

Chapter 2 : IS-LM model and Labour Market

EE312 Section 046402

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Contents

1	IS-LM Model	2
1.1	IS-LM summary	2
1.2	Maths	3
1.3	Equilibrium	5
1.4	Effectiveness of Policy	6
2	Aggregate Demand	8
2.1	Derivation of AD curve	8
2.2	Shift in AD curve	8
3	Labour Market Activities Short-run Aggregate Supply	9
3.1	The labor market	9
3.2	Labor Supply : Worker's Decision	10
3.3	Labor Demand : Firm Decision	10
3.4	Labor Market Equilibrium	12
4	Short-run Aggregate Supply	13
4.1	Derivation	13
4.2	Shift	13
5	AD-AS Equilibrium	15
6	AD shocks as cause of cycles	16
7	Impact of Monetary Policy : Non-neutrality of money	18
8	Impact of Fiscal Policy	19
9	Keynesian stabilization policy	20
10	Alternative view on cycles	21
11	Supply Shocks	22
11.1	Lower Z or Lower K	22
11.2	Lower Nominal Wage (W)	23

1 IS-LM Model

1.1 IS-LM summary

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 • $Y \uparrow \Rightarrow M^d \uparrow \dots$ but $MS \dots \Rightarrow$ then, r must..... (a) to make $M^d \dots$ (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

1.2 Maths

IS - Equation

$$\begin{array}{lcl} \text{Leakage} & = & \text{Withdrawal} \\ \text{.....} & = & \text{.....} \end{array}$$

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

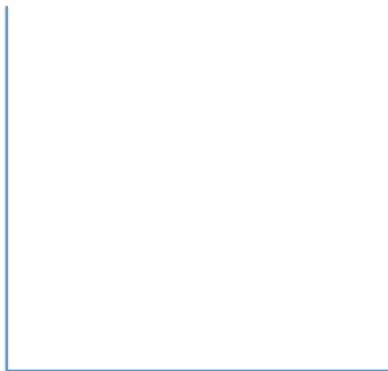
Solve for IS : Equilibrium in Goods Market, take as given. Solve for

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

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

- $|\text{Slope}| =$

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



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?

LM Equation

- 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.

$$M^d = M^S$$

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

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

$$\bullet \quad M^S = \frac{M_0^S}{P}$$
$$= \text{real money supply}$$

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

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

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

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

- LM curve shifts to the left can be caused by

- LM curve shifts to the right can be caused by

1.3 Equilibrium

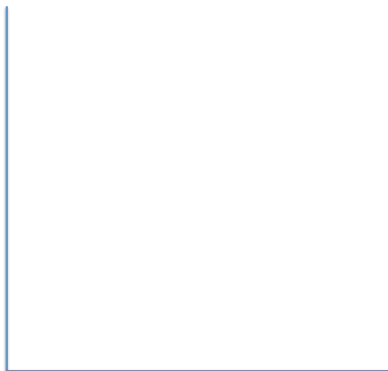
- LM equation : $r = \frac{c_0}{c_2} - \frac{M^S}{c_2} + \frac{c_1 Y}{c_2}$
- IS equation : $Y = \frac{1}{1-b} [a + I_0 + G_0 - bT_0] - \frac{i_1}{1-b} r$
- At equilibrium, (r^*, y^*) makes both equations hold true.
- Solve for equilibrium

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

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

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

1.4 Effectiveness of Policy

- 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.	

