



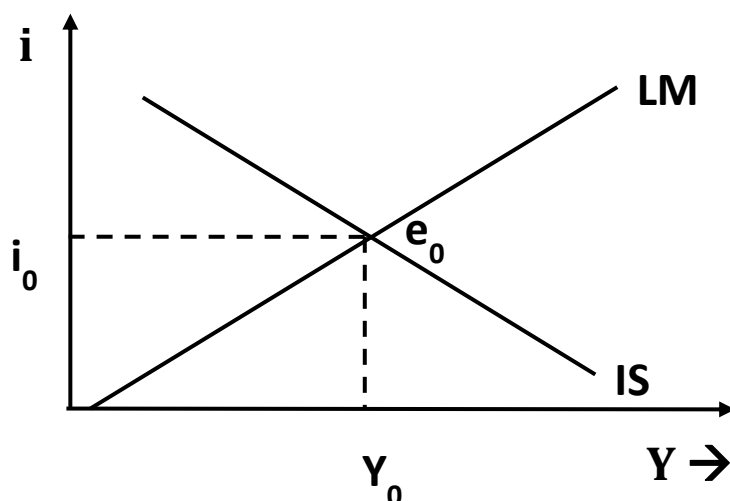
## Simultaneous Determination of Income and Interest and Corresponding Changes in Interest and Income: An IS-LM Analysis

### Structure of Class:

1. Simultaneous Determination of Income and Interest
  - Graphical Representation of IS-LM Interaction
  - Mathematical Derivation
2. Changes in Income and Interest
  - Fiscal Policy Expansion: Shift of IS Curve
  - Monetary Policy Expansion: Shift of LM Curve (Next Class)

### 1. Simultaneous Determination of Income and Interest Determination

#### Graphical Representation:



#### Mathematical Derivation:

$$y = \alpha_g (\bar{A} - b i) \quad \text{----- Equation of IS curve} \quad \text{- Eqn 1}$$

$$i = \frac{1}{h} (ky - \frac{M}{P}) \quad \text{----- Equation of LM curve} \quad \text{- Eqn 2}$$

Inserting Eqn 2 in Eqn 1 we get

$$y = \alpha_g [\bar{A} - \frac{b}{h} (ky - \frac{M}{P})]$$

$$y = [\alpha_g \bar{A}] - [\alpha_g \frac{b}{h} k]y + [\alpha_g \frac{b}{h} \frac{M}{P}]$$

$$y + [\alpha_g \frac{b}{h} k]y = [\alpha_g \bar{A}] + [\alpha_g \frac{b}{h} \frac{M}{P}]$$

$$y\{1 + [\alpha_g \frac{b}{h}k]\} = [\alpha_g \bar{A}] + [\alpha_g \frac{b}{h} \frac{M}{P}]$$

$$y = \underbrace{\left[ \frac{\alpha_g}{\{1 + [\alpha_g \frac{b}{h}k]\}} \right]}_{\gamma} \bar{A} + \underbrace{\left[ \frac{\alpha_g}{\{1 + [\alpha_g \frac{b}{h}k]\}} \right]}_{\gamma} \frac{b}{h} \frac{M}{P}$$

Let  $\left[ \frac{\alpha_g}{\{1 + [\alpha_g \frac{b}{h}k]\}} \right] = \gamma$  (pronounced as gamma)

$$y = \gamma \bar{A} + \gamma \frac{b}{h} \frac{M}{P} \longrightarrow \text{Determination of Equilibrium Income in IS-LM}$$

Where:

$$\bar{A} = C_0 - cT + c\bar{T}\bar{R} + \bar{I} + \bar{G}$$

**Fiscal Policy Multiplier and Monetary Policy Multiplier in IS-LM Framework**

$$\frac{\Delta y}{\Delta G} = \left[ \frac{\alpha_g}{\{1 + [\alpha_g \frac{b}{h}k]\}} \right] \longrightarrow \text{Change in income due to change in any component of } \bar{A},$$

say G: **It represents Fiscal policy multiplier in IS-LM framework**

$$\frac{\Delta y}{\Delta \frac{M}{P}} = \gamma \frac{b}{h} \longrightarrow \text{Change in income due to change in Money Supply:}$$

**It represents Monetary Policy Multiplier in IS-LM framework**

### Fiscal Expansion: Fiscal Policy Multiplier (IS Shifts)

In expansionary Fiscal Policy the IS curve shifts to the right, while in the expansionary Monetary Policy the LM curve shifts to the right.

