Topic 1: The Labour Market

Production Function

Formula:

$$Y = AF(K, N)$$

Y – Real Output

Factors of Production

K – Capital

- Capital good: a good that is produced, is used to produce other goods, and-unlike an intermediate good – is not used up in the same period in which it is produced
- **Example**: Equipment and Structures

N – Labour

A – Total Factor Productivity

- Effectiveness with which capital and labour are used
- Higher A, with the same factor of productions, we will be able to produce more output
- Technology and Management
- Others (raw materials, land, energy)

Example:

Cobb-Douglas Production Function:

$$Y = AK^{0.3}N^{0.7}$$

Marginal Product of Capital

Formula

$$MPK = \frac{\Delta Y}{\Delta K}$$

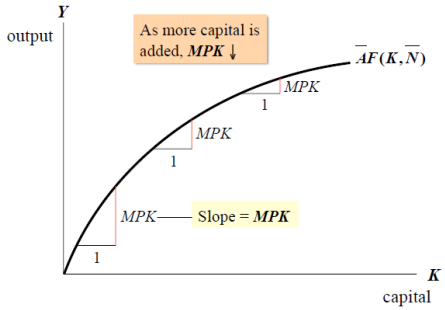
ΔY – Change in Real Output

ΔK – Change in Capital

Graphical Representation:

Figure 3.1 The production function relating Y and K

$\bar{A}$ and $\bar{N}$: means holding A and N constant



Taking $\frac{\partial Y}{\partial K}$

- **First Derivative**: Positive because gradient is positive
- **Second Derivative**: Negative because gradient is decreasing

Features:

- Slope of the production function with $(Y\ vs.\ K)$
  - Keeping A and N constant
- $MPK > 0 \rightarrow$ **Positive slope**
- MPK falls as K rises → **Diminishing marginal product of capital**

Marginal Product of Labour

Formula

$$MPN = \frac{\Delta Y}{\Delta N}$$

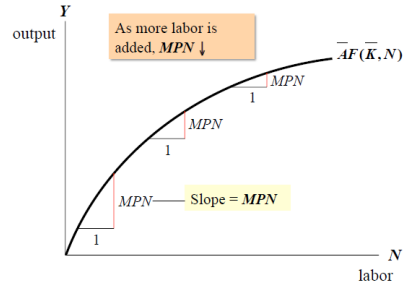
ΔY – Change in Real Output

ΔN – Change in Labour

Graphical Representation:

Figure 3.3 The production function relating Y and N

$\bar{A}$ and $\bar{K}$: means holding A and K constant



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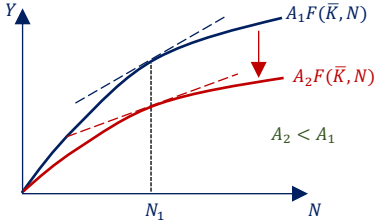
Supply Shocks or Productivity Shocks

What Happens?

- Affects the amount of output that can be produced for a given number of inputs (**Affects A**)
- **Example**: Weather, inventions and innovations, oil prices

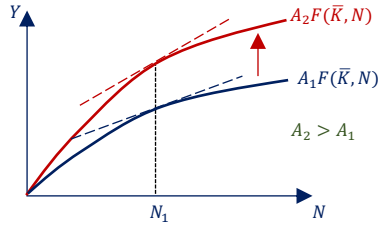
Negative/Adverse Shock (E.g. Flood)



- Note that there will be a parallel shift, it still passes through the origin. When labour is 0, the output is still 0
- Note that **K is constant** here
- Note that the **slope gets gentler** which means that **MPN decreases**

$$\downarrow A \rightarrow \downarrow MPN\ at\ evey\ level\ of\ N \rightarrow Downward\ Shift$$

Positive/Beneficial Shock (E.g. Innovation)



- Note that there will be a parallel shift, it still passes through the origin. When labour is 0, the output is still 0
- Note that K is constant here
- Note that the slope gets steeper which means that MPN increases

$$\uparrow A \rightarrow \uparrow MPN\ at\ evey\ level\ of\ N \rightarrow Upwards\ Shift$$

Returns to Scale

Suppose

$$Y_1 = AF(K_1, N_1)$$

Scale all the inputs by the same factor z:

$$K_2 = zK_1, N_2 = zN_1$$

For

$$Y_2 = AF(K_2, N_2)$$

Constant returns to scale	$Y_2 = zY_1$
Increasing returns to scale	$Y_2 > zY_1$
Decreasing returns to scale	$Y_2 < zY_1$

- Check if after scaling the K and L, what is Y_2 relative to Y_1

Demand for Labor (One Period)

Relation:

Relates quantity of labour demanded, N to real wage, w

Assumptions:

1) Hold total capital stock fixed – **Short Run** (Note that in the long run, we can invest more and have more equipment or the equipment could depreciate, therefore this could change in long run)
2) Workers are all alike (**Homogeneous**)
3) Labour market is **competitive** (Workers are price takers)
4) Firms **maximize profits**

Note that in the short run, K is fixed and therefore firms cannot vary the quantity of plants and equipment they have, but have flexibility in hiring and laying off workers

Firm's Labour Demand:

- Number of units of labour the firm would employ for different levels of real wage

Note that there is an inverse relationship between labour demand and real wage

Firm's Profit Maximization Problem:

- Firm maximises its profit, by choosing labour to employ N at real wage w (with fixed K in the short run)

Objective Function that we want to maximise

Profit Function | Real Output | Cost of hiring labour

$$\max_N \pi(K,N) = AF(K,N) - wN$$

First Order Condition:

$$A\left(\frac{\partial F(K,N)}{\partial N}\right) - w = 0$$

$$\Rightarrow A\left(\frac{\partial F(K,N)}{\partial N}\right) = w$$

MPN = Real Wage

Marginal Benefit = MPN
Marginal Cost = Real wage ($w = W/P$) where P is the general price level

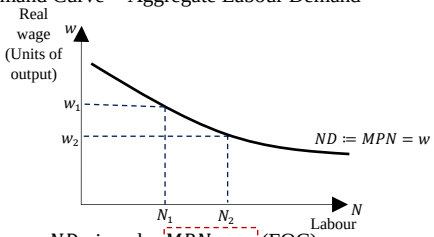
The FOC states that the equilibrium occurs when the **additional benefit** (real output) of **hiring one more unit of worker** is the same as the **cost** (real wage) of **hiring one more unit of worker**

Maximization of Profits

Marginal Benefit > Marginal Cost	$MPN > w$	$\uparrow N$
Marginal Benefit < Marginal Cost	$MPN < w$	$\downarrow N$
Marginal Benefit = Marginal Cost	$MPN = w$	Maximum Profits, no change in N

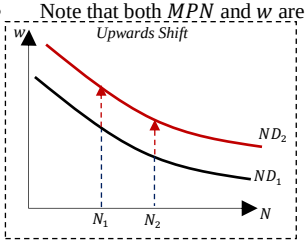
Labour Demand Curve

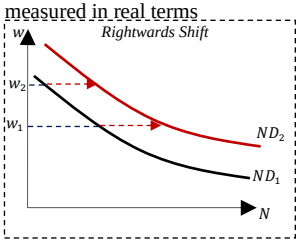
Labour Demand Curve = Aggregate Labour Demand



Demand Curve, ND given by $MPN = w$ (FOC)

- **Downward sloping** because when N increases, MPN decreases (**Diminishing Marginal Product of Labour**)
- Each firm hires labour until $MPN = w = W/P$
- Note that both MPN and w are measured in real terms





Factors Shifting Labour Demand Curve

- Look at things that affect the MPN
- Note that for the shift, we can either argue for an upwards or rightwards shift
- **Rightwards Shift** – Look at the y axis which is real wage and argue that for every real wage, w, firms want to $\uparrow N$
- **Upwards Shift** – Look at the x axis which is labour and argue that for every N, firms are more willing to pay $\uparrow w$ to hire workers

Productivity Shocks
Beneficial Shocks
$\rightarrow \uparrow A$
$\rightarrow \uparrow MPN$ at every N
$\rightarrow$ At every N, Firms willing to pay $\uparrow w$ to hire workers
$\rightarrow$ Labour demand curve shifts to the right
$\rightarrow \uparrow w$ to clear the labour market
$\rightarrow \uparrow N$ in equilibrium
$\rightarrow \uparrow \bar{Y}$ (Full employment Output)
- **Shifts** the curve

Size of the capital stock (K)
Higher capital stock
$\rightarrow \uparrow K$
$\rightarrow \uparrow MPN$ at every N
$\rightarrow$ At every N, Firms willing to pay $\uparrow w$ to hire workers
$\rightarrow$ Labour demand curve shifts to the right
$\rightarrow \uparrow w$ to clear the labour market
$\rightarrow \uparrow N$ in equilibrium
$\rightarrow \uparrow \bar{Y}$ (Full employment Output)
- **Shifts** the curve

Change in wage
- Causes a movement the curve, NOT a shift
- **Movement** along curve

Consumer Preferences:

Indifference Curves
Definition: An indifference curve (IC) shows all combinations of l and c that makes the consumer equally happy

Convex Shape:
- Indifference curves are convex → some c, some l lead to higher utility than a lot l, little c or a lot c and little l
- Due to **diminishing marginal utility**
- There will be **consumption smoothing** to maximise the utility for the consumer

Higher Indifference Curves:
- Higher indifference curve → Higher levels of happiness

Marginal Rate of Substitution (MRS):

Definition: The amount of c the consumer would be willing to substitute for one unit of l to maintain the same level of utility

- Negative of the slope of the indifference curve

Formula:

$$MRS_{l,c} = -\frac{\Delta c}{\Delta l}\Big|_{U=\bar{U}} = \frac{MU_l}{MU_c}$$

Utility Maximising Point:

- The utility maximising basket is where the **budget line is tangent to the indifference curve** (IC)
- At the tangency, the $MRS_{l,c}$ equals to the relative price of leisure in terms of consumption

$$MRS_{l,c} = w$$

Relative Prices:

Suppose the relative prices is:

$$\frac{P_c}{P_l}$$

Definition: The amount of l that the consumer needs to give up to gain 1 unit of c

Income-Leisure Trade-off:

Notations:

h = Units of time available (Time endowment that the consumer has)
l = Time spent in leisure (Choice variable)
$h - l$ = Time spent working (labour supply n^S)
c = Consumption (Choice variable)
u = Utility function (Tells us how much satisfaction the consumer gets from consumption and leisure since both gives satisfaction but consuming one means less consumption of the other)
w = Real wage

Consumption:
Financed by labour income, from time spent working $(h - l)$
- Function of leisure (Negatively related)
- Note that ***h* is exogeneous**

$$c = w(h - l)$$

Consumer/Worker's Maximization Problem

Objective function that we want to maximise:

$$\max_{c,l} u(c,l)$$

Constraint:

$$c = w(h - l)$$

Unconstrained Optimization Problem:
- Substitute the constraint inside to make the problem consist of only **one choice variable, *l***

$$\max_l u(w(h - l), l)$$

Why substituting will make it an unconstrained problem and why c is no longer a choice variable:

- When we substitute the constraint inside the objective function, when we try to maximise it, we will be considering the constraint while finding the value of l, therefore, we can just try to **maximise l using the substituted equation**
- c is no longer a choice variable because once we decide on the value of l, we can determine the value of c so the value of c is **pinned down by the value of l**

First Order Condition:

MRS of leisure for consumption $\frac{u_2(c,l)}{u_1(c,l)} = w$ Real wage

- This tells us that the **relative price of leisure to consumption is w**.
- MRS is how many units of l the consumer is willing to give up for one more unit of c
- **Relative prices** tell us how many units of c needs to be given up for 1 unit of l. When we have 1 unit of leisure, we will need to give up 1 unit of time since $l \uparrow$ for $(h - l)$. Therefore, when we give up that 1 unit of time, we will also be giving up 1 unit of real wage w which can be used for consumption

Budget Constraint

Formula:

$$c = w(h - l)$$

Slope:

$$-w$$

y-intercept:

$$wh$$

- This is when we only spend all the time we have working so $l = 0$ and therefore we will gain an income of wh which can be spent on consumption

x-intercept:

$$h$$

- This is the maximum amount of leisure we can afford which is the total time endowment and this is if we don't work at all

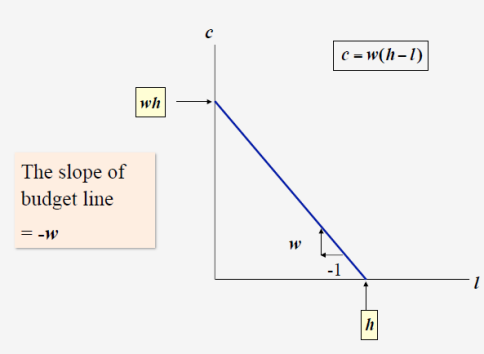


Figure 1 Budget Constraint Graph

Labour Supply

Relation:
Relates quantity of labour supplied, s^S to real wage, w

- Because $n^s = h - l$ the number of hours the worker supply is the total number of hours not spent on leisure
- From the FOC we can use that to relate the choice of leisure and since leisure pins down n^s as well, we can see the relation to real wage w