• Fiscal policy

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,

$$\begin{array}{lcl}
 G \uparrow & \rightarrow & \bar{r} \quad , \quad DAE \dots\dots \quad \& \quad Y \dots\dots \\
 & \searrow & \\
 & & Y \dots\dots \quad , \quad M^d \dots\dots, \quad \frac{\bar{M}S}{\bar{P}}, \quad r \dots\dots \rightarrow I \dots\dots \rightarrow Y \dots\dots
 \end{array}$$

** 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

- **Monetary policy**

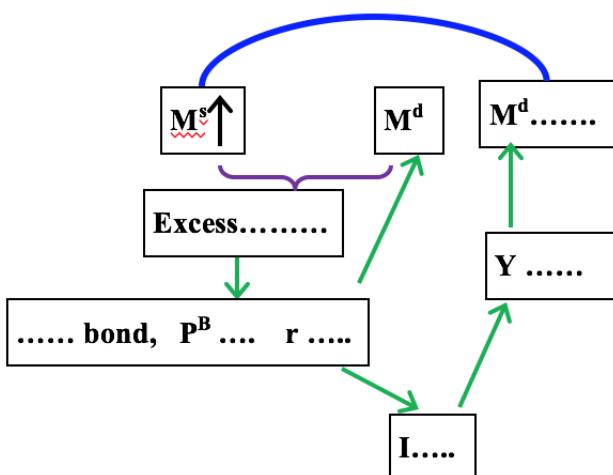
Expansionary Monetary ($MS \uparrow$) $\Rightarrow \frac{MS}{P}$ shift to the

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

2 Aggregate Demand

2.1 Derivation of AD curve

- Relationship between P and Y .
- Use IS-LM to plot the relationship that underpinned the AD curve.



- 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.

2.2 Shift in AD curve

- Suppose the governments uses expansionary fiscal policy and monetary policy
- Focus - nominal rigidity + labor market

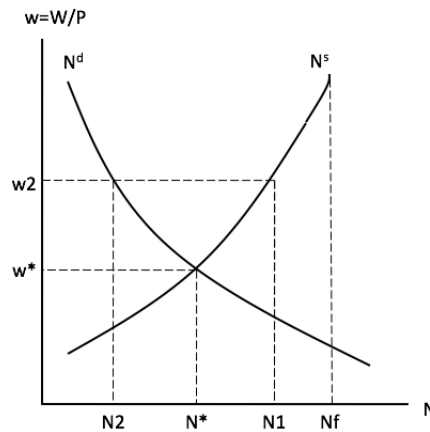
3 Labour Market Activities Short-run Aggregate Supply

- In the short-run, nominal wages are not completely flexible.
 - Some markets do not clear.
 - Involuntary (Keynesian) unemployment.
- Non-neutrality of money: changes in the money supply affect real variables.

3.1 The labor market

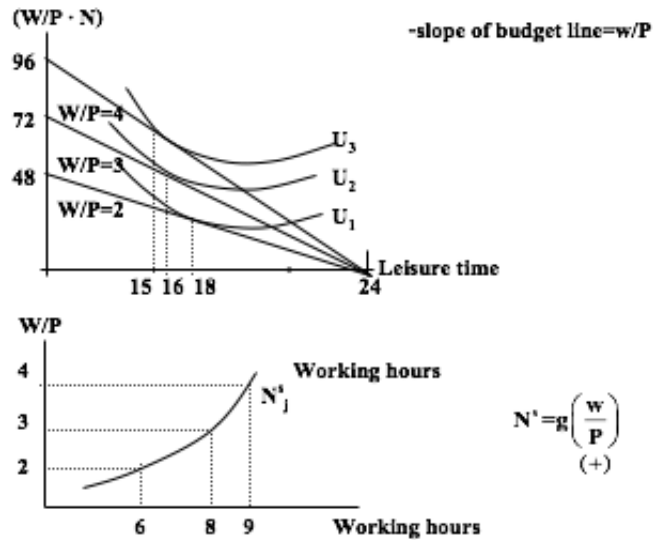
- In the short run, the nominal wage (W) is not flexible — wage rigidity.
 - Existence of labor contracts.
 - Cost of renegotiation when the situation changes.
 - Indexation of labor contracts is not popular.
- In theory, rigid nominal wages are treated as the fixed nominal wage rate.
- The labor market does not clear — Keynesian unemployment.
- Discretionary fiscal and monetary policy to stabilize the economy.