In IS-LM framework

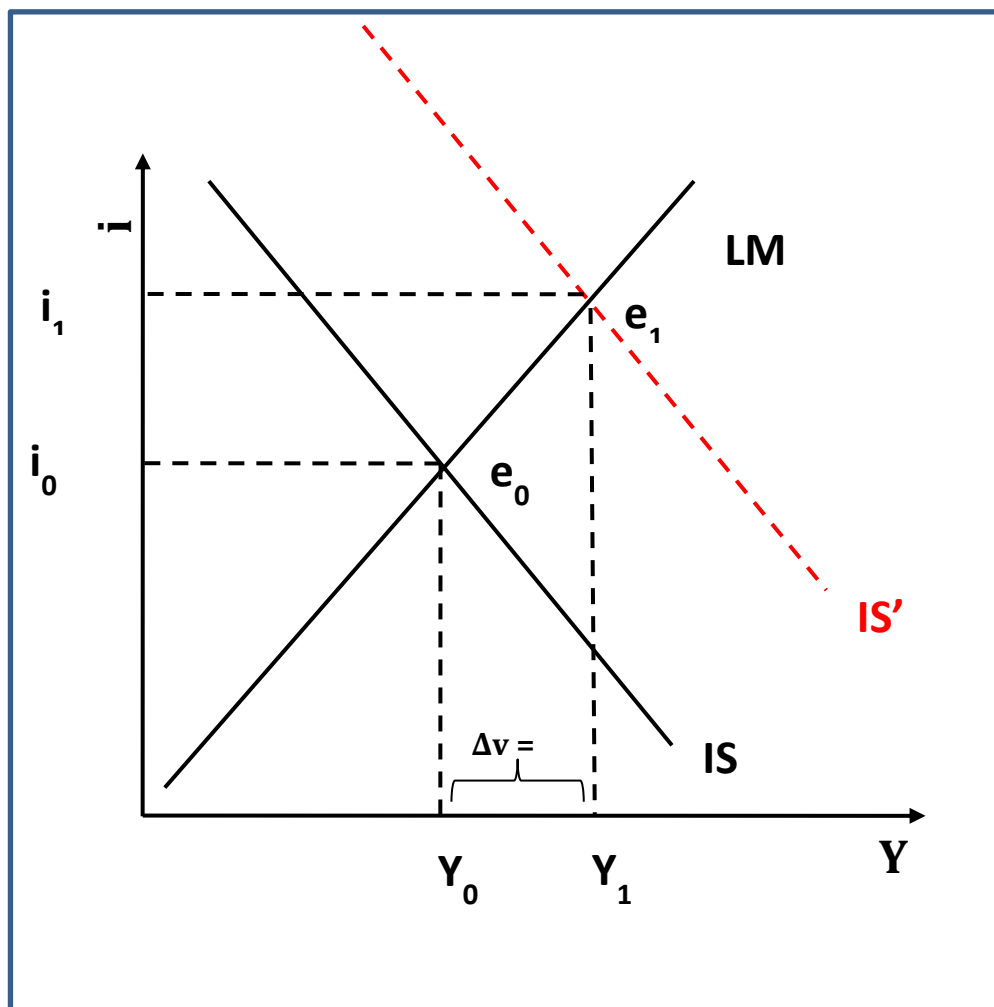
$$\frac{\Delta y}{\Delta \bar{A}} = \frac{\Delta y}{\Delta G} = \gamma$$

