Chapter 9

- Bond prices and interest rates
- Money demand (L)
- Money market equilibrium
- Connecting the money market to the goods market (Transmission Mechanism)
    - The effect of interest rates on consumption
    - The effect of interest rates on investment
    - The effect of interest rates on exports and imports
    - … and finally the effect of interest rates on AE and AD

- *Bond prices and interest rates*

Example:

Suppose you got a perpetual bond with a face value of $1000 that pays 5% interest.

$$0.05 * 1000 = \$50 \; per \; month$$

Assume that the market interest rate goes up to 10%. Could you sell your bond at $1000 given that your bond pays $50 (or 5% on $1000 face value)?

- Nobody would buy your bond at $1000. You have to decrease the price to a level that can compete with bonds that currently pay 10%.
- What would the price of your bond be?

*Bond price * 10% = $50 → Bond price = $500*

- Notice that when interest rate went up from 5% to 10%, the bond value decreased from $1000 to $500.
- There is a negative relationship between bond prices and interest rates.

Mathematically:

Future value (*FV*) and present value (*PV*) of an investment:

Suppose you invest \$1000 that pays *i = 2%* interest every year. What is the future value of your money after a year (FV_1)?

$FV_1 = PV * (1 + i) = 1000\ (1 + 0.02) = 1020$

PV: present value of your investment, bond, share, etc. that is \$1000 here.

Suppose you decide to keep all the money in the investment for another year. What is the value of your money after at the end of the second year (FV_2)?

$FV_2 = FV_1 * (1 + i) = 1020\ (1 + 0.02) = 1040.4$

Or, substitute $FV_1 = PV * (1 + i)$ in FV_2 equation:

$FV_2 = FV_1 * (1 + i) = PV * (1 + i) * (1 + i) = PV * (1 + i)^{\ 2}$

Similarly, we can calculate FV_3

$FV_3 = PV * (1 + i)^{\ 3}$

By rearranging the formula, we can calculate present value:

$FV_1 = PV * (1 + i) \quad \rightarrow \quad PV = \frac{FV_1}{(1+i)}$
$FV_2 = PV * (1 + i)^{\ 2} \rightarrow \quad PV = \frac{FV_2}{(1+i)^2}$
$FV_3 = PV * (1 + i)^{\ 3} \rightarrow \quad PV = \frac{FV_3}{(1+i)^3}$
$FV_t = PV * (1 + i)^{\ t} \rightarrow \quad PV = \frac{FV_t}{(1+i)^t}$

- A *bond* is a promise to pay. It is a *sequence* of payments in the future.
- *The bond price (bond value)* is the present value of future payments discounted at the market interest rate.

$$Bond\ price = PV = \frac{coupon}{(1+i)} + \frac{coupon}{(1+i)^2} + \frac{coupon}{(1+i)^3} + \cdots + \frac{coupon}{(1+i)^t}$$

Notice that as the interest rate (i) goes up, the bond price decreases.

❖ *Money Demand (L)*

- Demand for money means the demand for *holding* money.

A financial portfolio is a basket of financial assets.
Assumption: our portfolio includes two items:
- Money: a medium of exchange, no return/interest rate income
- Bonds: not used as a medium exchange, offers return

Why do we hold money? Three reasons.

- *Transaction motive*: Funds for expenses and covering the time lag between receiving income and spending.

- Demand for transactions is a function of income, such that:

- *Money demand for transaction = K*Y K > 0*

- *Precautionary motive*: Funds to cover unexpected costs.

- This is also a function of income, such that as income increases, money demand for precautionary reasons also increases (same as the transaction motive).

- *Speculation/asset motive*: Funds to buy bonds.

- This type is affected by the interest rate.

- At higher interest rates (ie, low bond prices), people prefer to keep more bonds and less cash → money demand decreases.
  At lower interest rates (ie, high bond prices), people prefer to keep less bonds and more cash → money demand increases.

- Money demand for speculation is inversely related to the interest rate.