- At $w^* = \frac{W^*}{P^*}$, employment = N^* .
- If W is fixed at $W_2 > W^*$, then $w_2 = \frac{W_2}{P^*}$; employment = N_2 .
- Keynesian unemployment = $N_1 - N_2$.
- **Employment depends on labour**



3.2 Labor Supply : Worker's Decision

- maximise utility subject to constraint
- budget constraint :



3.3 Labor Demand : Firm Decision

- The firm's production function

$$Y = zF(K, N^d)$$

where:

- Y = output of consumption goods;
- K = capital input;
- N^d = labor input (hours);
- z = total factor productivity (TFP). = the degree of sophistication of the production process.
- Properties of the production function
 - Constant returns to scale:
 - * $zF(xK, xN^d) = xzF(K, N^d)$
 - * Increase each input by x times will raise the total output by x times.
 - Output increases if either labor or capital increases.
 - * $MP_N = \frac{\partial Y}{\partial N^d} > 0$;
 - * $MP_K = \frac{\partial Y}{\partial K} > 0$.
 - * Upward slope of the production function.

- Profit

$$\begin{aligned}\pi &= TR - TC \\ &= PY - (WN + \text{Fixed Cost}) \\ &= PY - WN - \text{Fixed Cost}\end{aligned}$$

- **Profit maximising condition : MR = MC**

$$\begin{aligned}\frac{d\pi}{dN} &= \\ &= \end{aligned}$$

Rearrange,

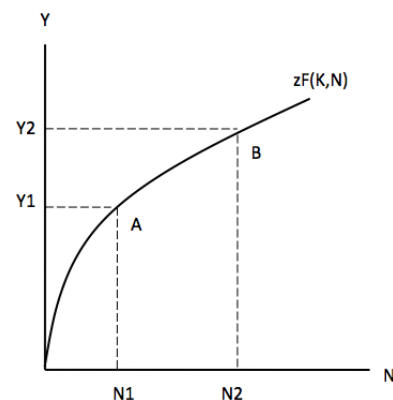
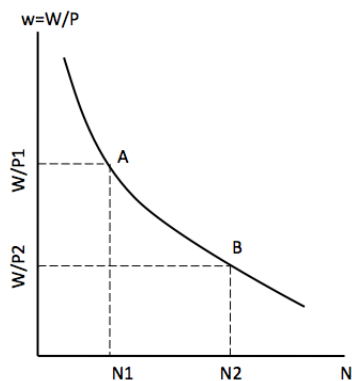
$$=$$

Marginal Revenue = Marginal Cost

- Example :

Labor (number of employees)	Output (number of output produced per day)	Marginal Product of labor
0	0	0
1	10	
2	19	
3	26	
4		
5		
6		

- **Marginal Product of labor is hence “labor demand function” as a function of real wage.**

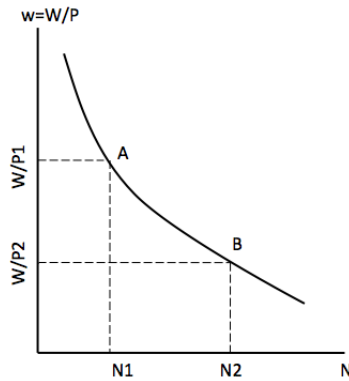


- **Production function, fixed capital**

The slope at A is MP_N when $N = N1$.

MP_N is falling as the labor input increases, given the capital input.