Thus,

$$\Delta y = \gamma \Delta G$$

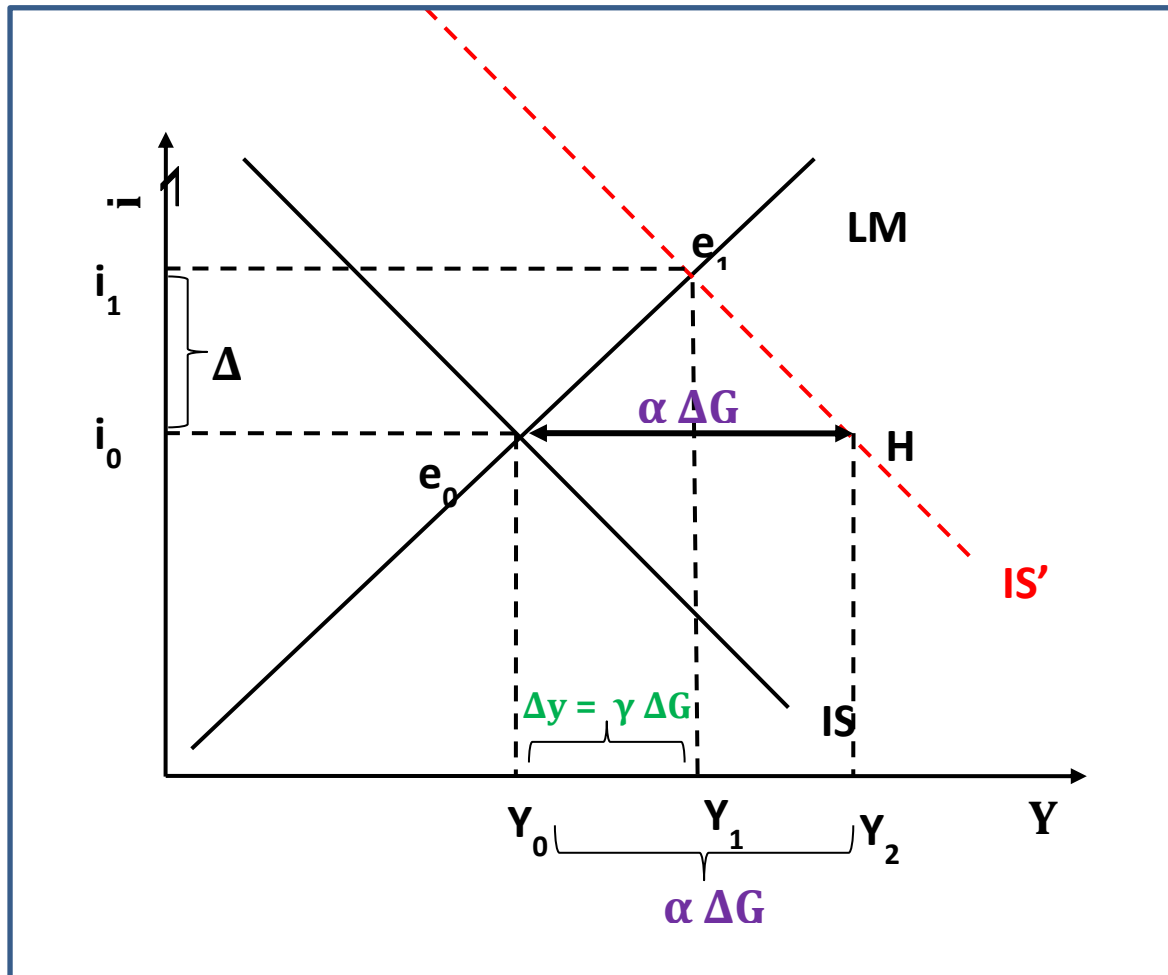
Hence, in Hicksian framework when ‘i’ and ‘Y’ are being determined simultaneously, the effect of Fiscal policy is reduced, as compared to the case when Income and Interest are determined independent of each other (As in the Keynesian Framework).

**Fiscal Policy Multiplier: Graphical Representation**



**Expansionary Fiscal Policy Multipliers: Mathematical Representation**

When Government expenditure changes by  $\Delta G$ , the IS curve shifts to the right by  $\alpha_g \Delta G$  (expansionary fiscal policy), while equilibrium income changes by  $\Delta Y = \gamma \Delta G$



