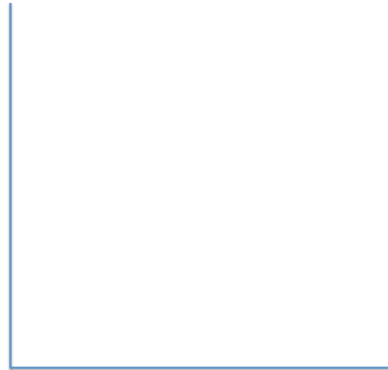
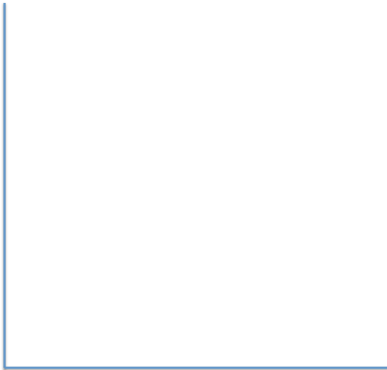


5.2 How monetary policy shifts the LM curve and the equilibrium in the IS-LM model.

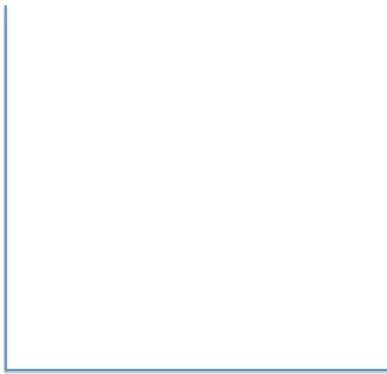
5.2.1 Expansionary Monetary Policy



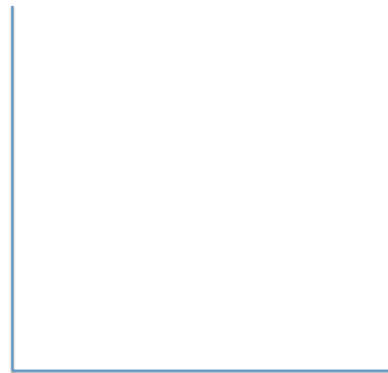
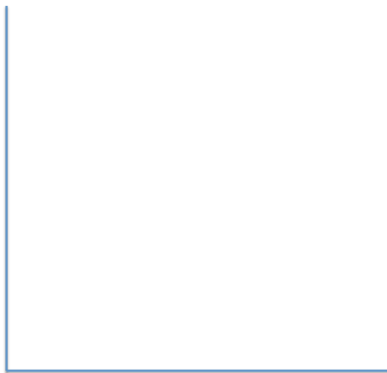
- M^S ;
 - OMO ; central bank bonds
 - Bank rate
 - legal reserve ratio
- $M^S \uparrow \Rightarrow r \dots\dots$
- $r \downarrow \Rightarrow I \dots\dots \Rightarrow DAE \dots\dots \Rightarrow Y \dots\dots$



5.2.2 Contractionary Monetary Policy



- M^S ;
- $M^S \downarrow \Rightarrow r \dots\dots$
- $r \uparrow \Rightarrow I \dots\dots \Rightarrow DAE \dots\dots \Rightarrow Y \dots\dots$



5.3 Other Analysis

- the IS-LM model can be used to explain the simultaneous use of fiscal and monetary policies.
- the IS-LM model can be used to explain shocks to consumption, investment, and money demand.

6 Understanding policy effectiveness

- IS-LM model can be used to understand how policy can be effective or not.
- Policy effectiveness : size of the change in Y when there is a change in an economic policy
- small change in economic policy $\rightarrow$ change in Y $\rightarrow$. the policy is effective.
- The key is to understand when **IS or LM curve is flat or steep**.

IS will be flat when	LM will be flat when
Interest elasticity of investment is (ϵ_I^r)	money demand elasticity of interest rate ($\epsilon_{M^d}^r$) is
When the LM curve is steep, monetary policy will be effective.	
And when the IS curve is steep, fiscal policy will be effective.	

6.1 Fiscal Policy Effectiveness

1. Expansionary fiscal policy ($G \uparrow$)

If real interest rate remains the same ($\bar{r}$) , DAE shifts

$\Rightarrow$ output (Y) for all level of

$\Rightarrow$ IS shift to the ; the size of shift is ΔG

2. As Y, Real money demand

Excess , bonds, Bond price and equilibrium interest rate

As r, investment, output (move along IS curve)

the second effect is called

total effect = the sum of the two effects

Hence,

$G \uparrow \rightarrow \bar{r} , DAE \dots & Y \dots$

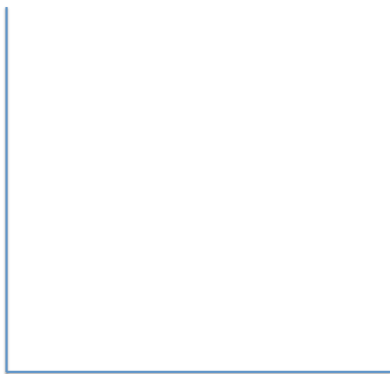


$Y \dots , M^d \dots , \frac{\bar{M}S}{\bar{P}} , r \dots \rightarrow I \dots \rightarrow Y \dots$