- Nominal wage (W) is fixed. As price increases, real wage $\left(\frac{W}{P}\right)$ and labor demand (N^d)



What does cause a rightward shift in N^d ? ; i.e. N^d increases for all levels of real wage

* MP_N increases as K

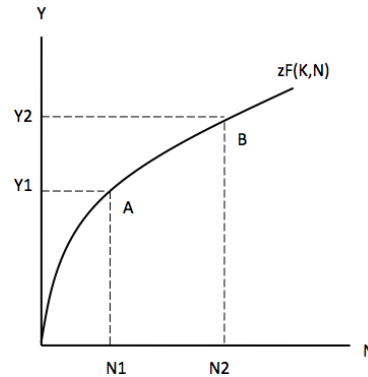
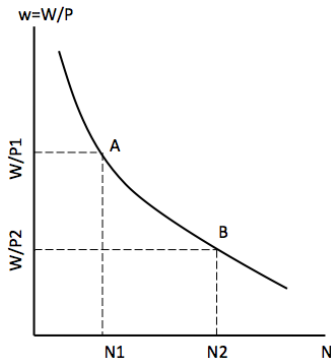
* MP_N increases as z

3.4 Labor Market Equilibrium

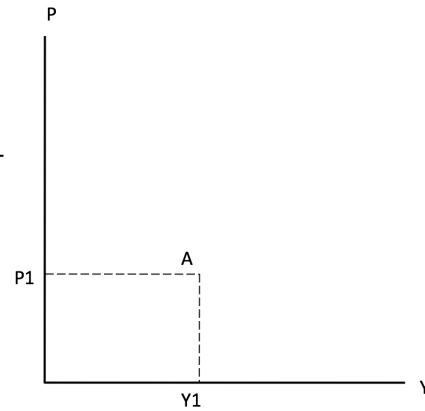
- In the short run nominal wage is fixed at a level below the nominal wage that makes full employment.
- Equilibrium number of labor employed depends on labor

4 Short-run Aggregate Supply

4.1 Derivation



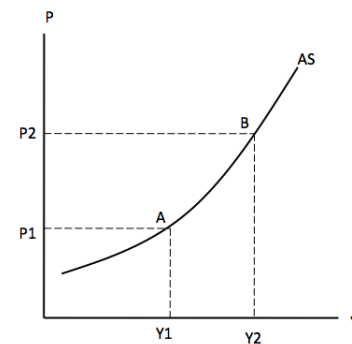
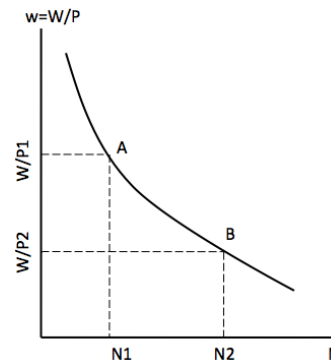
- Given technology and capital stock, the P-Y relationship is positive.
- AS is not related to interest rate



4.2 Shift

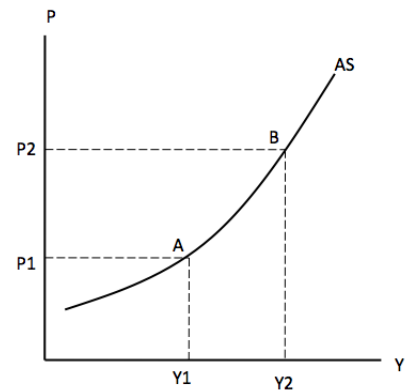
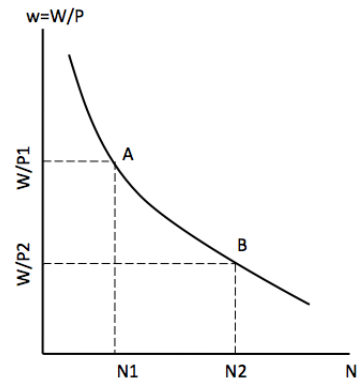
4.2.1 A higher W shifts AS to the

- As W increases, the real wage for all level of prices
- For all levels of price, the real wage, labor demand (N^d)
Output, AS shifts left.