Since  $\Delta G$  is the same, it implies that  $\alpha_g > \gamma$

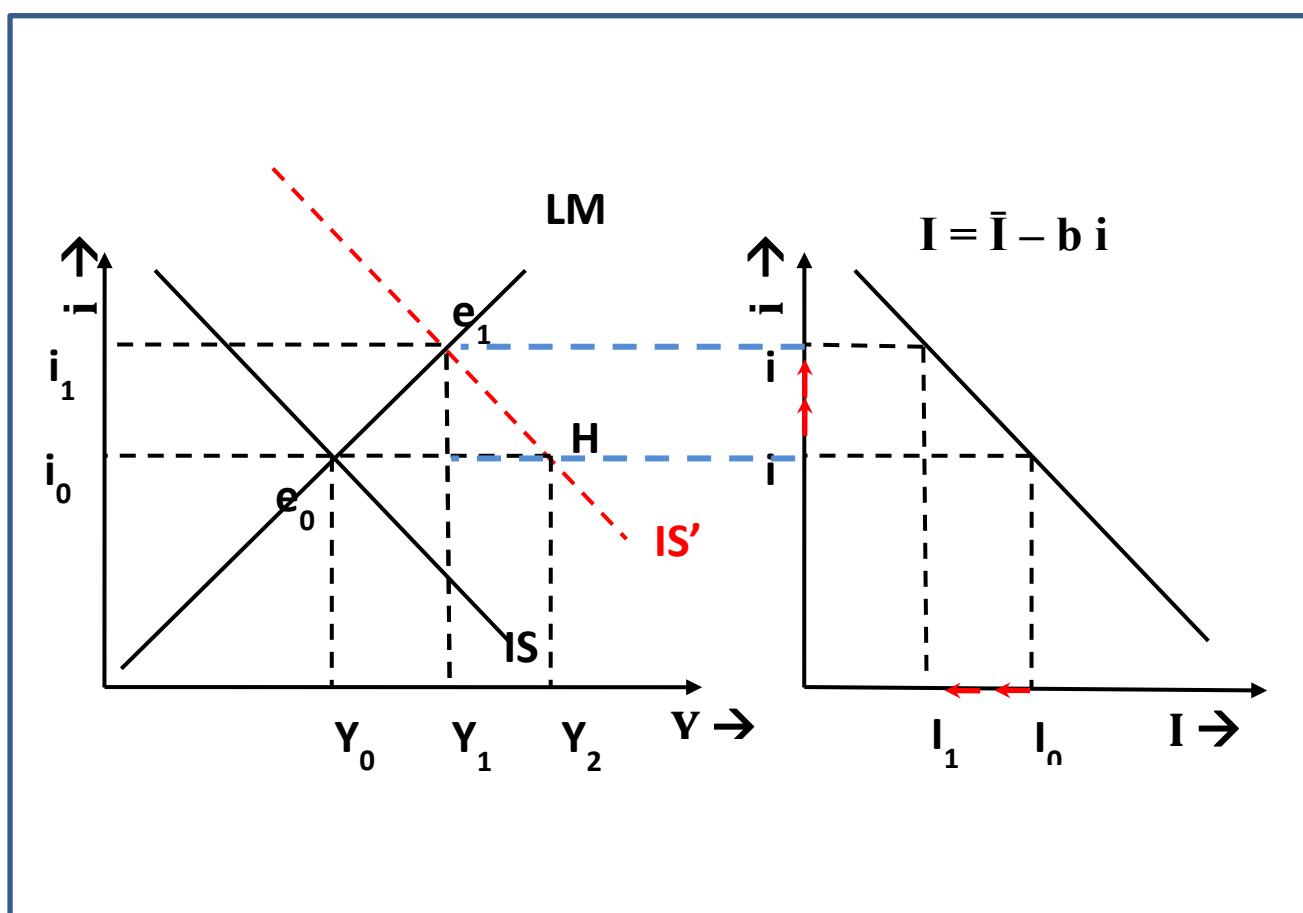
Thus, Fiscal Policy Multiplier in Keynesian framework ( $\alpha_g \Delta G$ ) is greater than Fiscal Policy Multiplier in Hicksian framework ( $\gamma \Delta G$ ).

### The Rationale: Crowding Out Effect

Why is  $\gamma\Delta G$  less than  $\alpha_g\Delta G$  ?

An expansionary Fiscal Policy leads to increase in rate of interest. This leads to decrease in investment by the private investors. Thus for every increase in Government Expenditure, say by USD 10 billion, interest rate goes up (say from 6% to 7%), thereby reducing Investments by the private Sector (say by USD 3 Billion).