** The larger ϵ_I^r is, crowding out effect is and fiscal policy is

** The larger $\epsilon_{M^d}^r$ is, crowding out effect is and fiscal policy is

- IS flat

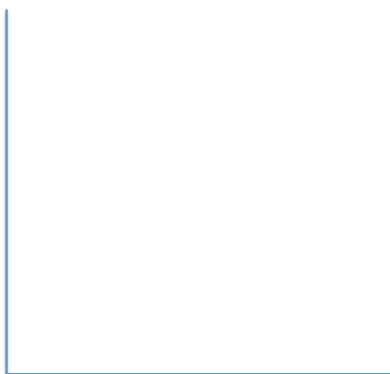


- IS steep

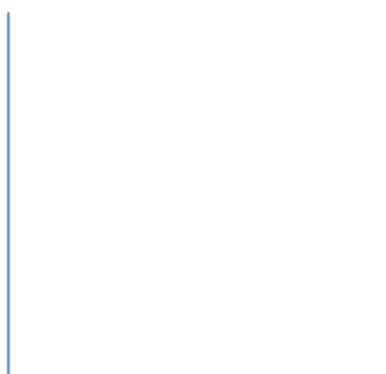


the steeper the IS, the effectiveness fiscal policy is.

- LM flat



- LM steep



the steeper the LM, the effectiveness fiscal policy is.

6.2 Monetary Policy Effectiveness

- **Monetary policy**

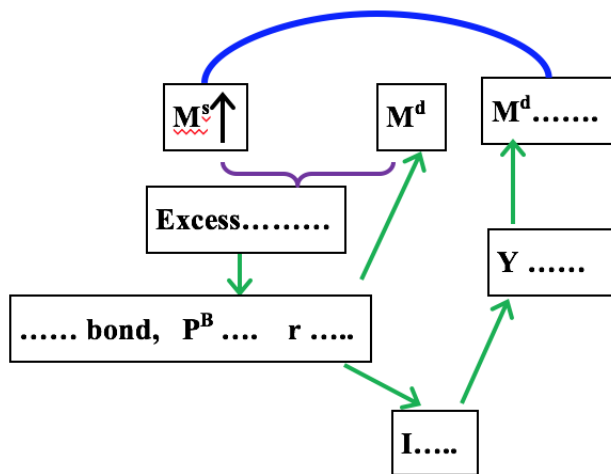
Expansionary Monetary ($MS \uparrow$) $\Rightarrow \frac{MS}{P}$ shift to the

Excess, people bonds,

bond price, r for all levels of

LM shifts to the

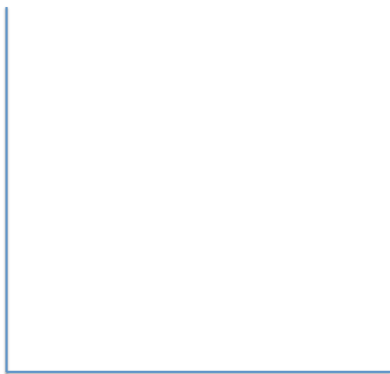
As r, investment $\rightarrow$ output (Y) (move along IS curve)



** The larger ε_I^r is, Δ interest rate has a..... effect on I . Thus, monetary policy is

** The larger $\varepsilon_{M^d}^r$ is, Δ interest rate has a..... effect on Money demand. When $MS \uparrow$, to eliminate the Excess M^S , Money demand must In this case, it requires a decrease in r . As r decreases by a little, investment by a As a result, Y by a

- IS flat

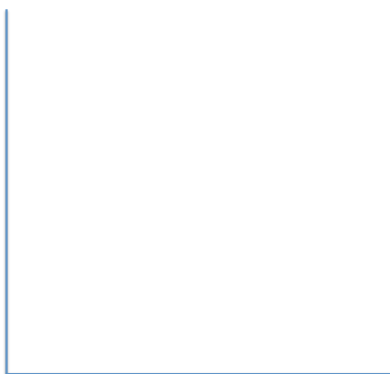


- IS steep

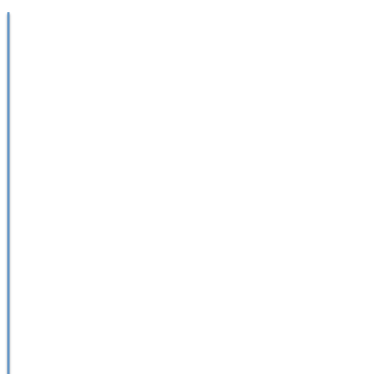


the steeper the IS, the effectiveness monetary policy is.