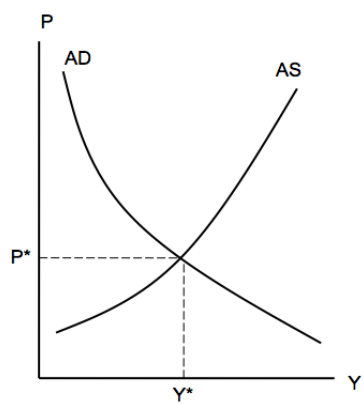
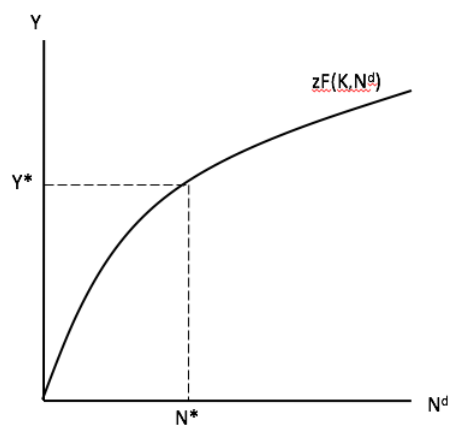
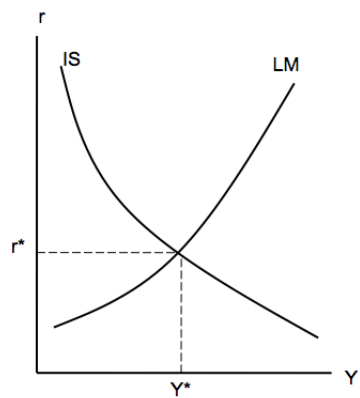
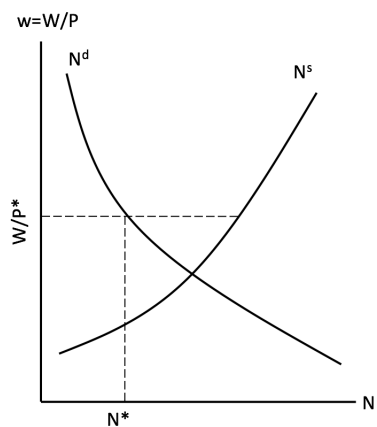


4.2.2 Lower Z and Lower K shifts AS to the

- Lower Z and Lower K shifts the production function
- MPN for all level of N
- For all level of prices and real wage, labor demand (N^d)
Output

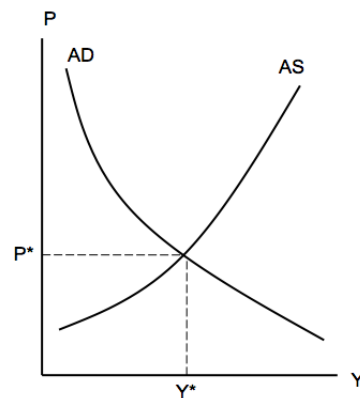
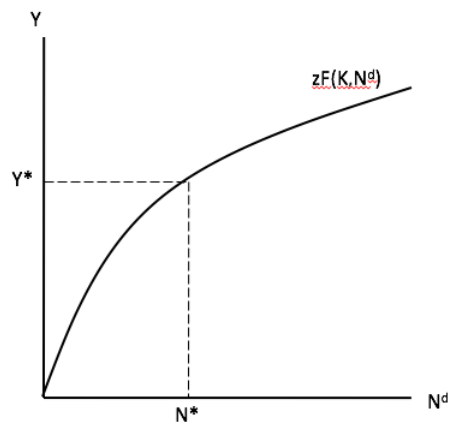
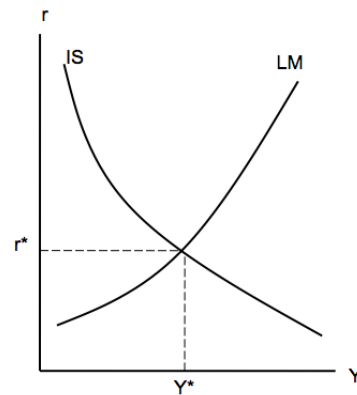
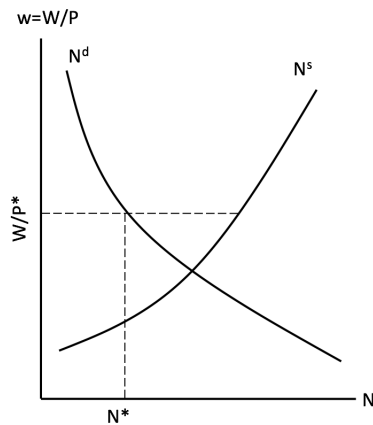