Model:
Income-Leisure Trade-off

- Determined by individuals (How much they want to work)
- Aggregate labour supply tends to be **upward sloping** because at higher real wage:
  - Existing worker work more hours
  - Other people enter the labour force (Those that are not working previously but find it more worthwhile now)

From FOC:

MRS of leisure for consumption $\frac{u_2(c,l)}{u_1(c,l)} = w$ Real wage

Marginal Benefit: Wage
Marginal Cost: Leisure Forgone

Direction of Slope of Labour Supply Curve:

- Upward sloping Labour Supply Curve

Consider increase in real wage, w

Substitution Effect:

- Keeping utility constant but changing the relative price

$\uparrow w = \frac{W}{P}$
$\rightarrow \uparrow$ Price of leisure relative to consumption $(\frac{P_l}{P_c})$
$\rightarrow \downarrow$leisure
$\rightarrow \uparrow NS$

Income Effect:

- Keeping relative prices constant but changing utility

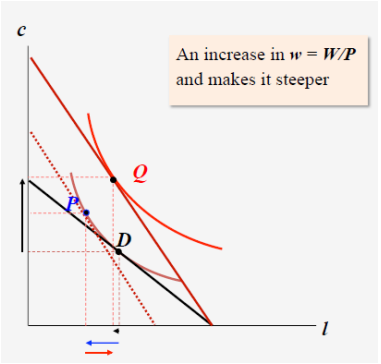
$\uparrow w = \frac{W}{P}$
$\rightarrow \uparrow$ worker's wealth
$\rightarrow$ leisure is normal good
$\rightarrow \uparrow$ leisure
$\rightarrow \downarrow NS$

- Note that for the same amount of work they now earn a higher income
- Leisure is a **normal good** ($\uparrow$ wealth $\rightarrow$ demand for leisure)

Overall Effect:
Note that both substitution effect and income effect are in opposite directions, therefore the overall effect depends on which dominates which

- Theoretically, we cannot determine which is larger and we need the data
- Empirically, SE > IE. Therefore, as real wage increases $\rightarrow$ labour supply $\uparrow \rightarrow$ labour supply curve upwards sloping

Decomposition of Substitution and Income Effect (Changes due to change in real wage, w):



Note that the change in w only changes the y-intercept and does not change the x-intercept

Substitution Effect:

- Draw an **intermediate budget line** that has the same slope as the final budget line. (Representing the change in relative prices)
- Keeping **utility constant** and **changing the relative prices**
- D to P

Income Effect:

- Look at the change from the intermediate budget line to the final point
- Keeping **relative prices constant** but increasing the purchasing power (**increase utility**)

Final Effect (Note that this can be in either direction theoretically):

- $D \rightarrow Q$
- $\uparrow w \rightarrow \downarrow l \rightarrow \uparrow n^s = h - l$
  - Note that since leisure behaves negatively to the labour supply, since leisure decreases, we can see that labour supply will increase

Factors Shifting Labour Supply Curve

Note that **leisure is a normal good** so when wealth/income increases, the consumption for leisure will increase

1) Wealth

↑ wealth
→ ↑ leisure
→ ↓ NS at every w
→ Labour supply curve shifts to the left
→ At every N, Firms willing to pay ↑ w to hire workers
→ ↑ w to clear the labour market
→ ↓ N in equilibrium
→ ↓ $\bar{Y}$ (Full employment Output)

2) Expected future real wage

↑ Expected future real wage
→ ↑ wealth
→ ↑ leisure
→ ↓ NS at every w
→ Labour supply curve shifts to the left
→ At every N, Firms willing to pay ↓ w to hire workers
→ ↓ w to clear the labour market
→ ↓ N in equilibrium
→ ↓ $\bar{Y}$ (Full employment Output)

3) Size of the working age population

- Higher birth rate, immigration

↑ Size of working age population
→ ↑ NS at every w
→ At every N, Firms willing to pay ↓ w to hire workers
→ Labour supply shifts to the right
→ ↓ w to clear the labour market
→ ↑ N in equilibrium
→ ↑ $\bar{Y}$ (Full employment Output)

4) Labour force participation rate

- Increase in female labour force participation rate
- Change in retirement age

↑ Labour force participation rate
→ ↑ NS at every w
→ At every N, Firms willing to pay ↓ w to hire workers
→ Labour supply shifts to the right
→ ↓ w to clear the labour market
→ ↑ N in equilibrium
→ ↑ $\bar{Y}$ (Full employment Output)

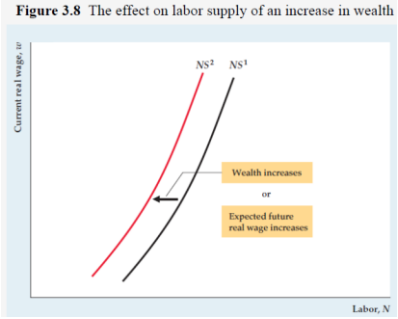


Figure 2 Example of Labour Supply Curve Shift

Labour Market Equilibrium

The following needs to be met for the market to be in equilibrium

Equilibrium:

- Supply = Demand
- Full-employment level
- Market-clearing real wage

Full Employment/ Potential Output:

$$\bar{Y} = AF(K, \bar{N})$$

$\bar{Y}$ – Full employment output (Not constant)
$\bar{N}$ – Fully employment level of employment (Not constant)

- The level of output that firms supply when wages and prices have fully adjusted (Market clears)
- Affected by:
  - **Changes in equilibrium employment**
  - **Production Function** (Changes in A, K, N)

Double Effect of Supply Shock:

Example: **Negative Supply Shock**

↓ A in Production Function
→ ↓ MPN for any N
→ ND shift downs, where ND is given by $MPN = w$
→ ↓ w *and* ↓ N in equilibrium for the labour market
→ Overall decrease of both A *and* N
→ Full employment output Y ↓

Note that there are 2 effects:
1) **Direct decrease** in A causing a decrease in Y from the production function
2) **Indirect increase** in A causing a decrease in N through the decrease in MPN

Both effects will be in the same direction and cause it to decrease mores

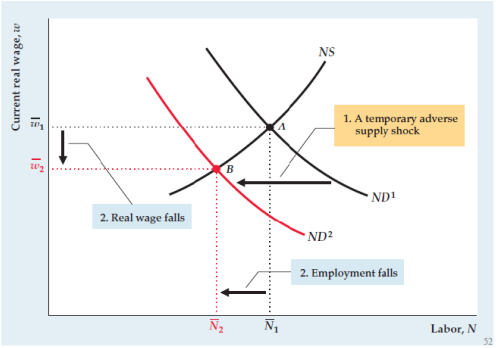


Figure 3 Example of Effect of Negative Supply Shock on Labour Market

Employment Status:

Adult Population:

- Employed
- Unemployed
- Not in labour force

Labour Force:

$$Employed + Unemployed$$

Unemployment Rate:

$$\frac{Unemployed}{Labour\ Force}$$

Participation Rate:

$$\frac{Labour\ Force}{Adult\ Population}$$

Employment Ratio:

$$\frac{Employement}{Adult\ Population}$$

- Because many who are classified as "out of labour force" are in fact discouraged workers – not actively looking for a job but will take it up if they find one

Natural Unemployment:

- Due to this unemployment, it is impossible to achieve 0 unemployment rate since they always exist
- The rate that prevails when output and employment are at full-employment level
- Full employment is where everyone else is employed other than those considered under natural unemployment

1) **Frictional Unemployment**
    a. Workers search for suitable jobs and firms search for suitable workers (Time lag)
2) **Structural Unemployment**
    a. Long term and chronic unemployment even when the economy is not in recession (especially for low-skilled workers)
    b. Relocation of labour from shrinking industries or declining regions

Cyclical Unemployment:

$$Cyclical\ Unemployment = Actual\ Unemployment\ Rate - Natural\ rate\ of\ unemployment$$

Topic 2: Goods Market

Basic Concepts

Income-Expenditure Identity:

$$Y = C + I + G$$

- Note that this identity is always true

Consumption:
- Goods and services purchased by consumers

Saving:
- Current income not consumed

National Savings

National Saving = Private Saving + Public Saving

$$S_{national} = S_{private} + S_{public}$$
$$= Y - T - C + T - G$$
$$= Y - C - G$$
$$S_{national} = Y - C - G$$

Private Saving:

$$S_{private} = Y - T - C$$

Y – Income, T – Taxes, C – Consumption

- Saving by the private sector
- Consumers' disposable income minus their consumption

Public Saving:

$$S_{public} = T - G$$

T – Tax Revenue, G – Government Expenditure

- Saving by the government
- Government Revenue – Government Spending
  - **Positive** – Budget Surplus
  - **Negative** – Budget Deficit → Public dissaving

Investment
- Purchases of new capital goods (machines and plants) by firms
- Purchase of new house and apartments by people

Government Spending
- Goods and services purchased by the federal, state, and local governments
- Take G as given (**Exogeneous**)

Consumption and Saving

Variables of interest: Current consumption and saving

2 Period Model Time Frame:
- Current Consumption: Consumption in Period 1 (Young)
- Future Consumption: Consumption in Period 2 (Old)

Trade-Off between current consumption and future consumption

Price of 1 unit of current C_t = 1 + r units of future C_{t+1}

- **Interest rate r** = Opportunity cost of current consumption because the consumption could earn the interest rate if the consumer saved and the extra r can be used for consumption in period 2

Consumption Smoothing Motive:

- Desire to have a relatively even pattern of consumption over time rather than to have a lot of consumption in one period but very little consumption in another period

Assumption
- Consumer is forward-looking and chooses consumption for the present and future to maximise lifetime satisfaction (When they decide how much to consume and save, they will consider both the present and the future)

Consumer's Intertemporal Budget Constraint:

Notations:

Period 1: The present (young)
Period 2: The future (old)
y_1, y_2 = Income in period 1, 2
c_1, c_2 = Consumption in period 1, 2
$s_1 = y_1 - c_1$ = Saving in period 1
- ($s_1 < 0$ if the consumer borrows in period 1)

$s_2 = y_2 - c_2$ = Saving in Period 2

Lower case – Individual's variables
Upper case – Aggregate variables (For the whole economy)

Budget Constraints:

Period 1 Budget Constraint:

$$s_1 = y_1 - c_1$$

Period 2 Budget Constraint:

$$c_2 = y_2 + (1+r)s_1$$
$$= y_2 + (1+r)(y_1 - c_1)$$

Intertemporal Budget Constraint:

Present Value of Lifetime Consumption (PVLC) $c_1 + \frac{c_2}{1+r}$ = $y_1 + \frac{y_2}{1+r}$ Present Value of Lifetime Resources (PVLR)

- Note that we must discount the value of consumption and income in period 2 because we want to put it into today's value and the **discounting factor will be $(1+r)$**

Individual's Budget Constraint with Lump Sum Taxes & Dividends:

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} + \pi_1 + \frac{\pi_2}{1+r} - \left(t_1 + \frac{t_2}{1+r}\right)$$

Present Value (Consumption) | Present Value (Income) | Present Value (Dividends) | Present Value (Taxes)

PVLC | PVLR with dividends after tax

Period 1 Budget Constraint with dividends and taxes:

$$c_1 + s_1 = y_1 + \pi_1 - t_1$$

Period 2 Budget Constraint with dividends and taxes:

$$c_2 = y_2 + \pi_2 + (1+r)s_1 - t_2$$

- Note with the lump sum taxes, we just need to reduce the PVLR due to the need to pay the taxes
- Note that consumers own the firms and are shareholders → Profit of firms goes to consumers as dividends → Additional resources for consumers to consume

Individual's Budget Constraint with Income Endogenized

$$c_1 + \frac{c_2}{1+r} = w_1(h - l_1) + \frac{w_2(h - l_2)}{1+r}$$

Present Value (Consumption) | Income in period 1 | Present Value of Income in period 2

PVLC | PVLR

$y_1 = w_1(h - l_1)$ – Income in period 1 because we take the number of hours worked multiplied with the real wage in period 1

$y_2 = w_2(h - l_2)$ – Income in period 2 because we take the number of hours worked multiplied with the real wage in period 2. Note that we will need to divide by $1 + r$ to put it into present value terms

Savings in Period 2:

Note that Savings in Period 2 is a function of s_1

$$s_2 = y_2 - c_2$$
$$= y_2 - \left(y_2 + (1+r)(y_1 - c_1)\right)$$
$$= -(1+r)s_1$$

Intuition:
- $s_1 > 0 \rightarrow s_2 < 0$ – This means that we are saving in period 1 and dissaving in period 2
- $s_1 < 0 \rightarrow s_2 > 0$ – This means that we are borrowing in period 1 and we will need to pay back the borrowings in period 2

