CHAPTER 10
AGGREGATE DEMAND I:
BUILDING THE IS-LM MODEL

Objectives:

- To understand the factors which determine the level of output in the short-run;

- To learn how, in the short run, the level of interest rates [*r*] both influences, and is influenced by, the level of real GDP [*Y*].

I. The Economy in the Short-run: An Introduction to Economic Fluctuations

1. Short-run versus long-run macroeconomic behaviour

- Many key macroeconomic variables (e.g. real GDP, unemployment) behave differently in the short run (e.g. from year to year) than in the long run (e.g. over a decade) or very long run (e.g. over many decades).

- For example, in the (very) long run output and employment trend upwards (***economic growth***) while in the short run output and employment fluctuate around trend in a pattern which is recurrent but neither regular nor predictable (the ***business cycle***).

- Moreover, the factors determining aggregate output differ between the short run and long run: in the **long run** output is determined by the available supplies of the factors of production and the technology of production; in the **short run** output responds to variations in aggregate demand for goods and services.

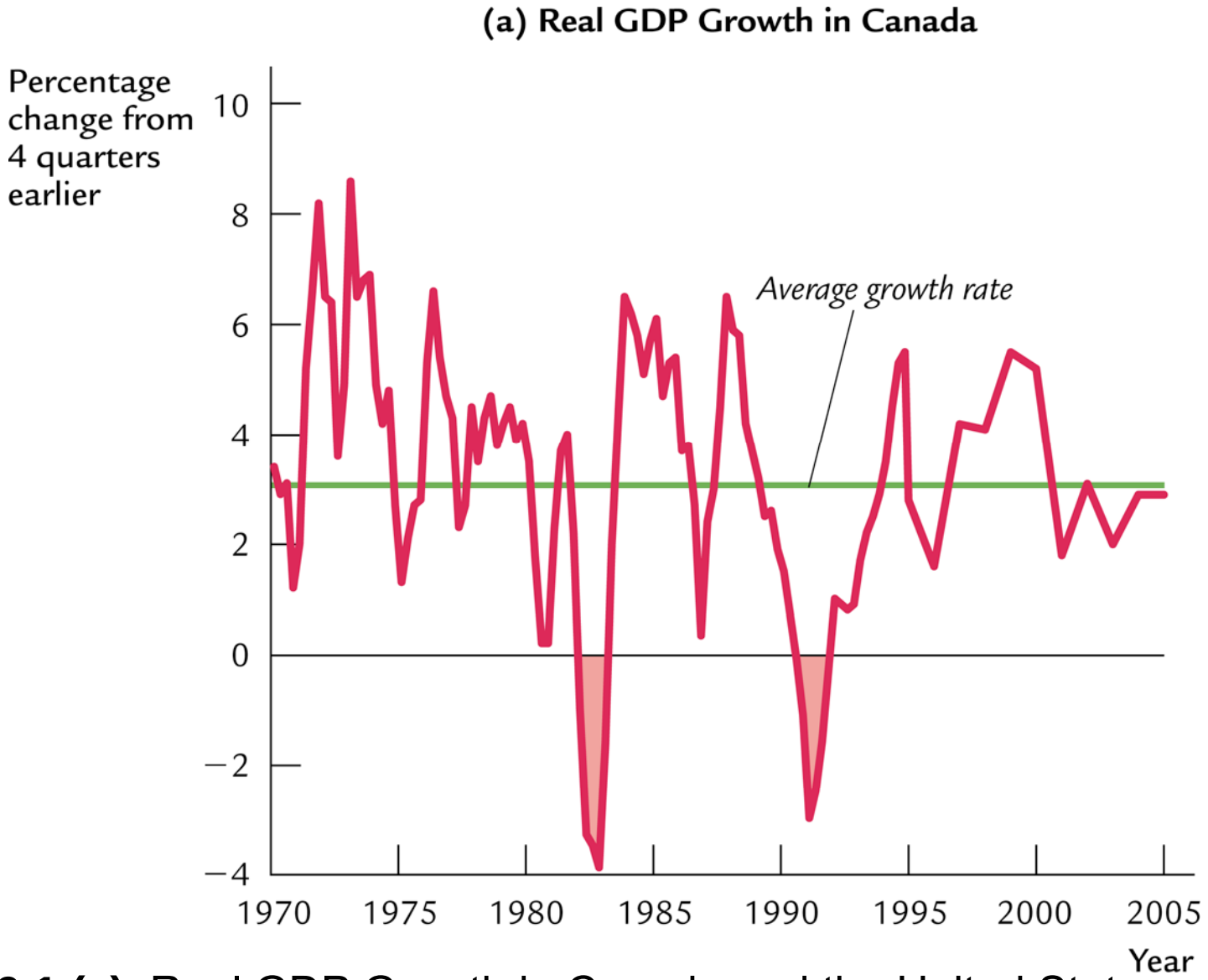


Figure 9.1 (a) Real GDP Growth in Canada and the United States

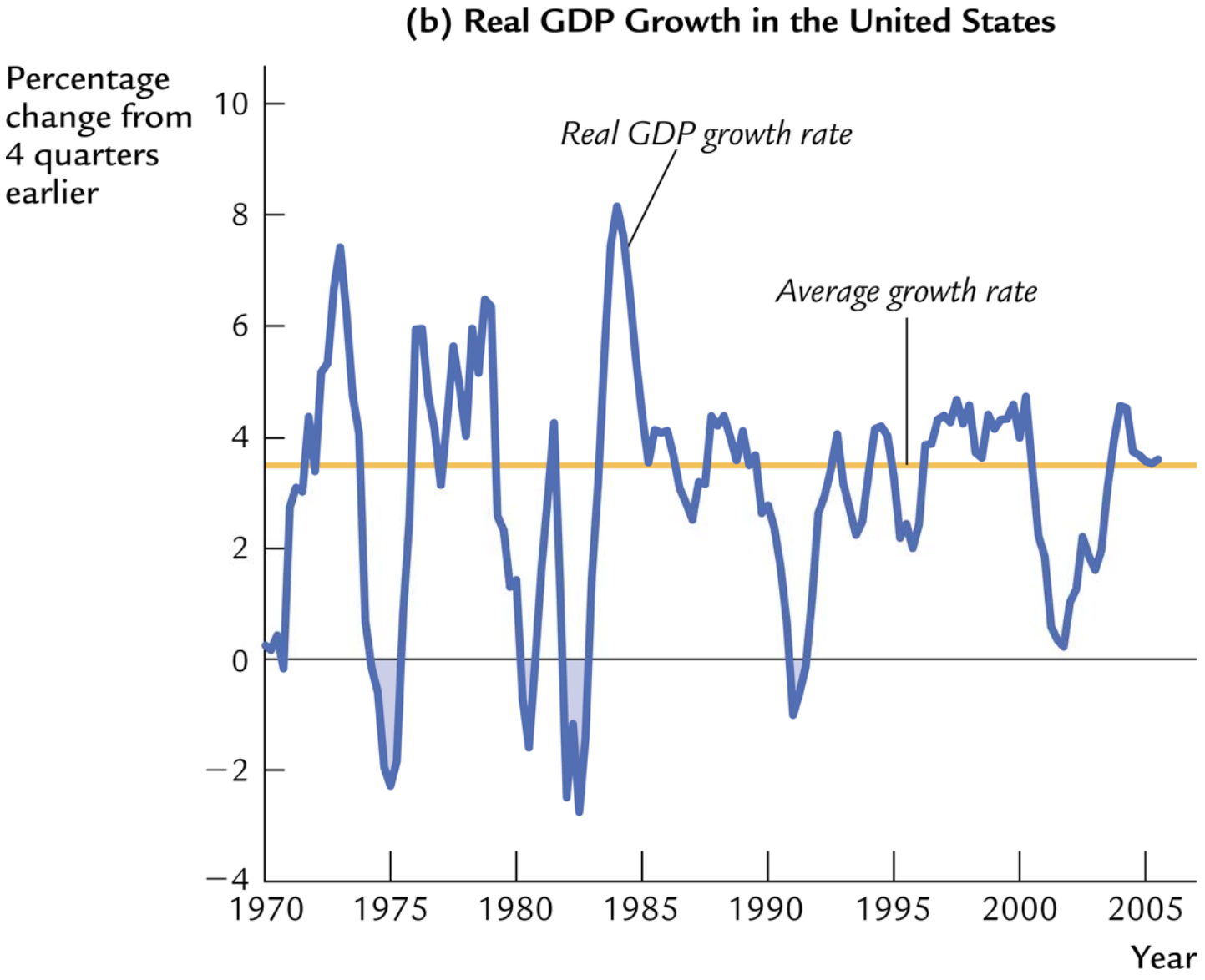


Figure 9.1 (b) Real GDP Growth in Canada and the United States

Mankiw and Scarth: Macroeconomics, Canadian Third Edition

2. Price flexibility and inflexibility

- Most macroeconomists believe that observed differences in macroeconomic behaviour between the short run and the long run result from differences in the behaviour of **prices**.