5 AD-AS Equilibrium



6 AD shocks as cause of cycles

- Keynesians believe that private investment is unstable, subject to expectations and animal spirit.
- Investment shocks shift the IS and AD curves.
- Changes in the interest rate further affects consumption and investment.
- Changes in the price level affect the real wage and the labor demand (and money demand).
- Employment, output and real income fluctuate.

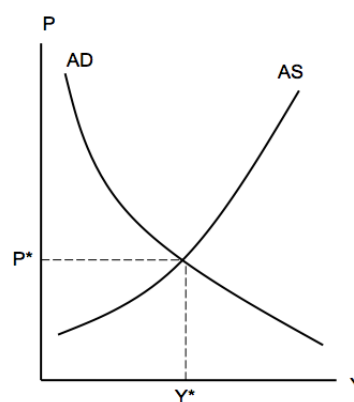
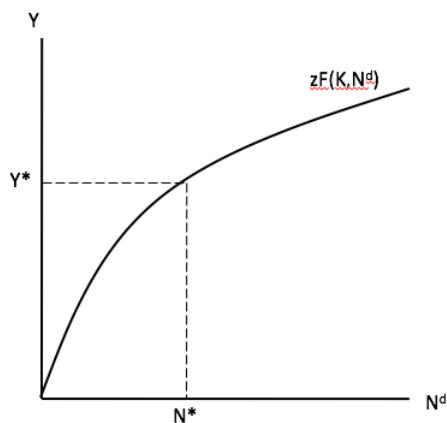
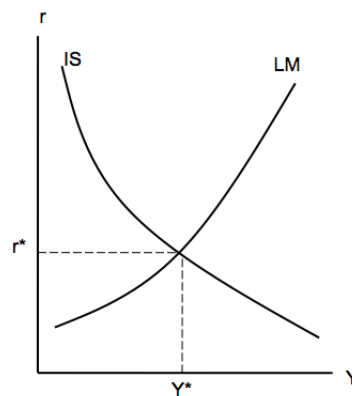
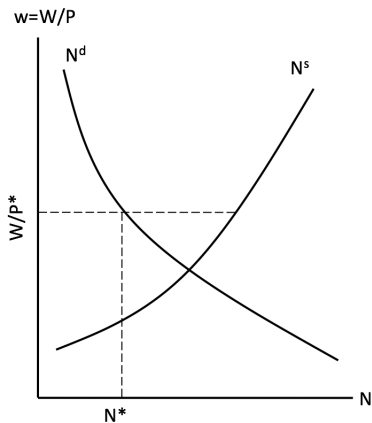


- Unstable investment (and AE) shifts the IS curve and the AD curve.
- The changing price shifts the LM curve.

- **AD shocks vs business cycles**

Variable	Data	Model
Consumption	procyclical	
Investment	procyclical	
Price Level	countercyclical	
Money Supply	procyclical	
Employment	procyclical	
Real wage	procyclical	