  Money demand for speculation = -hi

(h is a coefficient measuring the sensitivity of money demand to changes in interest rates)

Money demand (L):

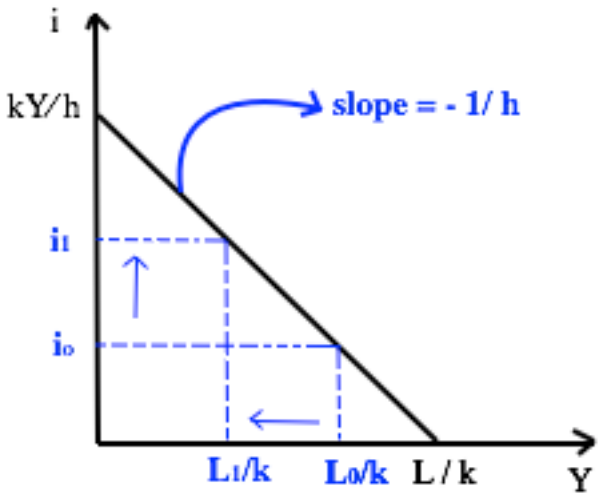
$L = KY - hi$

$\frac{\Delta L}{\Delta Y} > 0$

$\frac{\Delta L}{\Delta i} < 0$

Rearranging the money demand equation:

$i = {}^{KY}/_{h} - {}^{L}/_{h}$



- i increases → L increases along the L line. (move upward along the L)
- Y increases → L shifts to the right

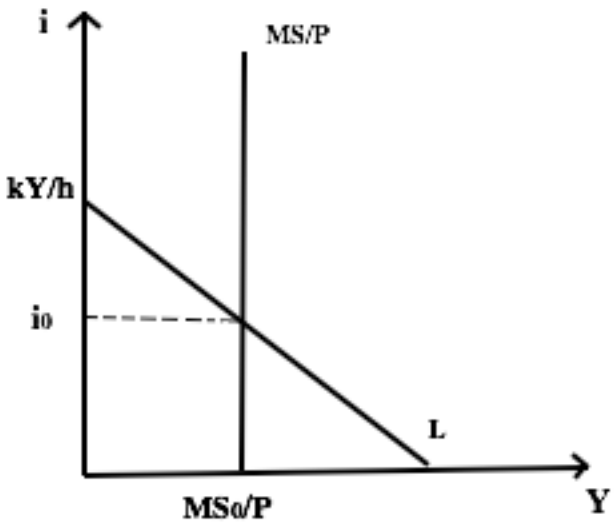
h increases → the absolute value of the slope decreases |-1/h|→ L is flatter

❖ *Money market equilibrium*

The money market, like all other markets, has two sides:

- Real money supply ($\frac{MS}{P}$)
- Money demand ($L = KY - hi$)
- Money market equilibrium: $MS = L$

Graph:



- Money market equilibrium → equilibrium interest rate
- MS/P = L (real money supply = real money demand)
- Graphically, i_0 is the equilibrium interest rate.
- If $i > i_0$ → MS/P > L → push the interest rate down until $i = i_0$
- If $i < i_0$ → MS/P < L → push the interest rate up until $i = i_0$
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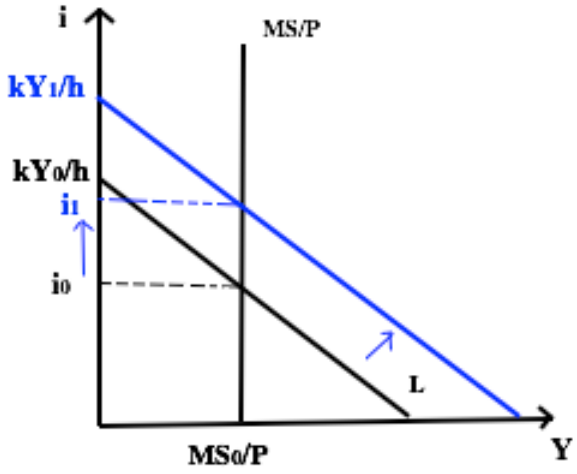
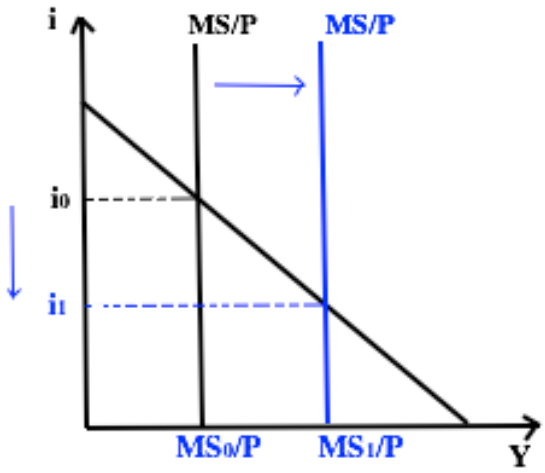
Show the effect of an increase in income (Y):



- Y increases → demand for money increases → L shifts to the right → interest rate rises.

- Graphically, when Y increases, the intercept (kY/h) increases, the demand line shifts up.

Show the effect of an increase in MS:



Money supply increases → MS/P shifts to the right → pushes the interest rate down.