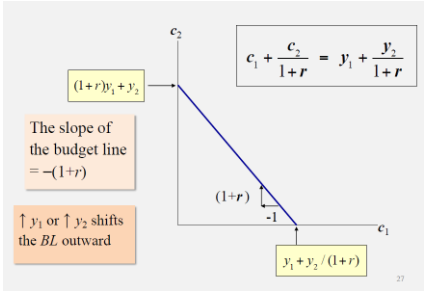
Graphical Representation of Intertemporal Budget Constraint

Intertemporal Budget Constraint:

Present Value of Lifetime Consumption (PVLC) | Present Value of Lifetime Resources (PVLR)

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r}$$

$$\Rightarrow c_2 = -(1+r)c_1 + \left((1+r)y_1 + y_2\right)$$



Slope:

- For every unit of c_1, the consumer will need to give up $(1+r)$ units of c_2. Because when we consume in period 1, we will not be able to gain the interest, r

$$-(1+r)$$

x-intercept:

- This is when c_2 is 0 and we will use all the resources from both period 1 and period 2 to consume in period 1

$$y_1 + \frac{y_2}{1+r}$$

y-intercept:

- This is when c_1 is 0 and we will use all the resources from both period 1 and period to consume in period 2

$$(1+r)y_1 + y_2$$

- Note an increase in y_1 or y_2 will cause the budget line to shift outwards

Present Value

Definition: Amount today that is equivalent to an amount to be received in the future, considering the interest that could be earned over the interval of time

- Note that **we divide by $1/(1+r)$** because that is the value c_2 in terms of c_1 because we need to discount the **compounding effect** to put it in terms of today's consumption

$$PV = \frac{X}{(1+r)^T}$$

Future Value

Definition: Value in terms of dollars or goods in the future

- Note that we multiply by $(1+r)$ as it is the amount of second-period consumption that the consumer must forgo for 1 unit of first-period consumption. For 1 unit of period 1 consumption, it will gain $(1+r)$ interest in the future

$$FV = X(1+r)^T$$

Effects of Changes that affects Consumption and Saving Decision:

1) Increase in income for period 1

$\uparrow y_1$
$\rightarrow \uparrow PVLR$
$\rightarrow$ Consumption Smoothing Motive
$\rightarrow \uparrow c_1$ & $\uparrow c_2$
$\rightarrow \uparrow s_1 = y_1 - c_1$

- Note that $\uparrow c_1 = MPC \times y_1$ and $0 < MPC < 1$, therefore the increase in consumption will be less than the increase in income, therefore, the overall effect on s_1 will still be and an increase

2) Increase in income for period 2

$\uparrow y_2$
$\rightarrow \uparrow PVLR$
$\rightarrow$ Consumption Smoothing Motive
$\rightarrow \uparrow c_1$ & $\uparrow c_2$
$\rightarrow \downarrow s_1 = y_1 - c_1$

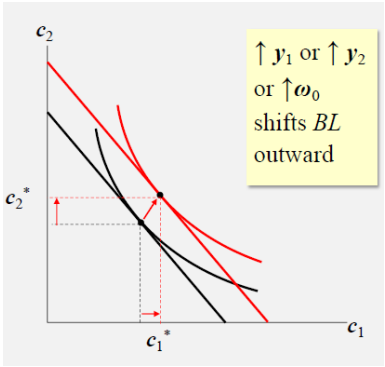
- Note that c_1 increases but y_1 is unchanged, therefore the overall effect on s_1 is a decrease

3) Increase in wealth

$\uparrow \omega_0$
$\rightarrow \uparrow PVLR$
$\rightarrow$ Consumption Smoothing Motive
$\rightarrow \uparrow c_1$ & $\uparrow c_2$
$\rightarrow \downarrow s_1 = y_1 - c_1$

- Note that c_1 increases but y_1 is unchanged, therefore the overall effect on s_1 is a decrease

Graphical Representation of Shifts in BL



Consumer's Consumption Saving Decision (2 Period)

Notations:

c_1 – Consumption (Choice variable) in period t
u – Instantaneous/period utility function in period t
- Same both periods

U – Lifetime utility function

$$U(c_1, c_2) = u(c_1) + \beta u(c_2)$$

- Note that we used a discount factor for the utility of period 2 because we want to put it into present value

β – Discount Factor, $0 < \beta < 1$
- The amount of utility 1 utility in period 2 is worth today
- Indicates how patient the consumer is
  - Higher $\beta \rightarrow$ Future utility is worth more today $\rightarrow$ More patient
  - Lower $\beta \rightarrow$ Future utility is worth less today $\rightarrow$ Less patient
- The lower the value of β, the more the consumer will want to spend more in period 1 since the consumer is inpatient and wants to spend the money now

ρ – Rate of time preference $\rho > 0$
- Defined to be $\boldsymbol{\beta = 1/(1+\rho)}$
- Measure of how impatient the consumer is
  - Higher $\rho \rightarrow$ More impatient
  - Lower $\rho \rightarrow$ More patient

Intertemporal Utility Maximization

Objective Function:

$$\max_{c_1, c_2} U(c_1, c_2) = u(c_1) + \beta u(c_2)$$

Constraint:
- Note that this is the intertemporal budget constraint

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r}$$
$$\Rightarrow c_2 = y_2 + (1+r)(y_1 - c_1)$$

Note that c_2 is a function of $c_1 \rightarrow c_2(c_1)$

Unconstrained Optimization Problem:
- Substitute IBC into the objective function

$$\max_{c_1} U(c_1, c_2) = u(c_1) + \beta u\big(y_2 + (1+r)(y_1 - c_1)\big)$$

- Note that with the substitution, we have that the only choice variable now is c_1. c_2 is pinned down by the choice of c_1

First Order Condition (FOC):

MRS of c_1 for c_2 $\frac{u'(c_1)}{\beta u'(c_2)} = 1 + r$ Relative Price of c_1 in terms of c_2

- **LHS**: MRS_{c_1,c_2} because it is the marginal utility of c_1 over the marginal utility of c_2. Note that we have discounted the utility for period 2 to put it in terms of present value
- **RHS**: Relative price of c_1 in terms of c_2. To gain 1 unit of c_1, we will need to give up $(1 + r)$ units of c_2 since it will be compounded, and we will lose that interest rate

Euler Equation:

$$u'(c_1) = [\beta(1 + r)]u'(c_2)$$

- Note that we can derive the Euler's Equation as well from the derivation of the FOC

Consumption Smoothing Motive:

- If the consumer has consumption smoothing motive, if the consumer has more income in one period, the consumer will spread out the consumption over 2 periods rather than just in 1 period to maximise utility.

2 Conditions must be met:

1) $u' > 0$
2) $u'' < 0$ (Diminishing Marginal Utility)

Reasoning:

- From Euler Equation and using $\beta = 1/(1 + \rho)$

$$u'(c_1) = \frac{1 + r}{1 + \rho} u'(c_2)$$

$u'' < 0$ means that u' is strictly decreasing → $c \uparrow \rightarrow u'(c) \downarrow$
→ This means that when u' and c has an inverse relationship
→ We also know that the functional form of $u(c_1)$ and $u(c_2)$ are the same since we assume that preferences does not change over time
→ With the relationship between r and ρ, we can see that r has an inverse relationship with c_1 and a positive relationship with c_2

Comparison between r and ρ	Comparison between Marginal Utilities	Comparison between c_1 and c_2	Requirements
$r > \rho$	$u'(c_1) > u'(c_2)$	$c_1 < c_2$	$u'' < 0$
$r = \rho$	$u'(c_1) = u'(c_2)$	$c_1 = c_2$	Any functional form of u (Perfect Consumption Smoothing)
$r < \rho$	$u'(c_1) < u'(c_2)$	$c_1 > c_2$	$u'' < 0$

Note:

- r – **Opportunity cost of current consumption**.
  - Higher $r \rightarrow$ Incentive to consume more tomorrow since we can earn the real interest rate r to consume more in the future
- ρ – **Measures impatience**.
  - Higher ρ (Lower β) → More impatient because future utility gets discounted more (future utility is worth less today) → Incentive to consume more today
- When $r = \rho$, **perfect consumption smoothing** occurs (constant consumption profile)
- If $r > \rho$ then the benefit to consume in the future is more so the consumption in period 2 will be higher. If $\rho > r$ then the benefit to consume today is more so the consumption in period 1 will be higher.

Change in real interest rate, r:

- Depends on whether the consumer is a saver or borrower

Increase in real interest, $r \uparrow$:

	Saver	Borrower
Income Effect	$\uparrow r \rightarrow$ Higher returns on savings → ↑ PVLR→ Makes the consumer increase consumption in both periods	$\uparrow r \rightarrow$ Higher cost of borrowings → ↓ PVLR → Makes the consumer reduce consumption in both periods
Substitution Effect	$\uparrow r \rightarrow$ Higher opportunity cost of current consumption → Reduce c_1 and increase c_2	$\uparrow r \rightarrow$ Higher opportunity cost of current consumption → Reduce c_1 and increase c_2
Overall Effect	$\uparrow c_2$ Direction of c_1 depends on size of SE and IE	$\downarrow c_1$ Direction of c_2 depends on size of SE and IE
Empirically	$SE > IE$ $\uparrow r \rightarrow \downarrow c_1 \rightarrow \uparrow s_1$	$SE > IE$ $\uparrow r \rightarrow \uparrow c_2$

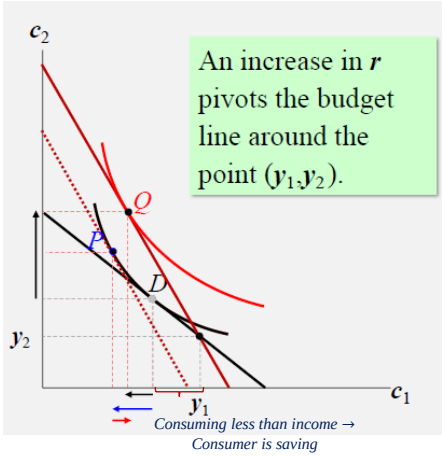
Decrease in real interest, $r \downarrow$:

	Saver	Borrower
Income Effect	$\downarrow r \rightarrow$ Lower returns on savings → ↓ PVLR → Makes the consumer reduce consumption in both periods	$\downarrow r \rightarrow$ Lower cost of borrowings → ↑ PVLR→ Makes the consumer increase consumption in both periods
Substitution Effect	$\downarrow r \rightarrow$ Lower opportunity cost of current consumption → Increase c_1 and decrease c_2	$\uparrow r \rightarrow$ Lower opportunity cost of current consumption → Increase c_1 and decrease c_2
Overall Effect	$\downarrow c_2$ Direction of c_1 depends on size of SE and IE	$\uparrow c_1$ Direction of c_2 depends on size of SE and IE
Empirically	$SE > IE$ $\downarrow r \rightarrow \uparrow c_1 \rightarrow \downarrow s_1$	$SE > IE$ $\downarrow r \rightarrow \downarrow c_2$

Note:

- For borrower: $\uparrow r \rightarrow \downarrow c_1, \uparrow s_1 \rightarrow$ May or may not turn the borrower into a saver, it depends on the utility function and budget constraint. But the borrower will borrow less
- For saver: $\downarrow r \rightarrow \downarrow c_2, \downarrow s_1 \rightarrow$ May or may not turn the saver into a borrower, it depends on the utility function and budget constraint. But the saver will save less

Graphical Representation for changes in r:



- Note that we can look at the point of current consumption vs current income to see if the consumer is saving or borrowing
  - $c_1 > y_1 \rightarrow$ Borrowing
  - $c_1 < y_1 \rightarrow$ Saving
- Note that the pivoting point for the budget line is where (y_1, y_2) because with a change in r, the point of the income will always be affordable to the consumer (i.e. the consumer don't borrow or save)

Substitution Effect:

- Only change in the relative price of c_1 to c_2
- Keeping Utility Constant

Income Effect:

- Parallel outward shift in the budget line (representing increase in income)
- No change in relative price of c_1 to c_2

Government Expenditure

Notations:

Period 1: Present
Period 2: Future

G_1, G_2 = Government Spending in period 1,2
T_1, T_2 = Lump-sum tax in period 1, 2
$B_1 = G_1 - T_1$ = Government borrowing in period 1, Quantity of government bonds issued in period 1

Government Borrowing:

- $B_1 > 0$ if the government dissaves/borrows in period 1, budget deficit
- $B_2 < 0$ if the government saves/lends in period 2, budget surplus

Issues bonds to finance the borrowing:
- People buy bonds → They borrow money to the government → bond matures then the debt is repaid by the government

Lump-Sum Tax:

- Tax for which the individual's liability **does not depend on behaviour**
- Fixed taxation amount **independent of a person's income, consumption of goods and services, or wealth**
- **Non distortionary**, it does not incite any change in behaviour since no matter what the person does, the amount of tax does not change. There is not way to change the amount of tax owed by changing one's behaviour

