Intermediate Macroeconomics

Chapter 6
The Neoclassical IS-LM Model

The Neoclassical IS - LM Model

- IS-LM Model
- The IS Curve
- The LM Curve
- IS-LM Equilibrium
- Fiscal and Monetary Policy

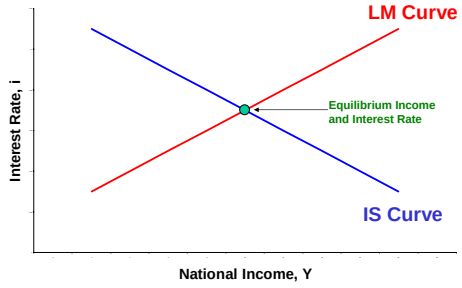
1. IS – LM Model
Introduce variable interest rate

	Simple Model Chapter 4	Keynesian Chapter 5	IS - LM Chapter 6
Income	Fixed	Variable	Variable
Interest Rates	Fixed	Fixed	Variable
Prices	Fixed	Fixed	Fixed
Consumption	Autonomous	Function of Income	Function of Income
Investment	Autonomous	Autonomous	Function of Interest Rate
Money Supply	Not Included	Not Included	Autonomous
Money Demand	Not Included	Not Included	Function of Income and Interest Rate

1. IS – LM Model
Introduce variable interest rate

- IS (Goods) Sector, Investment:
  $I = I_0 - b \cdot i$
  Solve for: $i_{IS} = f(Y)$
- LM (Money) Sector, Money Demand:
  $M_d = k \cdot Y - h \cdot i$
  Solve for: $i_{LM} = f(Y)$
- Equilibrium
  $i_{IS} = i_{LM}$
  Solve for Y

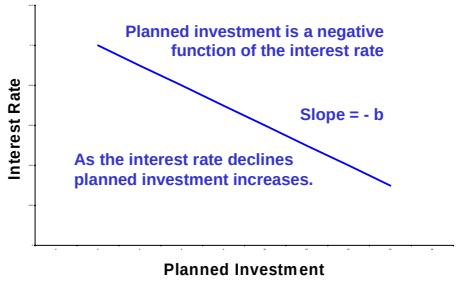
1. IS – LM Model
IS – LM Curves



1. IS – LM Model
Fiscal and monetary policy

- Fiscal Policy (spending and taxes)
  – shifts IS curve
  – increase in spending or cut in taxes shifts IS curve to the right
- Monetary Policy (money supply)
  – shifts LM curve
  – increase in money supply shifts LM curve to the right

2. IS curve
Investment



2. IS Curve
The "goods" market

Given:

$AE = C + I + G + NX$

$C = C_0 + c \cdot YD$

$I = I_0 - b \cdot i$

$G = G_0$

$NX = NX_0$

$YD = Y - t \cdot Y + TR_0$

2. IS Curve
Derive the IS curve (1 of 3)

- Given:
  - $AE = C + I + G + NX$
  - $C = C_0 + c \cdot YD$
  - $I = I_0 - b \cdot i$
  - $G = G_0$
  - $NX = 0$
  - $YD = Y - T_0 - t \cdot Y + TR$
- Step 1. Restate Aggregate Demand:

$AE = C_0 + c \cdot (Y - T_0 - t \cdot Y + TR) + I_0 - b \cdot i + G_0$

2. IS Curve
Derive the IS curve (2 of 3)

Step 2. State the Goods Market equilibrium condition:

$Y = AE$

Step 3. Substitute AE from Step 1 into Step 2:

$Y = C_0 + c \cdot (Y - T_0 - t \cdot Y + TR) + I_0 - b \cdot i + G_0$

2. IS Curve
Derive the IS curve (3 of 3)

Step 4. Solve for Interest Rate as a function of Income:

$Y = C_0 + c \cdot (Y - T_0 - t \cdot Y + TR) + I_0 - b \cdot i + G_0$

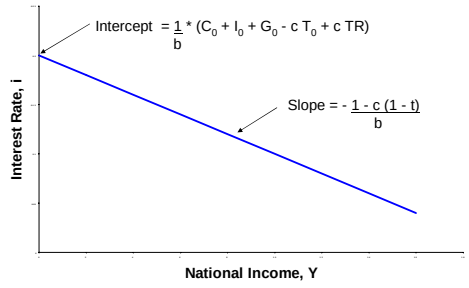
$b \cdot i = C_0 + I_0 + G_0 + c \cdot (Y - T_0 - t \cdot Y + TR) - Y$

$b \cdot i = C_0 + I_0 + G_0 - T_0 + c \cdot TR - [1 - c(1-t)] \cdot Y$

$$i = \frac{1}{b} \cdot (C_0 + I_0 + G_0 - c \cdot T_0 + c \cdot TR) - \frac{1 - c(1-t)}{b} \cdot Y$$

intercept — slope (negative)

2. IS Curve
Graph



2. IS Curve
Shift in the IS curve

A change in the intercept causes the IS curve to shift.