- In the long run, prices (of both final products and factors of production) are **flexible** and respond to variations in demand and supply; in the short run many prices are **"sticky"** at predetermined levels.

- While some prices (e.g. retail gasoline) change daily, most prices are changed relatively infrequently. One survey (chapter 19, page 601) found that 39 percent of firms change product prices only once a year, while an additional 10 percent change them less frequently than once a year.

- The causes of short-run price stickiness vary and include: costs of price adjustment (called “menu costs”); contracts (both explicit and implicit); and reluctance to be the first, among competitors, to change price (called “coordination failure”).

TABLE 19-1

The Frequency of Price Adjustment

This table is based on answers to the question: How often do the prices of your most important products change in a typical year?

Frequency	Percentage of Firms
Less than once	10.2
Once	39.3
1.01 to 2	15.6
2.01 to 4	12.9
4.01 to 12	7.5
12.01 to 52	4.3
52.01 to 365	8.6
More than 365	1.6

Source: Table 4.1, Alan S. Blinder, "On Sticky Prices: Academic Theories Meet the Real World," in N. G. Mankiw, ed., *Monetary Policy* (Chicago: University of Chicago Press, 1994), 117–154.

Table 19.1

3. A short-run aggregate demand and supply model

- In chapters 10, 11, and 12 we utilize a (Keynesian) model of short run output determination based on two key assumptions about aggregate supply:

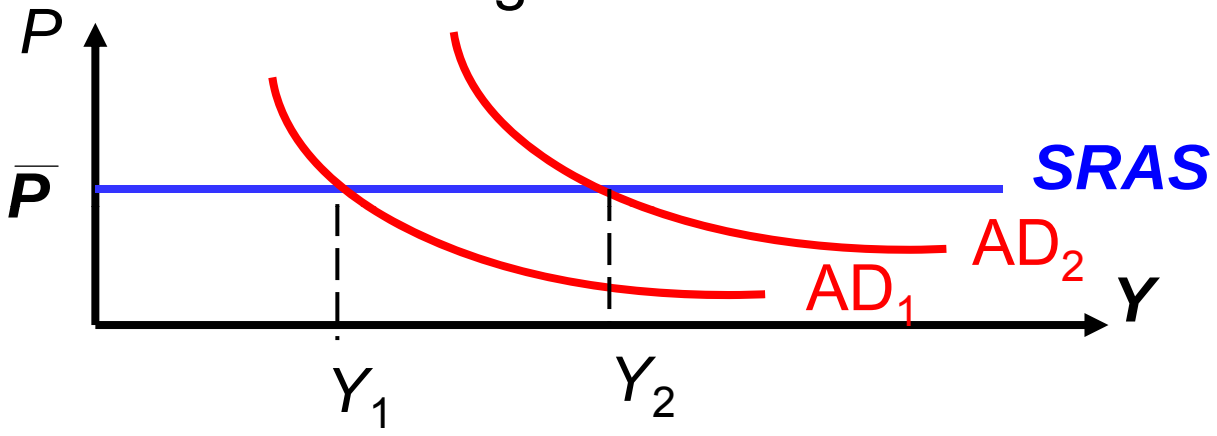
  1) **all** prices are **stuck** at predetermined levels in the short run and, hence, there is a given, predetermined value of the aggregate price level, denoted as $\bar{P}$;

  2) firms are willing to produce and sell **as much output** as buyers are willing to buy at given prices.

- Assumptions 1) and 2) imply that the economy's ***short-run aggregate supply (SRAS) curve*** is **horizontal** at the predetermined price level ($\bar{P}$).

- For a given price level, the economy's short-run equilibrium level of output is determined by the level of **aggregate demand** for output as shown by the position of the aggregate demand (AD) curve in the diagram below.

Fig. 10-1



- Short-run fluctuations in output are thus the result of variations in the level of demand for goods and services, or shifts of the AD curve.

- To construct a theory of short run output determination we need to analyse the determinants of aggregate demand for output – a task we now undertake.

I. The Keynesian-Cross Model of Output Determination.

- the simplest interpretation of Keynes' theory of short-run output determination;
- ignores the impact of interest rates and monetary policy;
- is a building block for the more complex and realistic IS-LM model.