Government's Budget Constraint

Period 1:

$$G_1 = T_1 + B_1$$

- Government Spending in period 1 is financed by tax revenue and borrowing in period 1

Period 2:

$$G_2 = T_2 - (1+r)(G_1 - T_1)$$

$(G_1 - T_1)$: Value of Government Borrowing (Period 1) in Period 2

- The amount that the government can spend in period 2 must be the tax revenue in period 2 - borrowing in period 1

Intertemporal Budget Constraint:

Present Value of Government Spending: $G_1 + \frac{G_2}{1+r}$ = $T_1 + \frac{T_2}{1+r}$: Present Value of Lump-Sum Taxes

- If $PVGS > PVLST$ then this means that the government spending is more than it earns over its 2 periods, so nobody will want to loan to them since they will not have any money to return. Therefore, this equation must hold

Fiscal Policy

- Measures to change S^d, influence the economy using government revenue or expenditure

Government Purchases (G)

- Temporary ↑ G (Expansionary Fiscal Policy) either by:
  - Financed by ↑ current T → ↓ current after-tax income → ↓ C^d today
  - Financed by ↑ future T → ↓ future after-tax income →↓ C^d today if people realize it
- Consumption Smoothing Motive → ↓ C^d < ↑ G → ↓ $S^d = Y - C^d - G$
  - There will be a split in the decrease in consumption today and tomorrow, therefore the decrease in consumption today will be less than government spending

$$\uparrow G \rightarrow \downarrow C^d \;\&\; \downarrow S^d$$

Taxes (T):

- Directly affects desired national savings
- ↑ T (Current or Future) → ↓ current after-tax income / ↓ future after-tax income → ↓ C^d today → ↓ $S^d = Y - C - G$
- ↓ T (Current or Future) → ↑ current after-tax income / ↑ future after-tax income → ↑ C^d today → ↑ $S^d = Y - C - G$

$$\uparrow T \rightarrow \downarrow S^d$$

Ricardian Equivalence

Definition: States that a cut in lump-sum tax today has no effect on consumers' consumption choices or on the equilibrium real interest rate. Provided current and future government spending remain unchanged

- Note that government will not want to tax now and reduce tax in the future as taxing is bad for elections and they won't want to allow the future government to take credit for being able to reduce taxes. Therefore, they will normally reduce tax now and increase tax in the future

Reasoning

Government Budget Constraint:

$$G_1 + \frac{G_2}{1+r} = T_1 + \frac{T_2}{1+r}$$

- If G_1 & G_2 are unchanged → ↓ $T_1 = \Delta T$ → ↑ $T_2 = (1+r)(\Delta T)$; else the **government cannot keep G_1 and G_2 unchanged**

$$PVLR\ of\ Govt\ After\ Tax\ Cut = T_1 - \Delta T + \frac{(T_2 + (1+r)\Delta T)}{1+r}$$
$$= T_1 + \frac{T_2}{1+r} = PVLR\ of\ Govt\ Before\ Tax\ Cut$$

- $\Delta PV(Taxes) = 0 \rightarrow \Delta PVLR\ after\ tax = 0 \rightarrow \Delta C^d = 0$

Tax cut today must be accompanied by an offsetting increase in expected future taxes because the government has a budget constraint to satisfy as well (G_1 *and* G_2 remains unchanged)
→ Taxpayers' abilities to consume today and in the future are the same as they originally were
→ Household's budget constraint remains the same ($\Delta PVLR$ after Tax = 0)
→ **With unchanged preferences, consumptions must stay the same**

Reasons that Ricardian Equivalence may not hold:

Borrowing Constraints
Consumer has a credit constraint
→ Unable to borrow against future income but wants to consume now
→ Government cuts taxes
→ Government is borrowing on behalf of the consumer
→ The consumer can spend the future income now
→ ↑ c_1 & ↓ c_2

Short-sightedness or Myopia
People may not see that tax will increase again in the future
→ Government cuts taxes now
→ ↑ c_1 since ↑ $(y_1 - t_1)$
→ However, future taxes will increase, and the consumer will need to use c_2 to finance the ↑ t_2

Failure to leave bequests
People may not leave money for their children to finance such taxes
→ Government taxes now
→ ↑ c_1 since ↑ $(y_1 - t_1)$
→ Future increase in tax may need to be paid by their children and they do not pay it

Non-lump-sum Taxes
Government increases non-lump-sum taxes
→ Distortions to incentives and behaviours
→ Workers may not want to work as much since they will be taxed higher
→ $y_1 \downarrow$
→ Decrease c_1 *and* c_2 due to consumption smoothing motives

Investment & Capital

Capital Good: A good that is
- Produced
- Used to produce other goods
- Not used up in the same period in which it is produced (Durable)

Capital Investment:
- Uses its current resources to increase its capacity to produce and earn profits in the future
- Becomes **capital with a lag** (After some time, the investment becomes capital)
- Purchases of new capital goods (machines and plants) by firms, and purchases of new house and apartments by people, and increases in firms' inventory holdings

$$Investment = Business\ Fixed\ Investment + Residential\ Fixed\ Investment + Inventory\ Investment$$

Inventory Investment: $Production - Sales$
- **Inventories**: Stocks of unsold finished goods, goods in process, and production materials (or raw materials) held by firms
- This happens when production is more than sales
- Useful for the business to see how the business is performing
  - **Production > Sales** → Positive Inventory Investment. Producing more than expected and the demand for the goods is not as much
  - **Sales > Production** → Negative inventory investment and producing lesser than expected and the demand for the good is high

Business Fixed Investment: Investment by firms in
- Structures (factories, warehouses, and office buildings)
- Equipment (machines, vehicles, computers, and furniture)

Intellectual property (software, investment in R&D, and literary, entertainment and artistic originals)

Importance of Investment:
- Fluctuates sharply over business cycles
  - Potential to **explain** what is going on in the economy
- Helps **economic growth**
  - Investment creates capital and capital enters into production function

Investment (2 Period Model)

Variables of Interest:
- Current Investment, I^t
- Future desired capital stock, K_2 (Investment becomes capital with a lag)

Periods:
- Current Investment = Investment in period 1
- Future capital stock = Capital stock in period 2

Equations Required:

Profit in period *t*:

$$\pi_t = Y_t - w_t N_t - I_t$$

Output in Period t | Wage Cost in Period t | Investment in Period t

Total Cost in Period t (Marginal Cost)

Output in period *t*:

$$Y_t = A_t F(K_t, N_t)$$

- Production Function for period t

Equation of motion

$$K_{t+1} = (1-d)K_t + I_t$$

Capital in Period $t+1$ | Remaining Capital from Period t | Investment in period t

- d = Depreciation rate
- I_t = Investment in period t
  - This investment becomes capital in period $t+1$ because it becomes capital with one-period lag
- Describes how capital stock evolves or changes over time

Gross Investment:

$$I_1 = K_2 - K_1 + dK_1$$

Gross Investment | Net Investment | Depreciation

Assumptions:
- Firms produce one unit of output using one unit of capital
- Real wage is w_t
- Price of new capital p_k = 1 unit of output

Choice Variables:

In period 1: N_1, I_1
In period 2: N_2
- Produces output using K_2
- **Sells used, depreciated capital** at the end of period 2 (after production & depreciation in period 2) $= (1-d)K_2$, converts it one for one into output and adds to profit in period 2
- Shut down

Firm's Profit Maximization Problem

Objective Function:

$$\Pi = \pi_1 + \frac{\pi_2}{1+r}$$

Present Value of Total Profit | Profit in Period 1 | Present Value of Profit in Period 2

$$\Pi = A_1 F(K_1, N_1) - w_1 N_1 - I_1 + \frac{A_2 F(K_2, N_2) - w_2 N_2 + (1-d)K_2}{1+r}$$

Profit for Period 1 | Present Value of Profit in Period 2 | Sale of Used Capital

$$\Pi = A_1 F(K_1, N_1) - w_1 N_1 - (K_2 - K_1 + dK_1) + \frac{A_2 F(K_2, N_2) - w_2 N_2 + (1-d)K_2}{1+r}$$

Gross Investment

Choice Variables: N_1, N_2, K_2

First Order Condition:

With respect to N_1:

$$\frac{\partial \Pi}{\partial N_1} = 0$$

$$A_1 \frac{\partial F(K_1, N_1)}{\partial N_1} = w_1$$

Marginal Product of Labour in Period 1 | $MPN_1 = w_1$ | Real wage in Period 1

- **Labour Demand in Period 1**

With respect to N_2:

$$\frac{\partial \Pi}{\partial N_2} = 0$$

$$A_2 \frac{\partial F(K_2, N_2)}{\partial N_2} = w_2$$

Marginal Product of Labour in Period 2 | $MPN_2 = w_2$ | Real wage in Period 2

- **Labour Demand in Period 2**

With respect to K_2:

$$\frac{\partial \Pi}{\partial K_2} = 0$$

$$A_2 \frac{\partial F(K_2, N_2)}{\partial N_2} = r + d$$

Marginal Product of Capital in Period 2: $MPK_2 = MPK^f$; User Cost of Capital: $= r + d$

- Marginal Benefit of additional unit of capital in the future = Marginal Cost of using capital
- **Marginal Benefit**: MPK_2
  - Investment becomes **capital stock with a lag** (Benefit only comes after 1 period of investing)
  - Investing now gives us **1 additional unit of capital** in the future and ***MPK* more units of output** in period 2
- **Marginal Cost**: User Cost of Capital
  - Expected real cost of using a unit of capital for a specified period
  - r – **Real interest rate**. We will forgo interest that could be earned when we put aside the resources when we invest. Opportunity cost of investing, if we do not investment, we can lend it out and gain interest
  - d – Over time, there is a **wear and tear cost** for capital and the value of capital will decrease after a period
  - p_k – **Cost of 1 unit of capital**. Note that we assumed it to be $p_k = 1$ but it could be different. In amount of output required to be converted into 1 unit of capital

$$uc = (r + d)p_k$$

Desired Capital Stock (K^*)

Definition: The level of capital stock at which $MPK^f = uc$

Shape of MPK:

- **Downward sloping** because of Diminishing Marginal Productivity of capital
- $\uparrow K \rightarrow \downarrow MPK^f$

Shape of uc:

- **Horizontal Line**
- Does not vary with K

Profit Maximising Point:

- $MPK^f = uc$
- If $MPK^f > uc \rightarrow \uparrow K \rightarrow \uparrow profits$ (Marginal Benefit > Marginal Cost)
- If $MPK^f < uc \rightarrow \downarrow K \rightarrow \uparrow profits$ (Marginal Cost > Marginal Benefit)

Graphical Determination of Desired Capital Stock

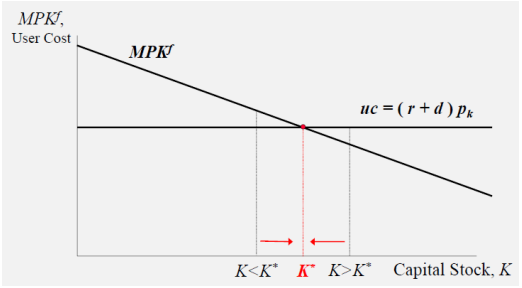


Figure 4 Graph of MPK = uc

- We can see that when $K > K^*$ or $K < K^*$, the firms will adjust capital stock to maximise profits
- Intersection point between $MPK^f = uc$ is the point of desired capital stock

Factors affecting change in desired capital stock

Real interest rate, r

- $\downarrow r \rightarrow \downarrow uc = (r + d)p_k \rightarrow$ Downward shift of $uc \rightarrow \uparrow K^* \rightarrow$ Overall $\uparrow I_t$ since $\uparrow K^*$
- Negative relationship between real interest rate, r and investment, I_t

Depreciation rate, d

- $\downarrow d \rightarrow \downarrow uc = (r + d)p_k \rightarrow$ Downward shift of $uc \rightarrow \uparrow K^* \rightarrow$ Overall $\uparrow I_t$ since $\uparrow K^*$
- Negative relationship between depreciation rate, d and investment, I_t

Price of capital, p_k

- $\downarrow p_k \rightarrow \downarrow uc = (r + d)p_k \rightarrow$ Downward shift of $uc \rightarrow \uparrow K^* \rightarrow$ Overall $\uparrow I_t$ since $\uparrow K^*$
- Negative relationship between price of capital, p_k and investment, I_t

Technological changes, MPK^f

- Technological advancement $\rightarrow \uparrow A \rightarrow \uparrow MPK^f \rightarrow \uparrow MPK^f$ at every $K \rightarrow$ Upward shift of the $MPK^f \rightarrow \uparrow K^* \rightarrow$ Overall $\uparrow I_t$ since $\uparrow K^*$
- Positive relationship between MPK^f and investment, I_t

Relationship between Desired Capital Stock and Investment

Gross Investment: $I_t = K^* - K_t + dK_t$ (Depreciation); Net Investment

$$\uparrow K^* \rightarrow \uparrow I_t$$

- **Δ Capital Stock** $\rightarrow$ Net Investment $= K^* - K_t$
- **New capital** $\rightarrow \uparrow K \rightarrow \Delta I_t$ (Depends on whether there is an increase in capital in period t or $t + 1$)
- **Depreciation** $\rightarrow \uparrow dK_t \rightarrow \uparrow I_t$

Components of Gross Investment:

1) **Desired Net Increase in Capital Stock**: $K^* - K_t$
2) **Investment needed to replace depreciated capital**: dK_t

Therefore K^* has a **positive relationship** with $I_t \rightarrow$ Any factors that have a positive relationship with K^* has a positive relationship with I_t

Desired Capital Stock with Taxes

Tax applied to firm's revenue: τ

Return to capital: $(1 - \tau)MPK^f$

Tax-adjusted user cost of capital: $\frac{uc}{1 - \tau}$

Tax-adjusted determination of desired capital stock: $MPK^f = \frac{uc}{1 - \tau}$

Changes to Determination of desired capital stock:

- $\uparrow \tau$, tax rate $\rightarrow \uparrow \frac{uc}{1-\tau} \rightarrow$ Upward shift of $uc \rightarrow \downarrow K^* \rightarrow$ Overall, $\downarrow I_t$ since $\downarrow K^*$
- Negative relationship between tax rate, τ and investment, I_t

Effective Tax Rate

Definition: The tax rate on firm revenue that would have the same effect on K^* as do the actual provisions of the tax code

- Summarises the **effects of various taxes** on desired capital stock, K^*
- Tax may not apply solely on the firm's revenue, and it will also affect the firm's incentive to invest.