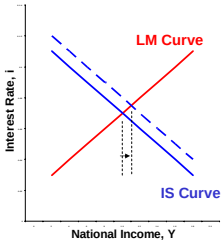
Intercept $= \frac{1}{b} * (C_0 + I_0 + G_0 - c\,T_0 + c\,TR)$

An increase in government spending or decrease in taxes increases the value of the intercept and causes the IS curve to shift up (or to the right).

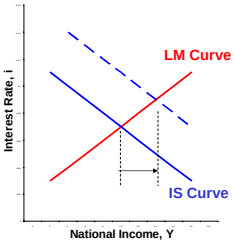
The size of the shift depends on the sensitivity of investment to the interest rate, b.

2. IS Curve
Fiscal policy effectiveness and IS curve shift

Small shift in IS Curve.
b is large.
Investment is very sensitive to changes in the interest rate



Large shift in IS Curve.
b is small.
Investment is not sensitive to changes in the interest rate



2. IS Curve
Fiscal policy effectiveness and IS curve shift

- Small shift in IS curve
  - Classical view, fiscal policy ineffective
  - Increase in government spending raises interest rate, which crowds out (reduces) investment spending. Net increase in aggregate spending may be small
- Large shift in IS curve
  - Keynesian view, fiscal policy effective.
  - Increase in government spending may raise the interest rate but has no effect on investment. Get big bang for buck.

2. IS Curve
Slope of the curve

Effectiveness of fiscal policy also depends on the slope of the IS curve

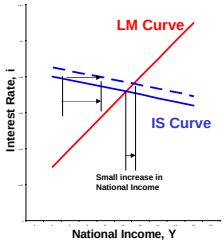
Slope $= -\frac{1 - c\,(1 - t)}{b}$

Keynesian: small b, steep curve
fiscal policy more effective

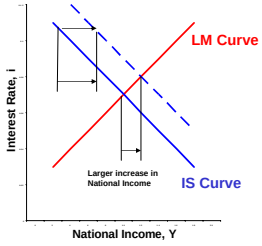
Classical: large b, flat curve
fiscal policy less effective

2. IS Curve
Fiscal policy effectiveness and IS curve slope

Flat IS Curve.
b is large.
Investment is very sensitive to changes in the interest rate



Steep IS Curve.
b is small.
Investment is not sensitive to changes in the interest rate



2. IS Curve
Fiscal policy effectiveness and IS curve slope

- Flat IS curve
  - Classical view, fiscal policy ineffective
  - Increase in government spending raises interest rate, which crowds out (reduces) investment spending. Net increase in aggregate spending may be small
- Steep IS curve
  - Keynesian view, fiscal policy effective.
  - Increase in government spending may raise the interest rate but has little effect on investment. Get big bang for buck.

3. LM Curve
Money Supply and Money Demand

- Money Supply:
  - assumed to be a some fixed level
- Money Demand:
  - negative function of interest rate. People hold more money when interest rates decline.
  - positive function of income. People hold more money as their income increases.

3. LM Curve
Derive the LM Curve (1 of 2)

- Given:

  Money Demand: $M_d = k \cdot Y - h \cdot i$

  Money Supply: $M_s = M$

- Step 1. State the money market equilibrium condition:

  $M_s = M_d$

- Step 2. Substitute equations for M_d and M_s into equilibrium condition:

  $M = k \cdot Y - h \cdot i$

3. LM Curve
Derive the LM Curve (2 of 2)

Step 3. Solve for Interest Rate as a function of Income:

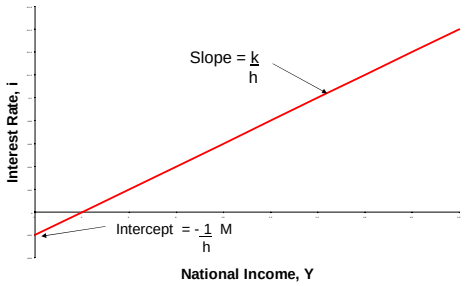
$$M = k \cdot Y - h \cdot i$$

$$h \cdot i = -M + k \cdot Y$$

$$i = -\frac{1}{h} \cdot M + \frac{k}{h} \cdot Y$$

intercept slope (positive)

3. LM Curve
Graph



3. LM Curve
Shift in the LM curve

A change in the intercept causes the LM curve to shift.

Intercept $= -\frac{1}{h} M$

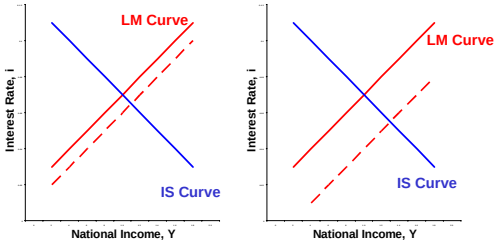
An increase in money supply, M, reduces the value of the intercept (more negative) and causes the LM curve to shift down (or to the right).

The size of the shift depends on the sensitivity of money demand to the interest rate, h.