1. The determinants of aggregate expenditure [*E*] in the Keynesian-Cross model.

- Assume a closed economy ✡ *NX*=0 and so:

$$E = C + I + G$$

- Consumption [*C*] is an increasing function of aggregate disposable income [*Y-T*]:

$$C = C(Y - T), \quad 0<MPC<1$$

- Planned investment spending is assumed to be an *exogenous* variable whose value is determined outside the model:

$$I = \bar{I}$$

- Both govt. spending on output and taxes are assumed to be *exogenous*, determined outside the model by fiscal policy:

$$G = \bar{G}; T = \bar{T}$$

2. The aggregate expenditure function.

$$E = C + I + G$$

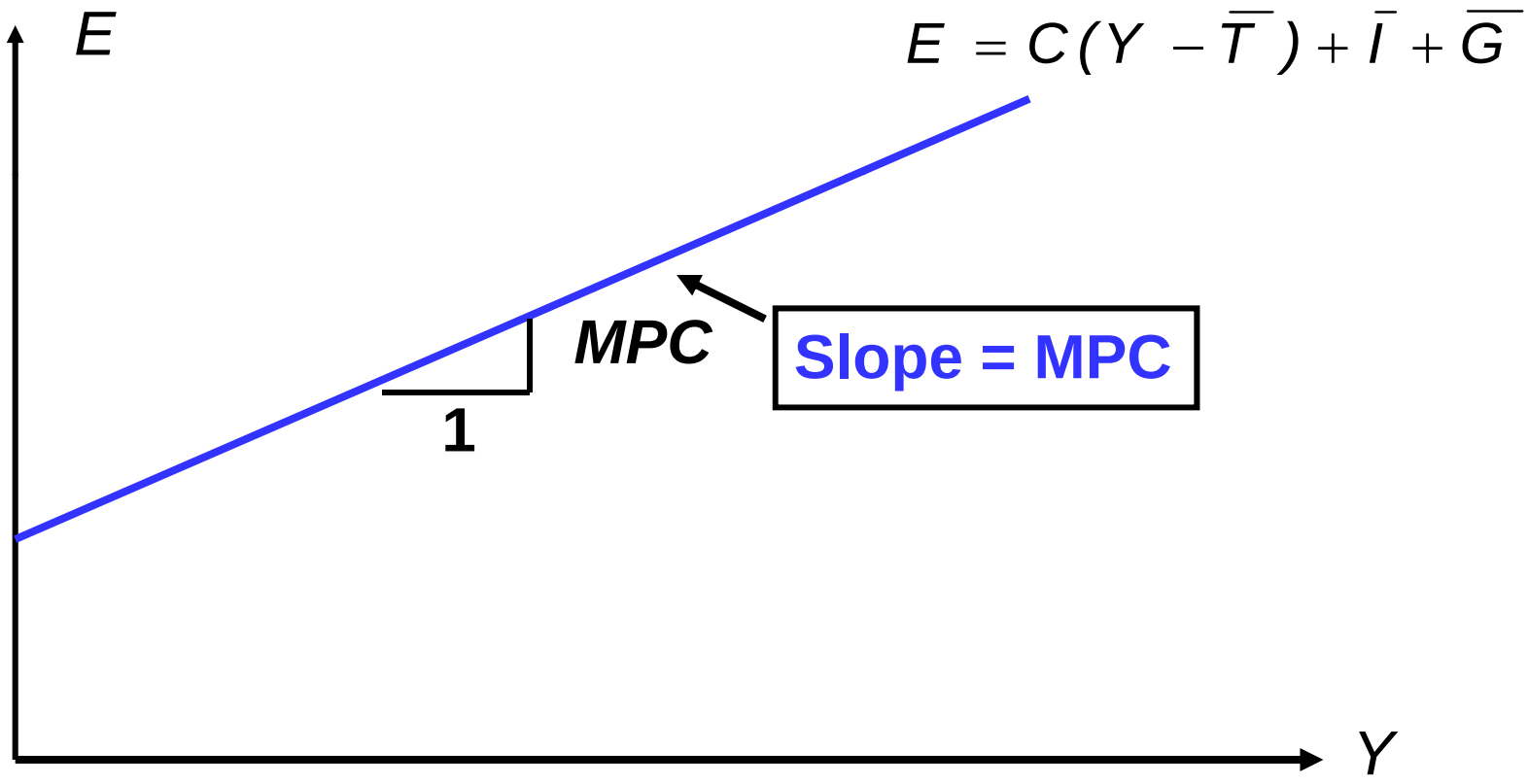
$$E = C(Y - \bar{T}) + \bar{I} + \bar{G}$$

- Planned aggregate expenditure is a function of:
  - real GDP [Y];
  - exogenous level of planned investment spending $[\bar{I}]$
  - exogenous fiscal policy variables $[\bar{G}, \bar{T}]$

3. The planned expenditure curve

- Shows how E varies with Y when $\bar{I}, \bar{G}$ and $\bar{T}$ are **held constant.**