Goods Market Equilibrium

Desired Consumption (C^d):
- Consumption of goods and services desired by the households (that maximises utility)

Desired National Savings (S^d):
- National saving when consumption is at its desired level

$$S^d = Y - C^d - G$$

Desired Investment (I^d):
- Investment desired by firms (that maximises profit)
- Can derived from K^* which is from the equation of motion
- Need to borrow money to invest

Model: Loanable Funds Framework

Equilibrium Condition:

Good Market Equilibrium Condition:

$Y = C^d + I^d - G$ or $S^d = I^d$

- Real interest rate adjusts so that

$$Aggregate\ Goods\ Supplied = Aggregate\ Goods\ Demanded$$

Note:
- This is different from the income-expenditure identity: $Y = C + I + G$ (This **always holds**, this is the actual value)
- Goods market equilibrium **need not hold**
  - Undesired goods may be produced → Unintended inventory investment

Loanable Funds Framework/ Saving Investment Diagram:

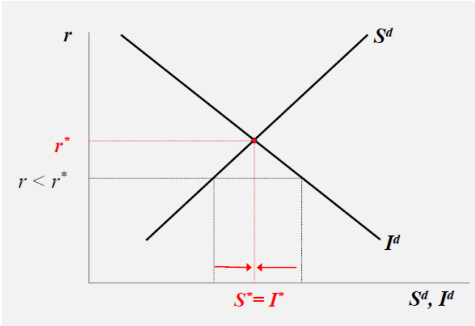


Figure 5 Graphical Representation of Loanable Funds Market

Upwards Sloping S^d:
- $\uparrow r \rightarrow \ SE > IE \rightarrow \downarrow C^d \rightarrow \uparrow S^d$
- Therefore as r increases, S^d increases as well

Downwards Sloping I^d:
- $\uparrow r \rightarrow \uparrow uc \rightarrow$ uc line shifts up $\rightarrow \downarrow K^* \rightarrow \downarrow I^d$
- Therefore as r increases, I^d decreases

Note:
- The model is **good for the long run**, but **not really for the short run** because interest rates are controlled by the Central Bank due to monetary policies
- ***r* is endogenized** here since we are considering for the whole economy rather than individual firms and the real interest rate will adjust for the whole economy

Equilibrium Point:
- Interest rate, r will adjust so that $S^d = I^d$
- $S^d > I^d \rightarrow$ Excess Supply of Loanable Funds $\rightarrow \downarrow r$ to clear the loanable funds market
- $I^d > S^d \rightarrow$ Excess Demand of Loanable Funds $\rightarrow \uparrow r$ to clear the loanable funds market
- This can be extended similarly to $Y = C^d + I^d + G$ where we can talk about the goods supplied vs. goods demanded

Factors that shift the Saving Investment Diagram:

Note that S^d, C^d and Y are in period 1

Shifts in Saving Curve

Change in Current Output, Y_1:
$\uparrow Y_1$
→ Consumption Smoothing Motive
$\rightarrow \uparrow C_1$
$\rightarrow \uparrow C_1 < \uparrow Y_1$
$\rightarrow \uparrow S^d = Y - C^d - G$
$\rightarrow \uparrow S^d$ for any r
$\rightarrow S^d$ shifts to the right
$\rightarrow \downarrow r$ to clear the loanable funds market
$\rightarrow \uparrow S^d$ and $\uparrow I^d$ in equilibrium

Change in Expected Future Output, Y_2:
$\uparrow Y_2$
→ Consumption Smoothing
$\rightarrow \uparrow C_1$
$\rightarrow \downarrow S^d = Y - C^d - G$
$\rightarrow \downarrow S^d$ for any r
$\rightarrow S^d$ shifts to the left
$\rightarrow \uparrow r$ to clear the loanable funds market
$\rightarrow \downarrow S^d$ and $\downarrow I^d$ in equilibrium

Change in Wealth, ω_0
$\uparrow \omega_0$
→ Consumption Smoothing Motive
$\rightarrow \uparrow C_1$
$\rightarrow \downarrow S^d = Y - C^d - G$
$\rightarrow \downarrow S^d$ at every r
→ Leftward shift of S^d
$\rightarrow \uparrow r$ to clear loanable funds market
$\rightarrow \downarrow S^d$ & $\downarrow I^d$ in equilibrium

Change in Government Purchases, G
$\uparrow G$
→ Financed by ↑ current T or future T
→ ↓ current after-tax income / ↓ future after-tax income
$\rightarrow \downarrow C^d$
→ Consumption Smoothing Motive
$\rightarrow \downarrow C^d < \uparrow G$
$\rightarrow \downarrow S^d = Y - C^d - G$
$\rightarrow \downarrow S^d$ at every r
→ Leftward shift of S^d
$\rightarrow \uparrow r$ to clear loanable funds market
$\rightarrow \downarrow S^d$ & $\downarrow I^d$ in equilibrium

Change in Taxes, T:
- If Ricardian Equivalence holds, then a change in current or future taxes does not change the consumption patterns of the consumer, provided Government Spending does not change for both periods

$\downarrow T$ (Current or Future)
→ ↑ current after-tax income / ↑future after-tax income
$\rightarrow \uparrow C^d$ today
$\rightarrow \downarrow S^d = Y - C - G \rightarrow \downarrow S^d$ at every r
→ Leftward shift of S^d
$\rightarrow \uparrow r$ to clear the loanable funds market
$\rightarrow \downarrow S^d$ & $\downarrow I^d$ in equilibrium

Shifts in Investment Curve:

Changes in Effective Tax Rate, τ:
- The tax rate on firm revenue that would have the same effect on K^* as do the actual provisions of the tax code

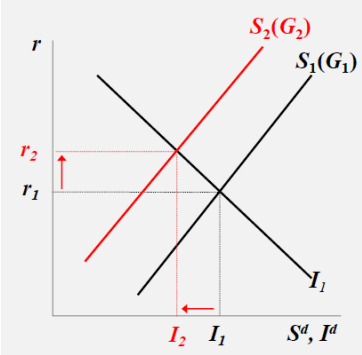
$\uparrow \tau$
$\rightarrow \uparrow$ Tax-adjusted user cost of capital, $\frac{uc}{1-\tau}$
→ Upwards shift of uc
$\rightarrow \downarrow K^*$
$\rightarrow \downarrow I^d$
$\rightarrow \downarrow I^d$ for every r
→ Leftwards shift of I^d
$\rightarrow \downarrow r$ to clear the loanable funds market
$\rightarrow \downarrow I^d$ & $\downarrow S^d$ in equilibrium

Changes in Marginal Product of Capital, MPK^f:

- When there are technological advancements that makes capital more efficient

Technological advancement
→↑ A
→↑ MPK^f
→↑ MPK^f at every K
→ Upwards Shift of MPK^f
→↑ K^*
→↑ I^d
→↑ I^d for every r
→ Rightwards shift of I^d
→↑ r to clear loanable funds market
→↑ I^d and ↑ S^d in equilibrium

Graphical Representation of Shifts in Saving-Investment Diagram



Crowding Out Effect:

Definition: Reduction of Investment that results when expansionary fiscal policy raises the interest rate (↑ G)

Expansionary Policy:

- A monetary or fiscal policy that increases aggregate demand (as opposed to contractionary policy)

Intuition:

↑ $G \rightarrow \downarrow S_d = Y - C^d - G \rightarrow \uparrow r \rightarrow \downarrow I^d$

- Rise of government spending **would raise interest rates**
- With the rise in government spending, it could crowd out the productive private investment and it could be bad if the government is not spending efficiently
- Government is using more real resources, some of which would **otherwise have gone into investment**

Topic 3: Asset Market

Money

Definition: Assets that are widely used and accepted as payment

Functions of Money:

1) Medium of Exchange
- Asset used in making transaction
- Money is the asset widely accepted in transactions for goods and services
- Accepted in exchange for goods because it can be exchanged for other goods
- Allows specialization and productivity gain
  - Since people will be able to specialise in things that they are good at and gain money in that sense
- Barter and the double coincidence of wants otherwise
  - We will need to ensure that the goods and service that we provide must coincide with the goods and services that they provide

2) Unit of account
- The basic unit for measuring economic value (e.g. dollars)
- The measure in which prices and other accounting records are recorded
- Used for the denomination of prices and contracts

3) Store of Value
- A means of holding wealth over time
- A way of transferring purchasing power from the present to the future
- Used to trade current goods for future goods
- Bonds and stocks offer higher expected returns but are less liquid
  - They are not accepted as mediums of exchange and therefore, needs to be liquidated before it can be traded and there could be some costs to it

Definitions

Liquidity:
- Relative ease and speed with which an asset can be converted into a medium of exchange

Fiat Money:
- Has no intrinsic value
- Modern Economy, it is mostly fiat money
- Example: Paper currency that we use

Commodity Money:
- Has intrinsic value
- E.g. Gold coins, Cigarettes in POW camps

Types of Money:

M1 (Most Liquid Assets)
- Currency
- Travellers' checks
- Transaction accounts
  - Cheques

M2 (Less Liquid than M1)
- Components of M1
- Saving Deposits, including MMDAs
  - Money Market Deposit Accounts
- Small-denomination time deposits
  - Less than 100k
- Money Market Mutual Funds - MMMFs (Noninstitutional)
  - When shares are bought in the mutual fund, the fund manager will use the pool of money to buy a portfolio of assets
  - May buy short term debt instruments (short term bonds)
  - Allows shareholders to write several cheques in a month

Money Supply

Definition: Amount of money available in the economy

M – Money supply (Either $M1$ or $M2$)

Changes in Money Supply (M^s)

- Central Bank changes M^s through **open-market operations (OMO)**

Treasury Bonds/ Bills:
- Issued by the government
- **Form of IOU**. When members of the public buys the bonds, they **lend money to the government** and when the bond matures, it is when the government will pay back
- Government **sells bonds when they are in a budget deficit** and needs to borrow money
- Central banks buy these bonds from the public. In exchange, the central bank must pay money to the public for this

Open Market Purchases
- Use newly printed money to buy financial assets (Bonds) from the public → ↑ M^S

Open Market Sale
- Sells financial assets (Bonds) to the public → ↓ M^S

Buy newly issued government bonds directly
- Buys bonds from government → Finance expenditures directly by printing money → **Inflation**
- Note that if the central bank is **independent** from the government, they **may not want to finance government expenditure**

Portfolio Allocation and Asset Demand

Allocation of Wealth:

Trade-off between:
1) Expected Return
2) Risk
3) Liquidity

Example of Comparisons

	Expected Return	Risk	Liquidity
Stocks	High	High	Low
Bonds	Low	Low	Low
Money	Low or Negative	Low (Unless Inflation)	High

Asset Demand

- Amount a wealth holder wants of an asset
- Wealth must be held in some form of asset

$$Sum\ of\ asset\ demands = Total\ wealth$$

Money Demand

Definition: The quantity of monetary assets that people want to hold in their portfolio

- Think of the quantity that the consumer wants to hold in $M1$

Money Demand Function

Real Money Demand: $\left(\frac{M}{P}\right)^d = L(Y,i)$ — Liquidity as a function of Y and i

$= L(Y, r + \pi^e)$

M – Nominal Money Demand
P – General Price Level
M/P – Real Money Balances
π^e – Expected inflation

- Real Money demand is a **function of liquidity**
- L is used for the real money demand function because money is the most liquid asset