Thus, the net impact of Government Expenditure Multiplier operates on USD 7 Billion and not USD 10 Billion. Hence, the net gain is not as much as it would have been in the Keynesian Model ( $\alpha_g\Delta G$ )



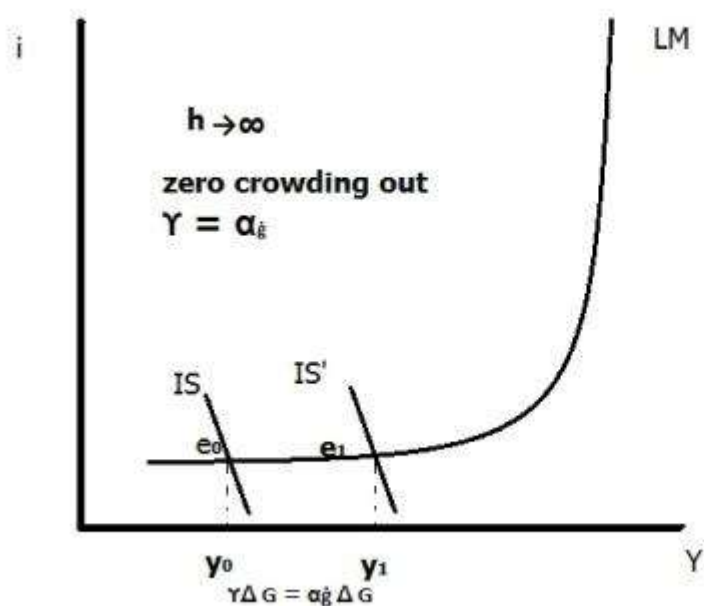
In Keynesian theory, the Goods Market and the Money Market are considered independent of each other. Therefore, Government Expenditure (USD 10Bn) would not have affected the interest rate in the Money Market. Interest would have remained constant. Resultantly, private Investment would have remained the same and not declined. Thus, the multiplier would have applied on the entire Government Expenditure (USD 10Bn), and not on the reduced final amount of USD 7 Bn as in the IS-LM Framework.

This withdrawal of investment by private investors, due to increase in the rate of interest, which takes place due to adoption of Expansionary Fiscal Policy by the Government, is referred to as **The Crowding Out Effect**.

**Expansionary Fiscal Policy in Extreme Regions**

Two Extreme Regions of the economy being considered are “Liquidity Trap” and “Classical Region”. It may be recalled that Liquidity Trap Region of Money Demand Curve becomes Keynesian region of the LM Curve (mirror images).

**Expansionary Fiscal Policy in Liquidity Trap (Keynesian Region)**



We know that under normal circumstances, when the government expenditure changes by  $\Delta G$ , the ‘IS’ curve shifts to the right by  $\alpha_g \Delta G$  and equilibrium income shifts by an amount  $\gamma \Delta G$ .

Wherein  $\gamma \Delta G$  is less than  $\alpha_g \Delta G$ .

However, if the economy is in liquidity trap region, the LM curve will be horizontal and as depicted above. The magnitude of displacement of “IS” curve to right to IS’ ( $\alpha_g \Delta G$ ) will be equal to magnitude of increase in income level from  $Y_0$  to  $Y_1$  ( $\gamma \Delta G$ ). Thus, it can be seen that there is no adverse effect of increased government spending on private investment. This phenomenon is attributable to the fact that despite an increase in the government expenditure, there is no accompanying increase in interest rate.

Since interest rates are not changing, private investment is not affected.