The central bank affects MS through MB by buying and selling bonds. (Discussed in chapter 10)

❖ *Connecting the money market to the goods market (Transmission Mechanism)*

The effect of the money market (interest rate and money supply) on the goods market components *(C + I + G + X - M)*:

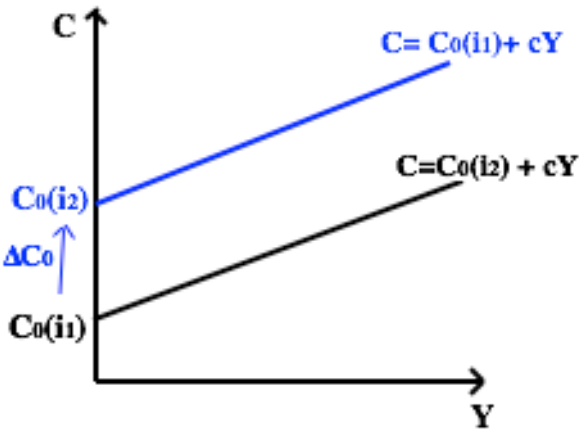
$$\Delta Interest\ rate\ and\ \Delta MS \rightarrow \left\{ \begin{array}{c} \text{Autonomous consumption } (\Delta C_0) \\ Investment\ (\Delta I) \\ Autonomous\ exports\ (\Delta X_0) \\ Autonomous\ imports\ (\Delta M_0) \end{array} \right\} \rightarrow \Delta AE_0 \rightarrow AD$$

- The effect of the interest rate on consumption
  The interest rate affects autonomous consumption (C_0) such that:

$$C = C_0 + cY$$
$$C = C(Y, i); \quad \frac{\Delta C}{\Delta Y} > 0, \qquad \frac{\Delta C}{\Delta i} < 0$$

The interest rate affects consumption expenditure in two ways:

- Through the value of wealth, such as bond value
- Through the cost of financing durable purchases such as loans, line of credits etc.



- The effect of the interest rate on investment expenditure

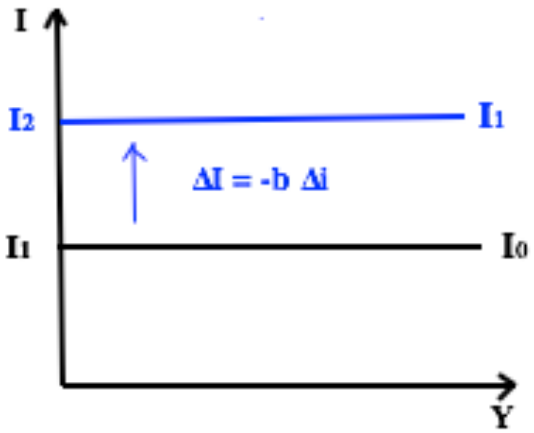
$$I = I_0 - bi; \quad \frac{\Delta I}{\Delta i} < 0$$

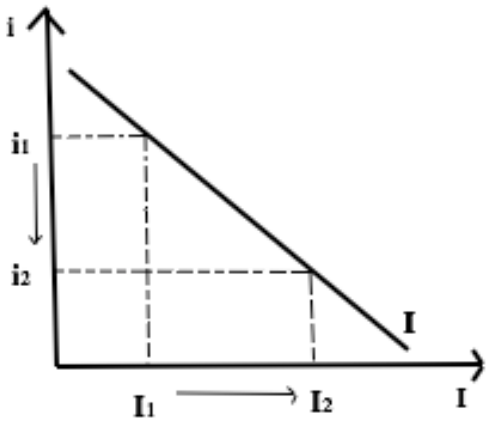
The interest rate affects investment in two ways:

- Cost of financing expansions in fixed capital or starting new projects.(building bigger factories, buying equipment etc)

- Cost of carrying inventories

Investment expenditure versus income (Y) Investment expenditure versus the interest rate:





If the interest rate (i) decreases → the cost of investment expenditure decreases → investment expenditure (I) increases (I shifts up)

- The effect of interest rates on exports and imports

This effect is through the exchange rate.

Suppose portfolio choices are:

- Money
- Domestic bonds pay $i_{domestic}$
- Foreign bonds pay $i_{foreign}$

Assume that domestic and foreign bonds are similar with the same risk and only the interest rates on them are different:

if $i_{domestic} > i_{foreign}$ → buy domestic bonds and sell foreign bonds → demand for domestic currency increases versus the foreign currency → the value of the domestic currency goes up or appreciates (That is, exchange rate falls).

if $i_{domestic} < i_{foreign}$ → sell domestic bonds and buy foreign bonds → demand for foreign currency increases versus the domestic currency → the value of the domestic currency goes down or depreciates (That is, exchange rate rises).