Factors affecting Money Demand

Assumptions:
- Money **does not pay interest** (Even though money in checking accounts may pay interests)

Real output/ income, Y
- $\uparrow Y \rightarrow$ More Spending and Transactions $\rightarrow$ More money is needed because money is a medium of exchange $\rightarrow \uparrow M^d$
- **Positive** relationship between Y and M^d

Nominal interest rate on nonmonetary assets, i
- Percentage increase in money the borrower pays the lender for the use of the money that is borrowed
- $\uparrow i \rightarrow \uparrow$ opportunity cost of holding money $\rightarrow$ Unable to lend it out to earn the interest $\rightarrow \downarrow M^d$
- **Negative** relationship between i and M^d
- Difference with interest rate for checking accounts
  - Interest rate for checking account is when we put it in the bank, and they generate interest for us. But we are assuming it is 0

Expected inflation rate, π^e
- Higher the expected inflation, the lesser people want to hold onto money because they can use it to invest and gain the interest rate
- **Negative** relationship between π^e and M^d

Real interest rate, r
- Higher the real interest rate, then the higher the rate on return for investing in bonds
- **Negative** relationship between r and M^d

Fisher Relation for Interest Rates

Real Interest Rate
- Growth **rate of purchasing power**, r
- Rate of return in units/ terms of goods
- Takes away the effect of money

Nominal Interest Rate
- Growth **rate of money invested**, i
- Rate of return in units/terms of money/dollars
- Does not distinguish the growth rate of money and purchasing power

Inflation Rate
- Growth **Rate of "Prices"**
- Think of the growth rate of CPI for example

$$\pi = \frac{(P_{t+1} - P_t)}{P_t} = \frac{P_{t+1}}{P_t} - 1 = \frac{\Delta P}{P}$$

P_t : Price level at time t

Fisher Relation

$$1 + r = \frac{1+i}{1+\pi}$$

What nominal interest rate, i tells us?
$1 + i$ – Return in terms of **money/dollars** next period from giving up \$1 in this period.

What real interest rate, r tells us?
$1 + r$ – Return in terms of **goods** next period from giving up one unit of goods this period

Relation between money and units of goods
- Need to **divide by the general price level** to see how many goods we can get this period

\$1 this period = $1/P_t$ units of goods this period

\$$(1 + i)$ next period = $(1 + i)/P_{t+1}$ units of goods next period

Derivation for Fisher Relation:

$$1 + r = \frac{No.\ of\ goods\ next\ period}{No.\ of\ goods\ given\ up\ this\ period}$$
$$= \frac{1+i}{\frac{P_{t+1}}{P_t}}$$
$$= \frac{1+i}{\frac{P_{t+1}}{P_t}}$$
$$= \frac{1+i}{1+\pi}$$

$\pi = \frac{P_{t+1}}{P_t} - 1$

Through rearrangement:

$$r = \frac{(i - \pi)}{1 + \pi}$$

Since π is usually close to 0, $1 + \pi \approx 1$

$$r \approx i - \pi$$
$$or$$
$$i \approx r + \pi$$

- Approximately, the nominal interest rate is the addition of the real interest rate with the growth rate of "prices"

Unless people expect large changes in growth rates of M or Y, $\pi^e \approx \pi$
This is assuming that r is constant and and we will have that $\Delta i = \Delta \pi^e$ but most of the time, the comovement is not constant since r will fluctuate

Asset Market Equilibrium

Type of Assets:

Money – Things in $M1$ and most of $M2$
- Includes currency and checking accounts
- Interest rate on monetary assets i^m
  - Unless stated explicitly, we assume $i^m = 0$ (i.e. money does not pay interest)
- Supply is fixed at ***M***
  - Determined by the Central Bank through OMO

Non-Monetary Assets – Everything that is not monetary
- Includes stocks, bonds, land etc.
- Pays Interest Rate $i \approx r + \pi^e$
- Supply is fixed at ***NM***

Walras Law:

Definition: If we have n markets, $n - 1$ markets are in equilibrium, then the last market must also be in equilibrium

Equilibrium Condition:

Total wealth held either as monetary or non-monetary assets
→ Money market is in equilibrium
→ Implies that non-monetary market is also in equilibrium (Walras Law)
→ Also implies Asset Market is in equilibrium

Asset Market Equilibrium ⇔ Money Market Equilibrium

Sufficient condition for Asset Market Equilibrium

Real Money Demand: $\frac{M^d}{P} = \frac{M^s}{P}$ Real Money Supply

Real Money Demand: $L(r + \pi^e, Y) = \frac{M}{P}$ Supply of real money balances

Graph for Money Market

Shape of Real Money Supply (M/P)

- Vertical Straight Line
- Nominal Money Supply exogenously fixed by central bank
  - By changing the money supply, central banks can change the levels of interest rate in the short run
- **Prices are assumed to be fixed in short run**

$$\left(\frac{M}{P}\right)^{S} = \left(\frac{\bar{M}}{\bar{P}}\right)$$

Shape of Real Money Demand (M^D)

- Downward sloping
- Demand for money behaves negatively with interest rate
  - $\uparrow r \rightarrow \uparrow$ Opportunity Cost for holding money $\rightarrow$ People will want to buy stocks more instead to earn the interest rate $\rightarrow \downarrow M^D$

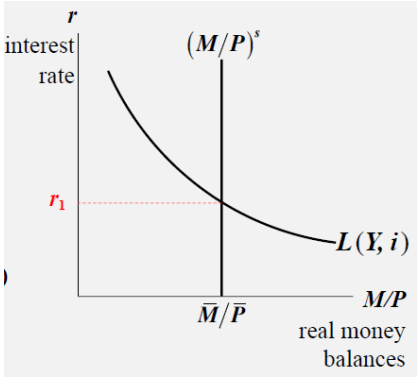


Figure 6 Graph of Money Market

Adjustment of interest rate to reach equilibrium point

r above equilibrium level
$\rightarrow$ Quantity of real money balances supplied > Quantity demanded
$\rightarrow$ People holding excess supply of money will try to use the money in their portfolio to buy non-monetary assets (E.g. bonds) because of the higher opportunity cost of holding money
$\rightarrow \uparrow$ People buying bonds, bond issuers will lower interest rates that they offer since there are more people lending now
$\rightarrow$ At r^*, people are content with their portfolios of monetary and nonmonetary assets

- Note that r must clear both goods and asset markets in short run

Determination of Values in Long Run

$$\frac{M}{P} = L(Y, r + \pi^e)$$

Variable	How is it determined?	Market to be Assessed
M	Exogenous	Fed – Open Market Operations
r	Adjusts to make $S^d = I^d$	Goods Market
Y	$\bar{Y} = AF(K, \bar{N})$	Labour Market
P	Adjusts to make $\frac{M}{P} = L(i, Y)$	Asset Market

- Note that P is pinned down by the Asset Market in the long run

Money Growth and Inflation

Changes of P in response to ΔM:

In the long run:
r – Determined by Goods Market
Y – Determined by Labour Market
π^e – Exogenous

For given values of $r, Y, \pi^e \rightarrow$ Money Demand does not change

- **$\Delta M \rightarrow \Delta P$ by the same percentage**
- A **proportionate change in money supply must lead to a proportionate change in general price level** for the asset market to be in equilibrium since Money Demand does not change

Inflation

Rate of Inflation = Growth rate of Nominal Money Supply – Growth rate of Real Money Demand

$$P = \frac{M}{L(Y, r + \pi^e)}$$

$$\frac{\Delta P}{P} = \frac{\Delta M}{M} - \frac{\Delta L(Y, r + \pi^e)}{L(Y, r + \pi^e)}$$

$$\pi = \frac{\Delta M}{M} - \eta_Y \frac{\Delta Y}{Y} - \eta_i \frac{\Delta i}{i}$$

- $\frac{\Delta M}{M}$: Growth Rate of Nominal Money Supplied
- $\eta_Y \frac{\Delta Y}{Y}$: Weighted Growth Rate of Money Demand wrt Y
- $\eta_i \frac{\Delta i}{i}$: Weighted Growth Rate of Money Demand wrt i

η_Y – Elasticity of money demanded with respect to Y

- Percentage change in money demand divided by percentage change in real output

$$\frac{\Delta M^d}{M^d} / \left(\frac{\Delta Y}{Y}\right)$$

$\eta_Y \frac{\Delta Y}{Y}$ – Percentage change in money demand induced by a percentage change in real output

- With a growth rate of real output, it tells us know much the growth rate of money demand will change

η_i – Elasticity of money demanded with respect to i

- Percentage change in money demand divided by percentage change in nominal interest rate

$$\frac{\Delta M^d}{M^d} / \left(\frac{\Delta i}{i}\right)$$

$\eta_i \frac{\Delta i}{i}$ – Percentage change in money demand induced by a percentage change in nominal interest rate

- With a growth rate of nominal interest rate, it tells us know much the growth rate of money demand will change

Inflation Rate

- Growth rate of nominal money supply – $\frac{\Delta M}{M}$
- Adjustment for growth rate of real money demand arising from growth in real output Y
- Adjustment for growth rate of real money demand arising from growth in nominal interest rate i

$$-\eta_Y \frac{\Delta Y}{Y} - \eta_i \frac{\Delta i}{i}$$

High Inflation Rates

Countries with high inflation $\rightarrow$ Growth of nominal money supply > Growth of real money demand

Hyperinflation

Definition: Inflation rate $\geq 50\%$ per month

Negative Effects:

- Money ceases to function as a store of value, and may not serve its other purposes (unit of account, medium of exchange)
- People may conduct transactions with barter or a stable foreign currency instead

Causes:

- Excessive money supply growth

Solution:

- Stop printing as much money to fund government spending
- May require painful fiscal reform $\rightarrow \downarrow G$ to reduce budget deficit

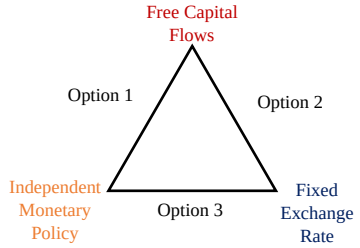
Caveats:

- Some countries still print a lot of money even knowing inflation will occur
- Printing money could be the only way to finance government expenditures $\rightarrow$ Government may want to tax the people, but people are poor and they don't have any money to borrow from

Open Economy Trilemma:

Problem:
Impossible for a country to achieve more than two things in the following 3 items:

1. **Exchange rate stability**
   - Fixed exchange rate to reduce further uncertainty
   - This reduces uncertainty for investors. For instance, if we have investors from US, they will need to exchange US dollar for SG dollar to invest here. After the investment cycle, they may want to take their earnings back. So they will need to exchange back to US dollar. So if the exchange rate fluctuates alot, they will not want to invest in SG since there is alot of uncertainty on their returns
   - *Note* to fix the exchange rate, there must always be supply for the other currency. If no one is willing to exchange at the current fixed rate, the central bank needs to use their reserves to honour the trade
2. **Independent monetary policy**
   - Ability to use monetary policy to stabilize the domestic economy
   - Under some situations, an expansionary monetary policy could lift the economy out of a recession
3. **Free capital movement**
   - Ability of local investors to invest abroad and of foreign investors to invest domestically (and to withdraw investment)
   - This is about whether the money can be taken out after the investment easily. This can help to ease uncertainty as well



Choice of the options depends on the state of the economy of the country

Option 1: Example US
- If we give up fixed exchange rate then even if the firms think that the interest rates are too low, the exchange rate will be determined through money and supply and the central bank does not need to use their reserves to maintain the fixed exchange rate

Option 2: Example Hong Kong
- Suppose Hong Kong is in a recession, and they want to lower interest rates to stimulate the economy, foreign investment want to take their money out to somewhere else where the returns are higher. If the interest rate is not consistent with the fixed exchange rate and the central bank will run out of reserves if firms keep wanting to invest somewhere else and exchanging the currency. Central bank may run out of reserves

Option 3: Example China
- They need to have control over capital flow. If there is control for capital flow then they can just control whether they want to allow capital to flow out so they can exchange the point when they want and stop letting capital flow out

Topic 4: IS-LM-FE Model

Short Run vs. Long Run

Short Run:
- Fixed Prices
- Output determined by aggregate demand
- Unemployment negatively related to output

Long Run:
- Prices are flexible
- Output determined by factors of production and technology
- Unemployment equals its natural rate (Economy produces at full employment output)

FE Line

FE Line: Full employment line, determined by the **labour market**

Condition from Labour Market:

Equilibrium in Labour Market
→ Full employment $\bar{N}$ & $\bar{Y}$

Note that in the long run, the economy will produce at this full employment output where there is no cyclical unemployment and it will be the natural rate of unemployment. In the short run, we can have a different story

Graphically:
Plot real interest rate against output, there will be a vertical line $Y = \bar{Y}$, since we know that output is not affected by real interest rate

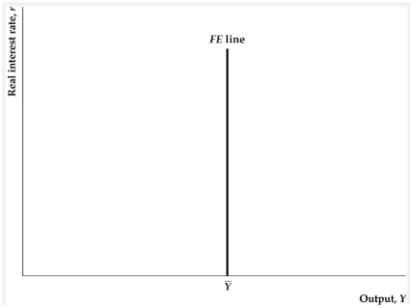


Figure 7 Graph of FE Line

IS Curve

IS Curve: Determined by the **Goods Market**

Condition from the Goods Market

$$I^d = S^d$$
$$Y = C^d + I^d + G$$

We note that r adjusts so that $I^d = S^d$ in the goods market. r is determined through the Goods Market

Definition:
- All combinations of output and real interest rate that clear the goods market
- For any given level of output, it shows the real interest rate necessary to equate $I^d = S^d$, and vice versa
- Downward sloping

Reason for Downward Sloping:

- For any level of output, the IS curve shows the level of interest rate required to clear the goods market. With an increase in output, a lower interest rate is required to clear the goods market

$\downarrow Y$
→ $0 < MPC < 1$
→ $\downarrow C^d < \downarrow Y$
→ $\downarrow S^d = Y - C^d - I^d$
→ $Leftward\ Shift\ of\ S^d$
→ $\uparrow r$ to clear the Goods Market
→ Due to the excess I^d
→ $\uparrow r$ causes an increase in S^d and a decrease in I^d
→ Brings the $S^d - I^d$ market back to equilibrium
→ Therefore, since with a decrease in the Y we have an increase In the r and therefore, we have a downward sloping IS curve

Shifts in LS Curve:

Note that the interest rate r adjusts to clear the goods market.