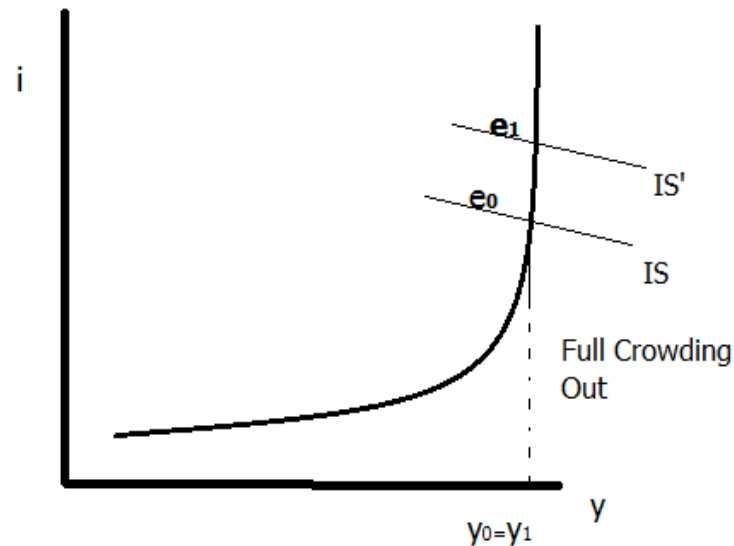
Thus, Crowding Out is Zero.

This represents the case of **Zero Crowding Out**.

In this region, Fiscal Policy Multiplier is Fully Effective.

(It shall be shown later that in this region Monetary Policy Multiplier is Totally Ineffective in Changing Income Levels)

Expansionary Fiscal Policy in Classical Region (Vertical LM Curve)



As depicted in the diagram above, in the classical region, the LM curve is vertical and accordingly, an increase in the government spending (resulting in shift of  $IS$  to  $IS'$ ) has no effect on the income level. However, the rate of interest goes up from  $i_0$  to  $i_1$  (Not shown here). This increase in interest rate prompts a corresponding reduction in private investment.

Thus, if the LM curve is vertical, the reduction in private investment would be equal to the increase in government spending.

That is for every 1 USD spent by Government, Private Investment reduces by 1 USD.

This one-on-one Crowding Out of Private Investment leads to Fiscal Policy which is totally ineffective in Increasing the level of Income.

Here Crowding Out is Full; and Fiscal Policy Multiplier is Zero.

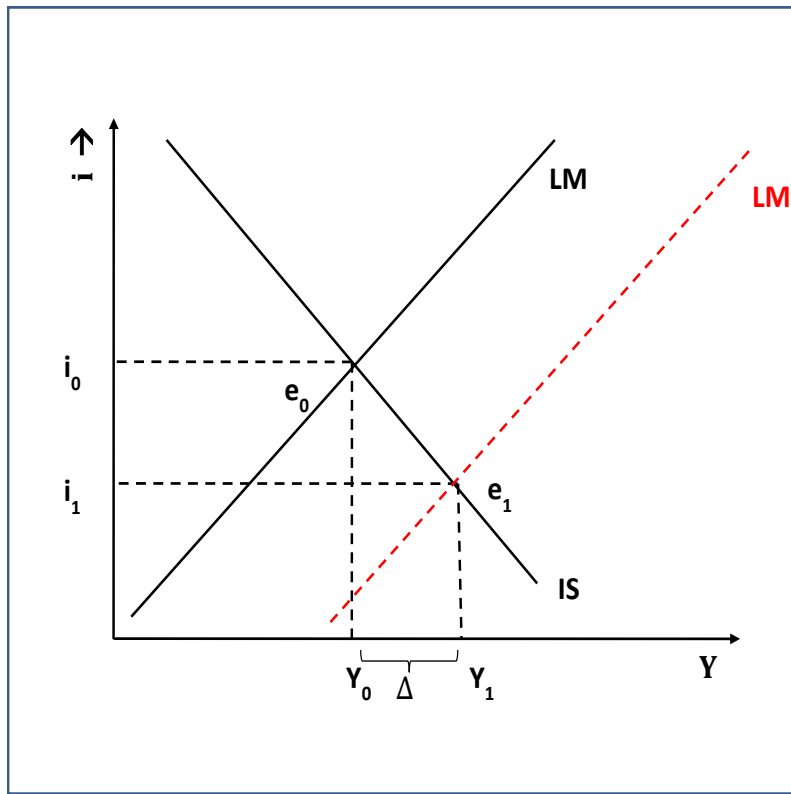
This represents the case of **Full Crowding Out**.

**Transmission Mechanism of Expansionary Fiscal Policy: Along the LM Curve**



**Preview of Next Class**

**Monetary Expansion: Monetary Policy Multiplier (LM Shifts)**



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