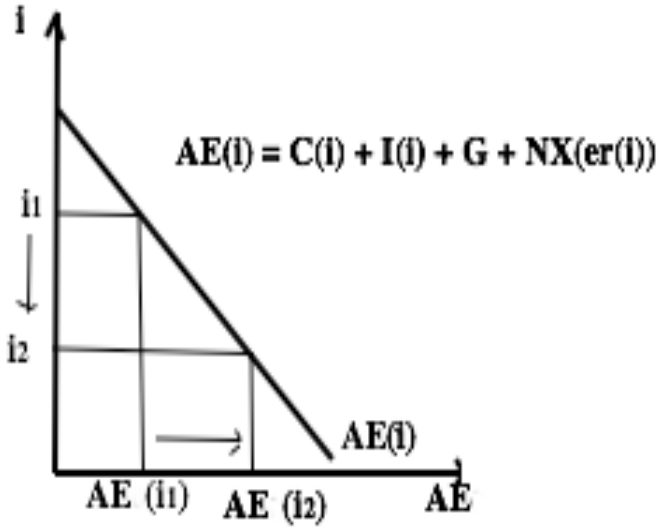
$$\downarrow i_{Domestic} \rightarrow domestic\ currency\ appreciates\ (exchange\ rate \uparrow) \rightarrow \uparrow X, \downarrow M \rightarrow \uparrow NX = X - M$$

$$\frac{\Delta NX}{\Delta i} < 0$$

- … and finally the effect of interest rates on aggregate expenditure (AE)

$$i\downarrow \rightarrow \left\{ \begin{matrix} C_o \\ I \\ X_0 \\ \\ M_0 \end{matrix} \right. \begin{matrix} \\ \\ \uparrow \\ \\ \downarrow \end{matrix} \left. \begin{matrix} \\ \\ \\ \\ \end{matrix} \right\} \rightarrow AE_0 \uparrow \rightarrow AE\ shifts\ up$$

Graph:

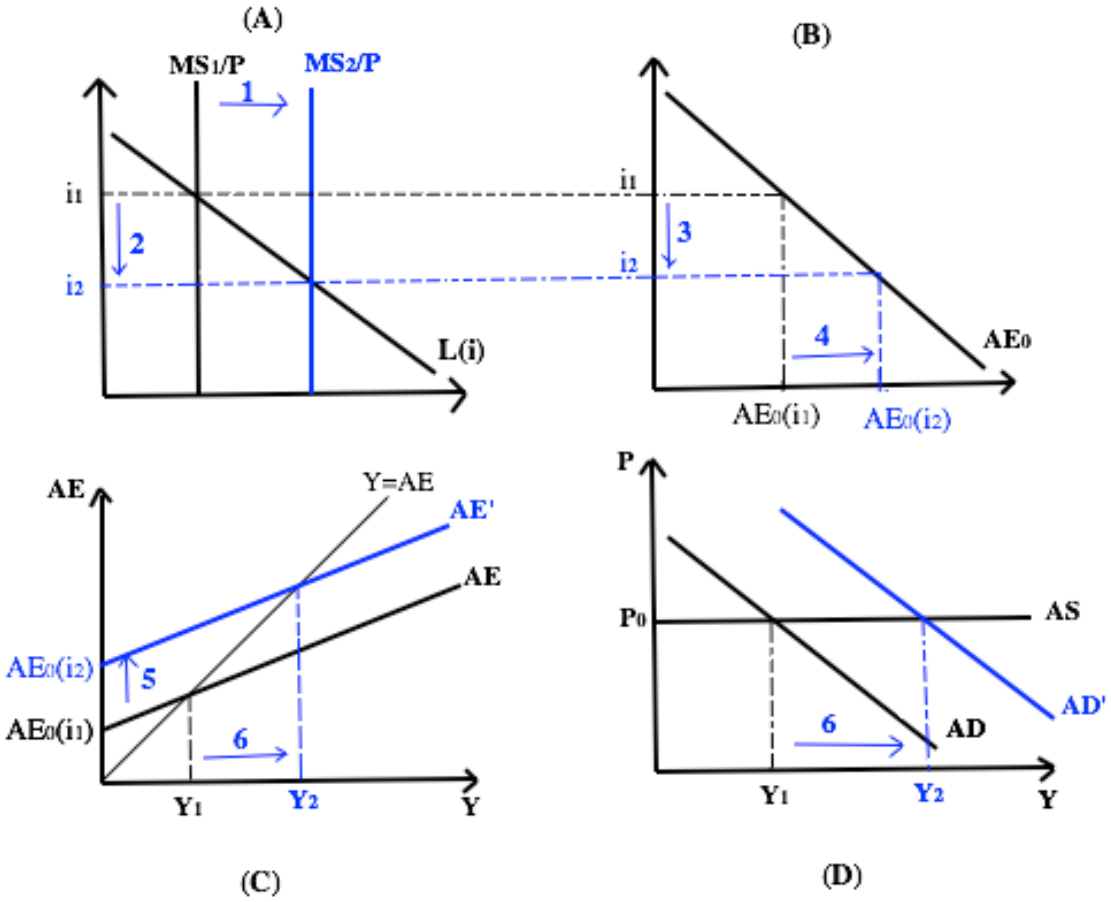


$$Slope\ of\ AE(i) = \frac{\Delta AE}{\Delta i} < 0$$

Summary of the transmission mechanism:

$$\uparrow MS \rightarrow \downarrow i \rightarrow \left\{ \begin{matrix} C_o \\ I \\ X_0 \\ M_0 \end{matrix} \right. \begin{matrix} \\ \\ \uparrow \\ \downarrow \end{matrix} \left. \begin{matrix} \\ \\ \\ \end{matrix} \right\} \rightarrow AE_0 \uparrow \rightarrow AE_0\ shifts\ up \rightarrow AD\ shifts\ to\ the\ right \rightarrow real\ GDP(Y) \uparrow$$

- The transmission mechanism on the four-panel diagram



1.Money supply (MS) increases → MS/P shifts to the right → 2. Interest rate falls → 3. Fall in interest rate affects AE_0 → 4. Autonomous aggregate expenditure (AE_0) increases (C_0, I, and NX_0 increase) → 5. AE shifts up → Output increases → 6. AD shifts to the right (Y increases)

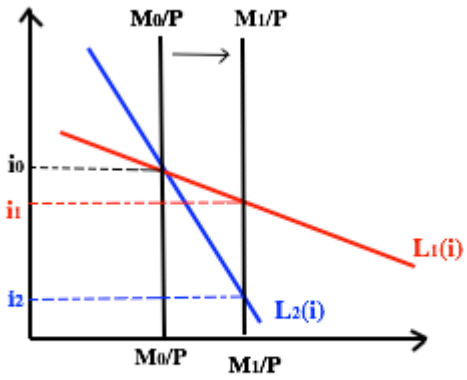
Conclusion: The central bank, by changing MS or the interest rate (i), can affect business cycles. (Monetary policy)

Expansionary monetary policy: ↑MS, ↓i → AD shifts to the right → ↑Y

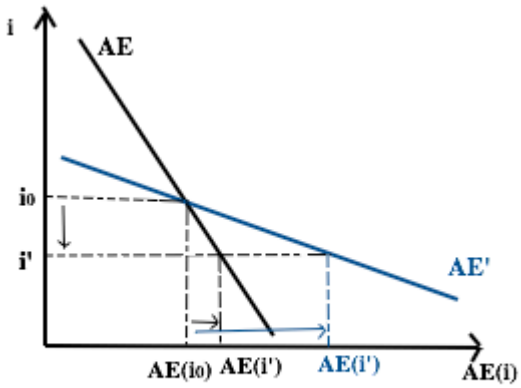
Contractionary monetary policy: ↓MS, ↑i → AD shifts to the left → ↓Y

How can the central bank physically change MS and/or interest rates? In chapter 10

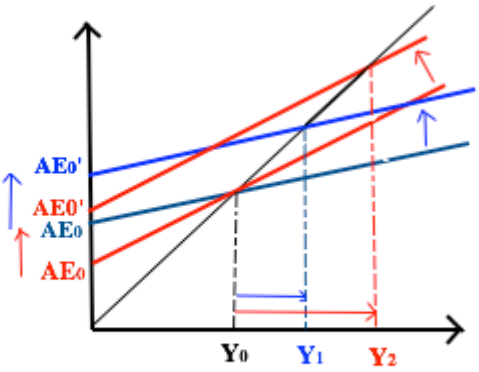
- Determinants of the strength of the transmission mechanism
    - Steeper money demand → (Diagram 1)
    - Flatter $AE_0(i)$ → (Diagram 2)
    - Steeper AE (bigger multiplier effect) → (Diagram 3)



1. Money Market



2. Interest rate and aggregate expenditure



3. Income and aggregate expenditure