- When there are any changes in **$\downarrow S^d$ relative to I^d** (when we have Y being kept constant) will shift the IS curve upwards. Because when we have a decrease in S^d, we will need **higher interest rates** to clear the goods market and keeping Y constant, we will have an **upwards shift of the *IS* curve**
- We want to see what happens to the equilibrium interest rates when we have a change in S^d and I^d when we have the same level of output

Factors:

Expected Future Income
↑ Expected Future Income
→ $\uparrow C^d$
→ $\downarrow S^d$
→ $\uparrow r$ needed to clear the goods market
→ Upwards shift of IS curve since Y is kept constant (Note that Y here means current income, so if future income increases then Y is constant)

Wealth
↑ wealth
→ $\uparrow C^d$
→ $\downarrow S^d$
→ $\uparrow r$ needed to clear the goods market
→ Upwards shift of IS curve since Y is kept constant

Temporary ↑ G (Expansionary Fiscal Policy)
↑ G
→ Financed by ↑ current T or future T
→ ↓ current after-tax income / ↓ future after-tax income
→ $\downarrow C^d$
→ Consumption Smoothing Motive
→ $\downarrow C^d < \uparrow G$
→ $\downarrow S^d = Y - C^d - G$
→ $\uparrow r$ to clear loanable funds market
→ Upwards shift of IS curve since Y is kept constant

Taxes (If Ricardian Equivalence does not hold)
↑ T
→ ↓ Current after-tax income
→ $\downarrow C^d$
→ $\downarrow S^d$
→↑ r to clear the Goods Market
→ Upwards shift of IS curve since Y is kept constant

Marginal Product of Capital (MPK)
↑ MPK
→↑ Desired K
→ $\uparrow I^d$
→ $\downarrow r$ to clear the Goods Market
→ Downwards shift of IS since Y is kept constant

Effective Tax Rate (τ):
↓ τ
→ $\downarrow uc$
→ ↑ Desired K
→ $\uparrow I^d$
→ $\downarrow r$ to clear the Goods Market
→ Downwards shift of IS since Y is kept constant

LM Curve

LM Curve: Determined by the **Asset Market**

Condition for the Asset Market:

$$\frac{M^s}{P} = \frac{M^d}{P}$$
$$\frac{M^s}{P} = L(Y, i)$$

Note that in the short run, r is determined conjointly by the Asset Market and the Goods Market
In the long run, only P is determined by the Asset Market, r is determined solely by the Goods Market

Definition:

- All combinations of output and real interest rate that clear the asset market
- For any given level of output, it shows the real interest rate necessary to equate real money demand and real money supply
- Upward Sloping

Reason for Upward Sloping:

- For any given level of output, the LM curve shows the interest rate required to clear the Asset Market. When output Y increases, we need to increase r to clear the Asset Market

$\uparrow Y$
$\rightarrow\uparrow$ transactions
$\rightarrow \uparrow M^d/P$ for any r
$\rightarrow L(Y,r)$ shifts to the right with the new output level
$\rightarrow$ Excess demand in money since there is no change in nominal money supply and prices are fixed in the short run, so we have fixed real money supply
$\rightarrow \uparrow r$ to clear the Asset Market
$\rightarrow$ Therefore, with an increase in the output, we have a higher r required to the clear the Asset Market and therefore, we have an upward sloping LM curve

Extra note on the restoration of equilibrium for the Asset Market:
For instance, when we have an excess in demand of money at the current interest rate due to a rightward shift of the Money Demand curve

When there is excess demand in the Asset Market (right after a shift, at the current level of interest rate)
$\rightarrow$ People will sell more nonmonetary assets in exchange for money (Since we have excess demand, it means that they want to change non monetary to monetary assets)
$\rightarrow \downarrow P$ of non monetary assets (Prices of bonds)
$\rightarrow \uparrow r$ (Because with an decrease in the prices of bonds, there will be an increase in the return to bonds which is also the real interest rate)
$\rightarrow$ Non monetary assets looks more attractive (relative to monetary assets now)
$\rightarrow \downarrow M^d/P$ (Reduce in demand of monetary assets since non-monetary assets)

Shifts in the LM Curve:

Note that the interest rate r adjusts to clear the Asset Market in the short run

- When there are any changes that $\uparrow M^s/P$ **relative to** $\frac{M^d}{P} = L(Y,i)$ (when we have Y being kept constant) will shift **the LM curve downwards**. For any given level of Y, when we have **an increase in real money supply**, there will be an excess of money supply and we need to **lower r** to clear the Asset Market
- We want to see what happens to the equilibrium interest rates when we have a change in real money supply and real money demand when we have the same level of output

Factors:

Nominal Money Supply (M^s)
$\downarrow M^s$
$\rightarrow \downarrow M^s/P$ (Since we are assuming prices are rigid in the short run)
$\rightarrow$ Excess money supply in the asset market
$\rightarrow \downarrow r$ to clear the asset market
$\rightarrow$ Downward shift of the LM curve

General Price Level (P)
$\uparrow P$
$\rightarrow \downarrow M^s/P$ (This is assuming that the nominal money supply is kept constant)
$\rightarrow$ Excess money supply in the asset market
$\rightarrow \downarrow r$ to clear the asset market
$\rightarrow$ Downward shift of the LM curve

Expected Inflation Rate (π^e)
$\downarrow \pi^e$
$\rightarrow$ Since $i \approx r + \pi^e$ (Due to the fisher relation)
$\rightarrow \downarrow i$
$\rightarrow$ Lower opportunity cost of holding money
$\rightarrow \uparrow M^d/S$
$\rightarrow$ Excess money demand in the asset market
$\rightarrow\uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM Curve

Interest rate on money (i)
Note that this is the interest rate for holding money (note that this is not the non monetary asset i that we normally have)
$\uparrow i$ on money
$\rightarrow$ Holding onto money will provide better returns
$\rightarrow \uparrow M^d/P$
$\rightarrow$ Excess money demand in the asset market
$\rightarrow\uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM Curve

Wealth (ω_0)
$\uparrow \omega_0$
$\rightarrow \uparrow$ Consumption and More Transactions (Similar to increase in income)
$\rightarrow \uparrow M^d/P$ (Demand for money increases)
$\rightarrow$ Excess money demand in the asset market
$\rightarrow \uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM curve

Risk of alternative assets
$\uparrow$ risk of alternative assets
$\rightarrow \downarrow$ demand for non-monetary assets
$\rightarrow \uparrow$ P of non monetary assets
$\rightarrow \downarrow$r
$\rightarrow$ Non monetary assets looks less attractive (relative to monetary assets)
$\rightarrow \uparrow M^d/P$
$\rightarrow$ Excess demand in the asset market
$\rightarrow\uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM Curve

Liquidity of Alternative Assets
$\downarrow$ Liquidity of alternative assets
$\rightarrow \downarrow$ demand for non-monetary assets
$\rightarrow \uparrow$ P of non monetary assets
$\rightarrow \downarrow$r
$\rightarrow$ Non monetary assets looks less attractive (relative to monetary assets)
$\rightarrow \uparrow M^d/P$
$\rightarrow$ Excess demand in the asset market
$\rightarrow\uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM Curve

Efficiency of Payment Technologies
$\downarrow$ Efficiency of Payment Technologies
$\rightarrow \downarrow$ demand for non-monetary assets
$\rightarrow \uparrow$ P of non monetary assets
$\rightarrow \downarrow$r
$\rightarrow$ Non monetary assets looks less attractive (relative to monetary assets)
$\rightarrow \uparrow M^d/P$
$\rightarrow$ Excess demand in the asset market
$\rightarrow\uparrow r$ to clear the asset market
$\rightarrow$ Upward shift of the LM Curve

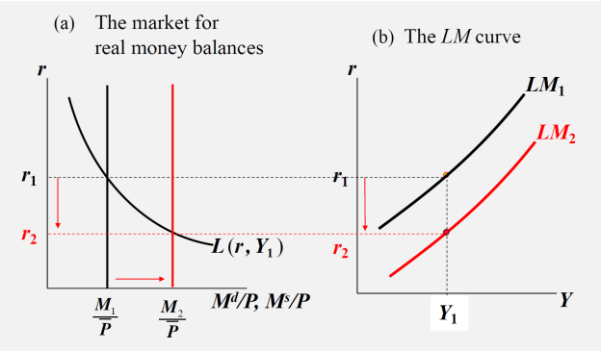
Monetary Policy Analysis

Implementation:
Central bank decides how much money to supply (M^s) through open market operations

Affects the market through the changes in M^s

- We note that the M^s affects the market through the asset market (money market)

Graphically:



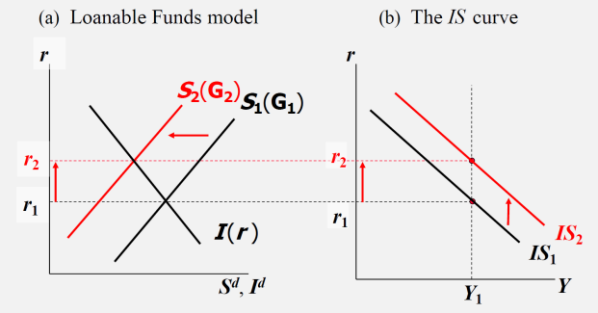
↑ M^s
→ Note that this is assuming that P does not adjust
→ ↑ M^s/P
→ Excess money supply
→ ↑ r to clear the asset market
→ Upwards shift of the LM curve (at the given level of Y)

Fiscal Policy Analysis

Implementation:
Government decides about the level of spending G and taxation

Affects the market through:
G, C^d and therefore, consequently S^d which then affects the goods market (IS curve)

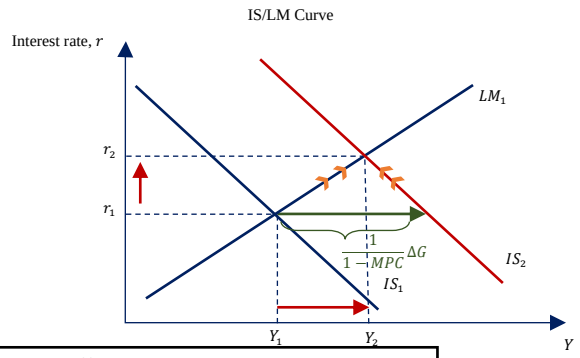
Graphically



↑ G
→ Financed by ↑ current T or future T
→ ↓ current after-tax income / ↓ future after-tax income
→ ↓ C^d
→ Consumption Smoothing Motive
→ ↓ $C^d <$ ↑ G
→ ↓ $S^d = Y - C^d - G$
→ ↑ r to clear loanable funds market
→ Upwards shift of IS curve since Y is kept constant

Note that this part accounts for ΔY initially caused by the increase in G already since we already analysed that ↓ $C^d <$ ↓ G so we have that there will be an increase in Y and that will be the start that leads to the multiplier effect

Multiplier Effect and Crowding Out Effect



Multiplier Effect is caused by the initial increase in G
→ ΔG
→ ↑ Y due to ↑ G
→ ↑ C by MPC
→ Further increase in Y due to increase in C
→ Further increase in C by MPC
⋮

The overall multiplier effect is a geometric series and summing them all we will have the following overall increase in Y:

$$\Delta Y = \left(\frac{1}{1 - MPC}\right)\Delta G$$

Sequence of Events:

1. IS curve shifts to the right due to the initially increase in Y as per the multiplier effect. We note that with an increase in Y, there will an increase in money demand, and this will cause a movement along the LM curve
2. Due to the increase in money demand, there is excess money demand in the asset market and ↑r is need to clear the asset market and we will therefore have an increase in r
3. However, due to an increase in r, there will be an increase in r, there will be higher opp cost for consumption (SE dominates) and higher user cost of capital, therefore, ↓ S^d & I^d
4. Therefore, there will be an upward movement along the LM and IS curve to reach the new equilibrium at r_2 and Y_2. Note that the final increase in Y is lesser than the increase caused by the multiplier effect due to the crowding out effect.