- LM flat



- LM steep



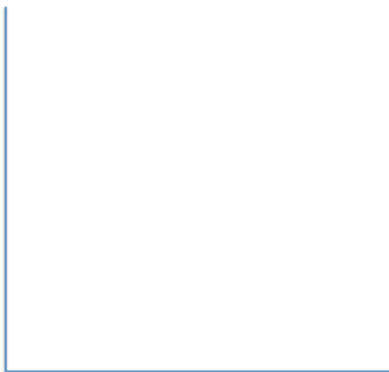
the steeper the LM, the effectiveness fiscal policy is.

7 Linking IS-LM to Aggregate Demand

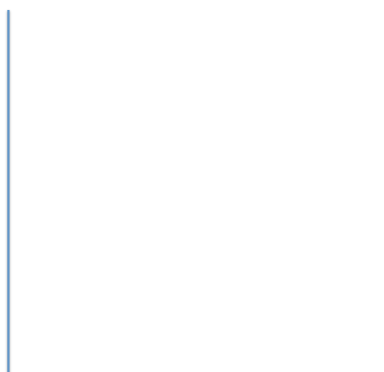
7.1 Derivation of AD curve

- We can use IS-LM to plot the relationship that underpinned the AD curve.
- Why, as price level rises, output falls.

ISLM



Aggregate Demand (AD)



- A change in price level shifts the LM curve, resulting in the new equilibrium output.
- The change in output resulting from the change in price represents a movement along the AD curve.

7.2 Shift in AD curve

- Suppose the governments uses expansionary fiscal policy/ contractionary fiscal policy

ISLM



AD

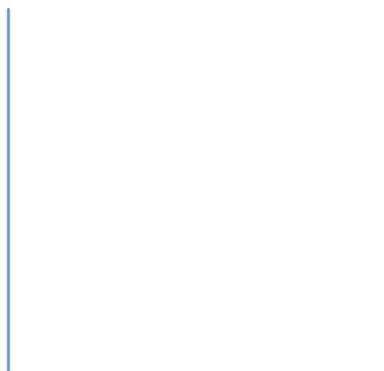


- Suppose the central bank uses expansionary monetary policy/ contractionary monetary policy

ISLM



AD



8 Equations

8.1 IS - Equation

Leakage = Injection

..... =

- $C = a + bY^d$
- $I = I_0 + i_1 r$
- $G = G_0$
- $T = T_0$

Solve for IS : Equilibrium in Goods Market, take as given. Solve for

- IS equation : $Y = \frac{1}{1-b} [a + I_0 + G_0 - bT_0] - \frac{i_1}{1-b} r$

- Slope : $\frac{\Delta Y}{\Delta r} =$

- $|\text{Slope}| =$

8.2 The LM equation

$$M^d = M^S$$

$$\text{Real money Demand} = \text{Real Money Supply}$$

$$L(Y, r) = \frac{\text{Nominal money supply}}{\text{Price level}}$$

$$=$$

$$\bullet \quad M^S = \frac{M_0^S}{P}$$

$$= \text{real money supply}$$

$$\bullet \quad M^d = c_0 \dots c_1 Y \dots c_2 r$$

Solve for LM : Equilibrium in Money Market, take as given. Solve for

$$\bullet \text{ LM equation : } r = \frac{c_0}{c_2} - \frac{M^S}{c_2} + \frac{c_1 Y}{c_2}$$

$$\bullet \quad \left| \text{Slope} \right| =$$

8.3 Equilibrium

$$\bullet \text{ LM equation : } r = \frac{c_0}{c_2} - \frac{M^S}{c_2} + \frac{c_1 Y}{c_2}$$

$$\bullet \text{ IS equation : } Y = \frac{1}{1-b} [a + I_0 + G_0 - bT_0] - \frac{i_1}{1-b} r$$

• At equilibrium, (r^*, y^*) makes both equations hold true.

• Solve for equilibrium

$$Y = \left[\frac{1}{(1-b) + i_1(c_1/c_2)} \right] \left[a + I_0 + G_0 - bT_0 + \frac{i_1}{c_2} (M_0^S - c_0) \right]$$

$$r = \left[\frac{1}{(1-b) + i_1(c_1/c_2)} \right] \left\{ \frac{(1-b)}{c_2} (c_0 - M^S) + \frac{c_1}{c_2} [a + I_0 + G - bT] \right\}$$