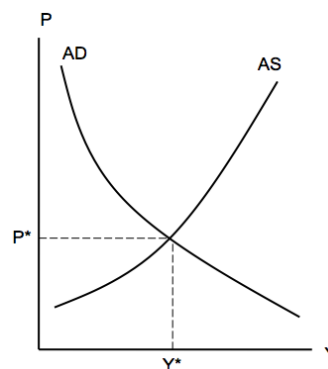
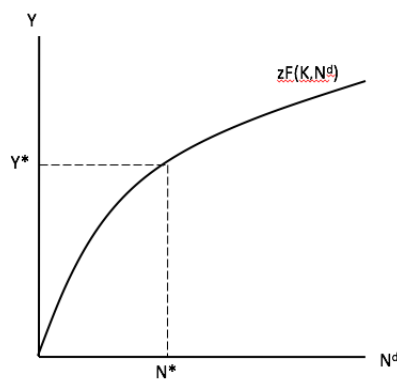
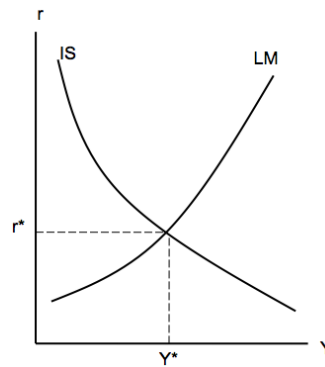
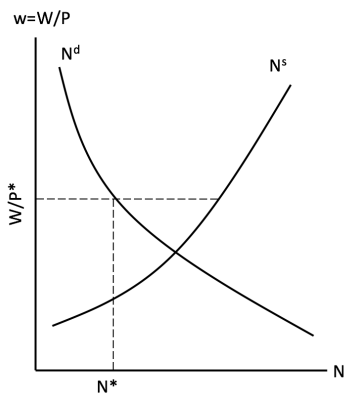
7 Impact of Monetary Policy : Non-neutrality of money



• Monetary policy

1. Economy is at E. r^* N^* P^* and Y^*
2. 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) **for all levels of Price**
3. As output for all level of Price, AD shifts to the
 Price level to and Output to
 (a) Labor market
 P , real wage and Y (movement along AS curve)
 (b) ISLM
 P , real money supply to
 LM shifts to the
 Output
 This is called

8 Impact of Fiscal Policy



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

** If price were constant, total effect = 1 effect + 2 effect

3. From (1) and (2), IS curve shifts to the, and then Y for all levels of price

Hence, AD shifts to the

Y and P

(a) Labor market

As P , real wage and Y (movement along AS curve)

(b) ISLM

As P , real money supply to

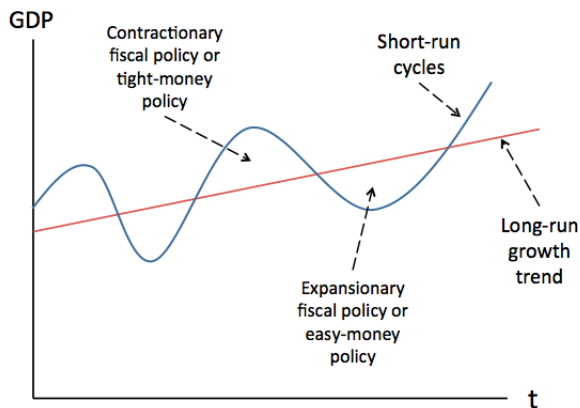
LM shifts to the

Output

This is called

9 Keynesian stabilization policy

- Government can stabilize the economy through fiscal (G and T) and monetary policies (Ms).
- Increase AD when real output is below trend.
 - Expansionary fiscal policy or easy-money policy.
- Decrease AD when real output is above trend.
 - Contractionary fiscal policy or tight-money policy.
- **Counter-cyclical policies**