Temporary Adverse Supply Shock

Supply Shocks affects A which is the total factor productivity, but it causes a chain effect

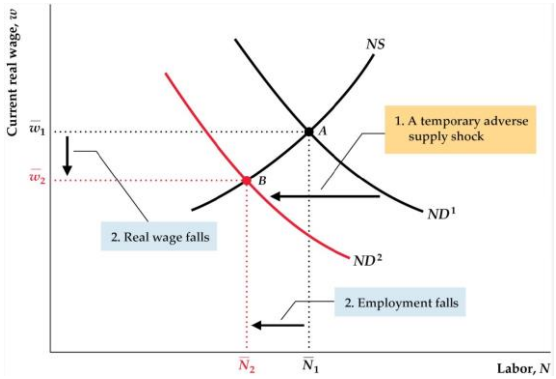


Figure 8 Analysis on the Labour Market

Analysis from the Labour Market

$\downarrow A$
$\rightarrow \downarrow MPN$ for any N
$\rightarrow ND$ shifts down (Since labour demand, $ND := MPN = W/P$)
$\rightarrow \downarrow \frac{W}{P}$ and $\downarrow \bar{N}$

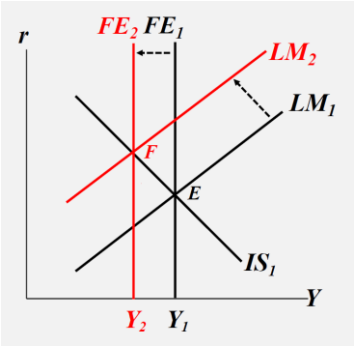


Figure 9 Analysis on the IS-LM-FE

Analysis from the IS-LM-FE

After going through the labour market:
$\downarrow A$ & $\downarrow \bar{N}$
$\rightarrow \downarrow \bar{Y}$
→ Leftward shift of the FE line since the full employment output decreased
→ IS & LM will intersect on the right of the FE line *(Note that the intersection of the IS and LM curve determines the AD and FE determines the AS)*
→ Since there is excess demand of goods in the market
$\rightarrow \uparrow P$
$\rightarrow \downarrow M^S/P$
→ Excess demand for money
$\rightarrow \uparrow r$ to clear the asset market
→ LM curve shifts to the left and upwards
→ New equilibrium is reached

Aggregate Demand (AD)

Definition: Shows the set of equilibrium points that arise in the IS-LM model as we change the price level and see what happens to the output

Relationship:
- Quantity of goods demanded (Y)
- General Price Level (P)

Note that the AD shows: Combinations of P and Y where IS and LM intersect

Downward Sloping

$\downarrow P$
$\rightarrow \uparrow M^S/P$
→ LM curve shifts downwards since for every level of output, we need a lower interest rate to clear the asset market
$\rightarrow \downarrow r$ to clear the asset market
$\rightarrow \uparrow C^d$ & $\downarrow I^d$ (Due to the decrease in r)
$\rightarrow \uparrow Y = C^d + I^d$

Therefore, we see that as P is decreasing, Y is increasing, therefore, the AD curve is downwards sloping

Shifts in *AD* curve:

Note that the AD shifts to the point of the intersection between the IS and LM. Therefore, if IS and LM intersects on the left now, the AD curve shifts to the left as well

Note that with any shifts in the IS or the LM curve, the intersection of them will be different and the factors that describes it is the same as per what we have to describe the shifts in the IS and LM curves

Aggregate Supply (AS)

Definition: Shows the relationship between the general price level and the aggregate amount of output that firms supply

Relationship:
- Quantity of goods supplied (Y)
- General Price Level (P)

Short Run AS Curve (SRAS)

Horizontal line
- Assuming that prices remain fixed in the short run and firms supply the quantity of output demanded at this fixed price level

Models applicable
- Keynesian Model (Because of the assuming that prices are fixed in the short run)

Note that there is no SRAS for the Classical model because they believe in price flexibility and therefore, firms will not want to supply at the fixed price level

Long Run AS Curve (LRAS)

Vertical Line at the full employment output (Determined by the FE line)
- In the long run, firms maximize profits and therefore will want to produce at the full employment output since the full employment output maximises profits
- Note that the full employment output is not affected by price and prices are completely flexible in the long run

Models applicable
- Classical Model
- Keynesian Model

Note that both the Classical and Keynesian Models agree that in the long run, prices will be flexible, they only disagree on the point that prices are flexible in the short run

Shifts in the AS Curve:

Note that the LRAS is given by the full employment output so if there are any shifts in the FE line, it will shift the LRAS as well.

- Changes in labour force
- Changes in total factor of productivity

General Equilibrium:

Consider the various school of thoughts:

If Keynesian, we will have a short run equilibrium and long-run equilibrium

If Classical, it will always be long run equilibrium and the short run will be irrelevant

Policy Analysis:
Expansionary Monetary Policy

Assumption: This is a Keynesian Model analysis. For the classical model, it will just be a straight shift upwards. When the economy is not in general equilibrium, the goods and asset market are in equilibrium since they adjust faster than the labour market. Firms will be willing (at least temporarily to produce extra output to meet the expanded demand in the short run)

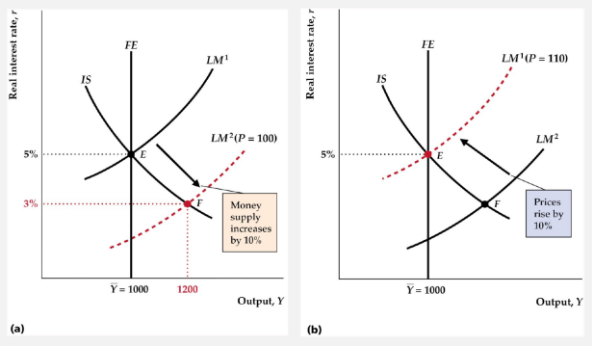


Figure 10 IS-LM-FE Analysis

IS-LM-FE Analysis:

(Short Run as seen in part (a) of the graph)
↑ M^s (Due to the expansionary monetary policy)
→ ↑ M^s/P
→ Downward shift of the LM curve since we need a lower interest rate to clear the asset market
→ People try to get rid of excess money balances by buying more assets (Increase in price of non monetary assets due to increase demand and causes a decrease in r due to lower returns to investment)
→ ↓ r to clear the asset market
→ ↑ C^d & I^d (Due to the decrease in r)
→ ↑ Y temporarily
→ New intersection point of IS and LM will be at F due to the changes in r resulting in the changes in the C^d, I^d, M^d
→ Note that since prices are rigid, prices do not adjust to clear the excess demand in the economy (*Note that since IS-LM intersects on the right of FE, we have excess demand of goods in the economy)*

(Long Run as seen in part (b) of the graph)
In the long run, **prices are flexible**:
↑ P (To clear the excess demand in the economy)
→ ↓ M^s/P
→ Upward shift of the LM curve since for any given level of output we need a higher level of interest rate to clear the asset market
→ ↑ r to clear the goods market
→ Intersection point between $IS - LM$ goes back to the original point

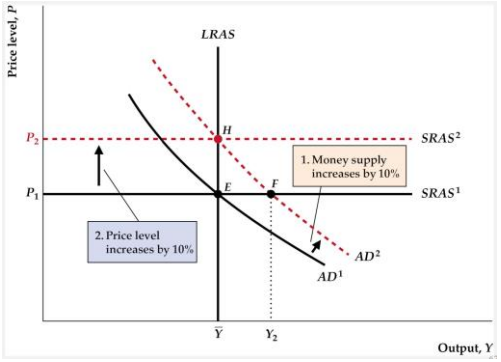


Figure 11 AD-AS Analysis

AD-AS Analysis:

(Short-Run)
↑ M^s initially (due to expansionary monetary policy)
→ ↑ AD vertically by the same amount because to keep the aggregate demand at the same point, we need to increase P at the same proportion as M^s so that the real money supply is the same. Therefore, the intersection of IS and LM will still be at the same point.
→ SRAS does not change in the short run and it intersects the AD_2 at the point F and that is the short run equilibrium since prices are rigid (under Keynesian model)
→ Therefore, we have excess demand in the short run

(Long-Run)
In the long run, **prices are flexible**:
↑ P by the same amount as the increase in money supply to clear the excess demand
→ This brings the equilibrium point up to H since we have a higher equilibrium price but we go back to the full employment output
→ Price levels will increase but we note that the output remains the same in the long run

Money is neutral in the long run

Money Neutrality:

Definition: Money is neutral if a change in the nominal money supply changes the price level proportionately but has no effect on real variables

- Note that the money neutrality analysis should only be used on monetary policy and shouldn't be used on fiscal policy

Comparison Between the Various Models

Note that this is a combination of Topics 6, 7, 8 since I want to compare between the various models and how they work over various situations and how differently

Models:

1. Classical
2. New Classical (Real Business Cycle (RBC) Theory)
3. Keynesian
4. Expectations Augmented-Philips Curve

Classical Model:

Characteristics:

Prices and wages adjust quickly
- Price flexibility

Economy is self-correcting
- Any government intervention not needed, they are busybodies

Money is neutral in the short run
- When we have a monetary policy, the prices adjust quickly and there are no real effects (So there is no point in doing it)
- This also leads to only the long-run equilibrium existing

Classical Dichotomy:
- The theoretical separation of real and nominal variables in the classical model (Implies nominal variables do not affect real variables)

Only long-run equilibrium exists:
- Since prices adjusts instantaneously, there won't be any short run equilibrium which is caused by price rigidity

Business Cycles:
- Economy's best response to disturbances since it is self-correcting, and it will adjust back to equilibrium by itself

New Classical:

Characteristics:
Same assumptions as per the Classical Model, just that we consider additionally what happens when in the short run, money is not neutral

Main Sources of Business Cycles:
- Productivity shocks are the main sources of cycles
- Recession caused by insufficient supply
- Look at the adverse supply shocks, due to a shift in the FE, it causes insufficient supply

New Classical Misperception Theory:
- Due to misperception, it causes consumers/ firms to misinterpret market signals and causes an imperfect shift of the AD or AS such that there are real effects when there are changes in nominal money supply. (This shows that money is not neutral)
- Note that for this case, we will consider SRAS to be upward sloping due to the nature of the misperception. Note that SRAS is considered since we are trying to explain real effects of nominal money supply changes in the short run
- Note that in the long run, prices will adjust perfectly as well and we will get back to the full employment output

Keynesian Model:

Characteristics:

Prices and wages adjust slowly
- Prices are rigid in the short run

Economy may be out of equilibrium for a long time
- Because equilibrium is achieved after a long time and therefore, government intervention is justified to lift the economy

When the economy is out of equilibrium (Since it does not adjust immediately), output is determined by *AD* rather than FE which is at the intersection between IS & LM
- Note that in the long run, firms will still want to produce at the FE output since it is profit maximizing. However, in the short run, firms will be willing to supply at the fixed prices

Long-run equilibrium can be achieved
- After a long time, prices will be flexible, and prices will adjust such that the excess demand or excess supply is eliminated.

Business Cycles:
- Disequilibrium situations due to the slow adjustment of the economy

Main Sources of Business Cycles:
- AD shocks are the main sources of cycles
- Recession caused by insufficient demand

Price Stickiness:

Menu Costs
- Firms will change their prices if profit loss from sticky prices > menu costs
- Menu costs are costs associated with changing prices

Near Rationality
- When there is a small monetary shock, if prices don't change, then there will be a loss in possible profits. But since people start at the profit maximising output and if people are near rational, they may not want to change it since there is very little loss in profit
- More on like behavioural analysis

Coordination Failure

Efficiency Wage
- When we have an efficiency wage, it will be higher than the market clearing wage since firms will be earning higher profits due to the extra effort given by workers. Therefore, wages will be sticky, and firms will not want to change the prices
- Due to this higher wage, there will be excess labour supply in the economy as well

Staggering of Wages and Prices

Expectations Augmented Philips Curve

Builds on the Misperception Theory

Relationship between inflation and unemployment:
- Suppose that expected inflation, π^e and natural rate of unemployment are constant, then we have a negative relationship between inflation and unemployment
- Else, we have a negative relationship between unanticipated inflation and cyclical unemployment

$$\underbrace{\pi - \pi^e}_{\text{Unanticipated inflation}} = -h\underbrace{(u - \bar{u})}_{\text{Cyclical unemployment}}$$