3. LM Curve
Monetary policy and LM curve shift

Small shift in LM Curve.
h is large.
Money demand is very sensitive to changes in the interest rate

Large shift in LM Curve.
h is small.
Large change in interest rate required to change money demand



3. LM Curve
Monetary policy and LM curve shift

- Small shift in LM curve
  - Keynesian view, monetary policy ineffective
  - Increase in money supply is met by an increase in money demand without a significant decline in the interest rate. No stimulus to investment spending.
- Large shift in LM curve
  - Classical view, monetary policy effective.
  - Increase in money supply leads to a large decline in the interest rate in order to increase money demand. Increases investment spending.

3. LM Curve
Slope of the LM curve

Effectiveness of monetary policy also depends on the slope of the LM curve

$$\text{Slope} = \frac{k}{h}$$

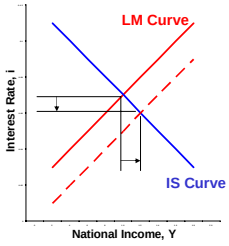
Keynesian: large h, flat curve
monetary policy less effective

Classical: small h, steep curve
monetary policy more effective

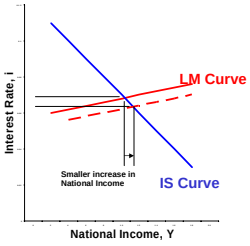
Note: little debate over change in money demand with change in income, k.

3. LM Curve
Monetary policy and LM curve slope

Steep LM Curve.
h is small.
Money demand is insensitive to changes in the interest rate



Flat LM Curve.
h is large.
Money demand is very sensitive to changes in the interest rate



3. LM Curve
Monetary policy and LM curve slope

- Flat LM curve
  - Keynesian view, monetary policy ineffective
  - Increase in money supply has little or no effect on the interest rate. Money demand adjusts to match money supply. No change in interest rate means no change in investment and aggregate spending
- Steep LM curve
  - Classical view, monetary policy effective.
  - Increase in money supply lowers the interest rate, which increases investment spending.

4. IS - LM Equilibrium
Solve the model (1 of 2)

Step 1. Apply IS - LM equilibrium condition

$$i_{IS} = i_{LM}$$

Step 2. Substitute IS (step 4) and LM (step 3) solutions for interest rate:

$$\frac{1}{b} \cdot (C_0 + I_0 + G_0 + c \cdot TR - c \cdot T_0) - \frac{1 - c(1-t)}{b} \cdot Y$$

$$= -\frac{1}{h} \cdot M + \frac{k}{h} \cdot Y$$

4. IS - LM Equilibrium
Solve the model (2 of 2)

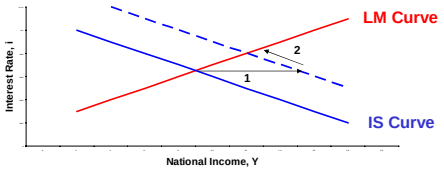
Step 3. Solve for Income, Y

$$Y = \frac{h}{[1-c(1-t)] \cdot h + b \cdot k}(C_0 + I_0 + G_0 + c \cdot TR - c \cdot T_0) + \frac{b}{[1-c(1-t)] \cdot h + b \cdot k} M$$

Autonomous Spending Multiplier

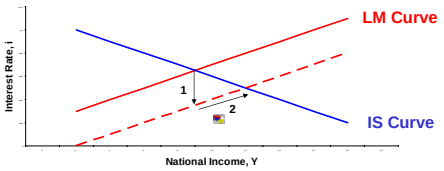
Money Multiplier

5. Fiscal and Monetary Policy
Fiscal Policy



1 – Increase in government spending (expansionary fiscal policy)
National income rises with increase in spending (C and G)
2 – Increase in income leads to increase in money demand.
Interest rate rises to maintain balance between money supply and money demand.
Investment spending declines with higher interest rate.
Aggregate spending and national income decline.

5. Fiscal and Monetary Policy
Monetary Policy



1 – increase in money supply (expansionary monetary policy).
interest rate falls to maintain balance between money demand and money supply.
2 – lower interest rate stimulates investment spending.
increase in national income with higher spending also raises money demand which leads to an increase in the interest rate.

5. Fiscal and Monetary Policy
Expansionary fiscal policy

- Investment negatively related to interest rate (investment curve downward sloping)
- Aggregate expenditures negatively related to interest rate (downward sloping)
- Fiscal policy change shifts the IS curve only. Increase in government spending or cut in taxes shifts IS curve to the right

	Keynes	Classical
Investment and interest rate	Insensitive (*inelastic*) *b* is small	Sensitive (elastic) *b* is large
IS curve intercept shift, 1/b	Large	Small
IS curve slope, - [1-c(1-t)]/b	Steep	Flat
Crowding out of investment	Small	Large

5. Fiscal and Monetary Policy Summary
Expansionary monetary policy

- Money demand negatively related to interest rate and positively related to income
- LM curve upward sloping. An increase in income requires an increase in interest rate to maintain constant money demand.
- Monetary policy change shifts the LM curve only. Increase in money supply shifts LM curve to the right

	Keynes	Classical
Money demand and interest rate	Sensitive (*elastic*) *h* is large	Insensitive (inelastic) *h* is small
LM curve intercept shift, 1/h	Small	Large
IS curve slope, k/h	Flat	Steep
Change in investment	Small	Large