- **Optimal policy action?**

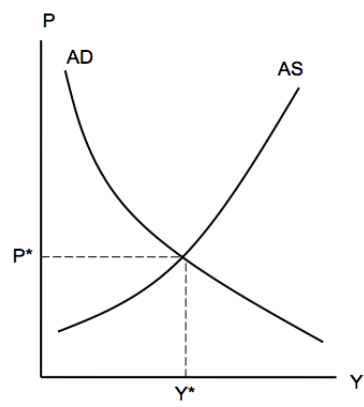
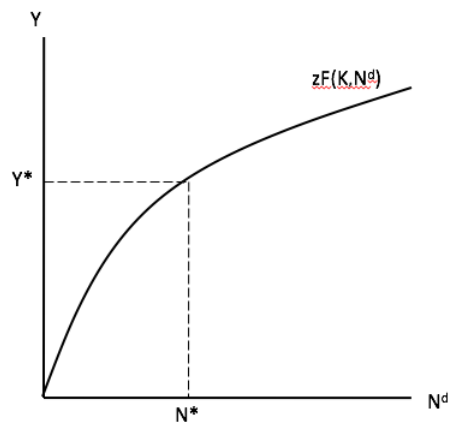
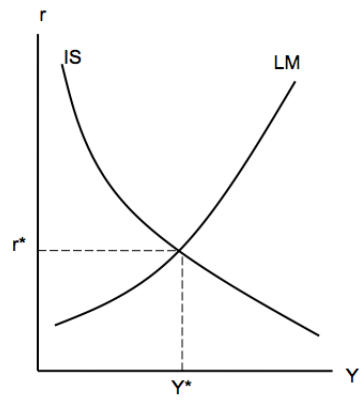
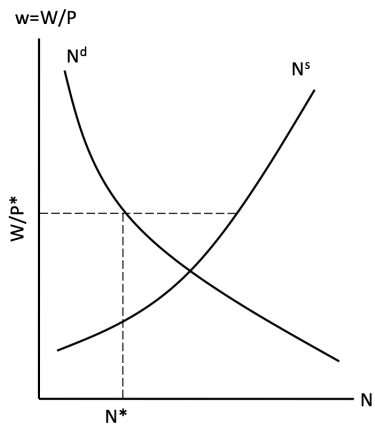
1. Keynesian stabilization policy requires 'government wisdom'.
 - (a) Information on the behavior of the economy,
 - (b) Correct timing of action.
2. Government failure?
 - (a) Lack of information on the magnitudes and directions of macro variables.
 - (b) Wrong timing further destabilizes the economy.
 - (c) Unstable money demand.
3. Policy lags
 - (a) Lag in collecting information about the economy.
 - (b) Lag in formulating appropriate policy.
 - i. Executive and legislative processes in fiscal policy.
 - ii. Monetary Policy Committee's meetings.
 - (c) Lag in timing of policy effects.
 - i. Uncertain length of lag results in wrong timing.

10 Alternative view on cycles

- Most people believe a recession is bad and must be avoided at all cost.
- **Austrian economics: Joseph Schumpeter.**
 - Recessions are a natural feature of the economy.
 - Necessary adjustment for change — creative destruction.
 - Capital is released from inefficient firms and sectors with low productivity to new ones.
- Friedrich von Hayek
 - Fundamental factors for long-term growth is productivity.
 - Booms nurture unprofitable investments.
 - * Too much investment; too little saving.
 - * These are corrected by a recession, releasing resources from low yields for profitable investments.
 - * Monetary policy to prevent a recession allows the misallocation to persist.
 - Benefits of business cycles:
 - * Cycles are short-run phenomenon.
 - * Output loss during recessions is compensated by output gain during booms with the same long-run growth trend.
 - * Demand management policy makes no long-term gain.
 - * Booms allow business restructuring and more risky investment to boost future productivity.
 - * Recessions weed out unprofitable investment and allow resource reallocation.
- Recent lessons
 - 1998: The US's Fed bailed out Long-Term Capital Management from collapse.
 - 2001: The Fed cut its policy rate sharply to prevent a stock market bubble burst.
 - 2002-2005: very low interest rates; housing bubbles developed.
 - 2006: The sub-prime loan crisis exploded.
 - 2008: the global financial crisis.

11 Supply Shocks

11.1 Lower Z or Lower K



11.2 Lower Nominal Wage (W)