Fig. 10-2



- *E* increases with *Y* *because C increases with Y*:

$$\Uparrow Y \rightarrow \Uparrow (Y - \bar{T}) \rightarrow \Uparrow C \rightarrow \Uparrow E$$

- The slope of the *E* curve equals the *MPC*:

$$\text{Slope} = \frac{\Delta E}{\Delta Y} = \frac{\Delta C}{\Delta Y} = \frac{\Delta C}{\Delta (Y - \bar{T})} = MPC$$

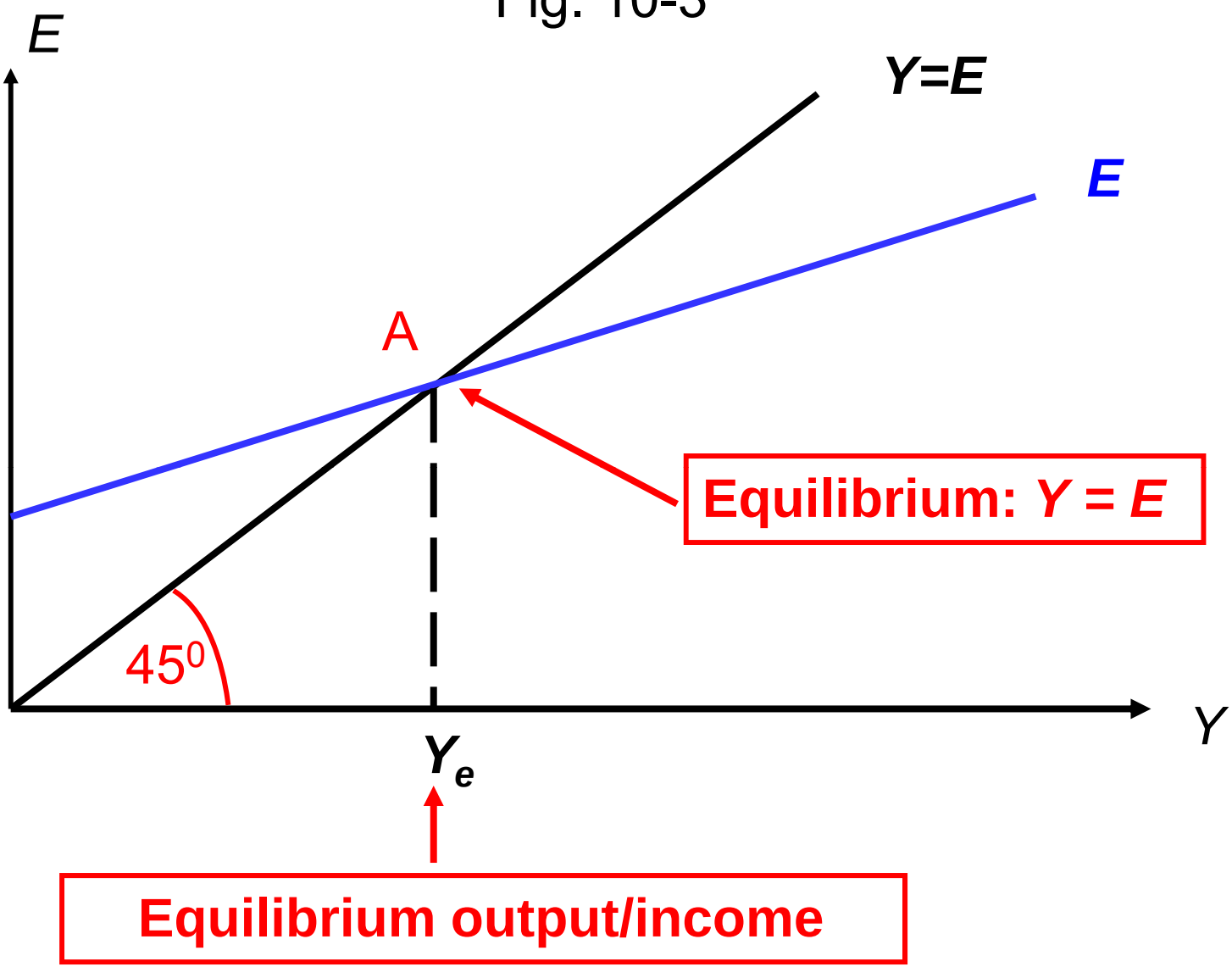
4. The equilibrium of the economy.

- We assume that firms **adjust their output levels to match the level of planned expenditure**:

  Y⇧ or ⇩, until $Y = E$.

- **Def: *The level of Y such that Y = E is called the equilibrium Y.***

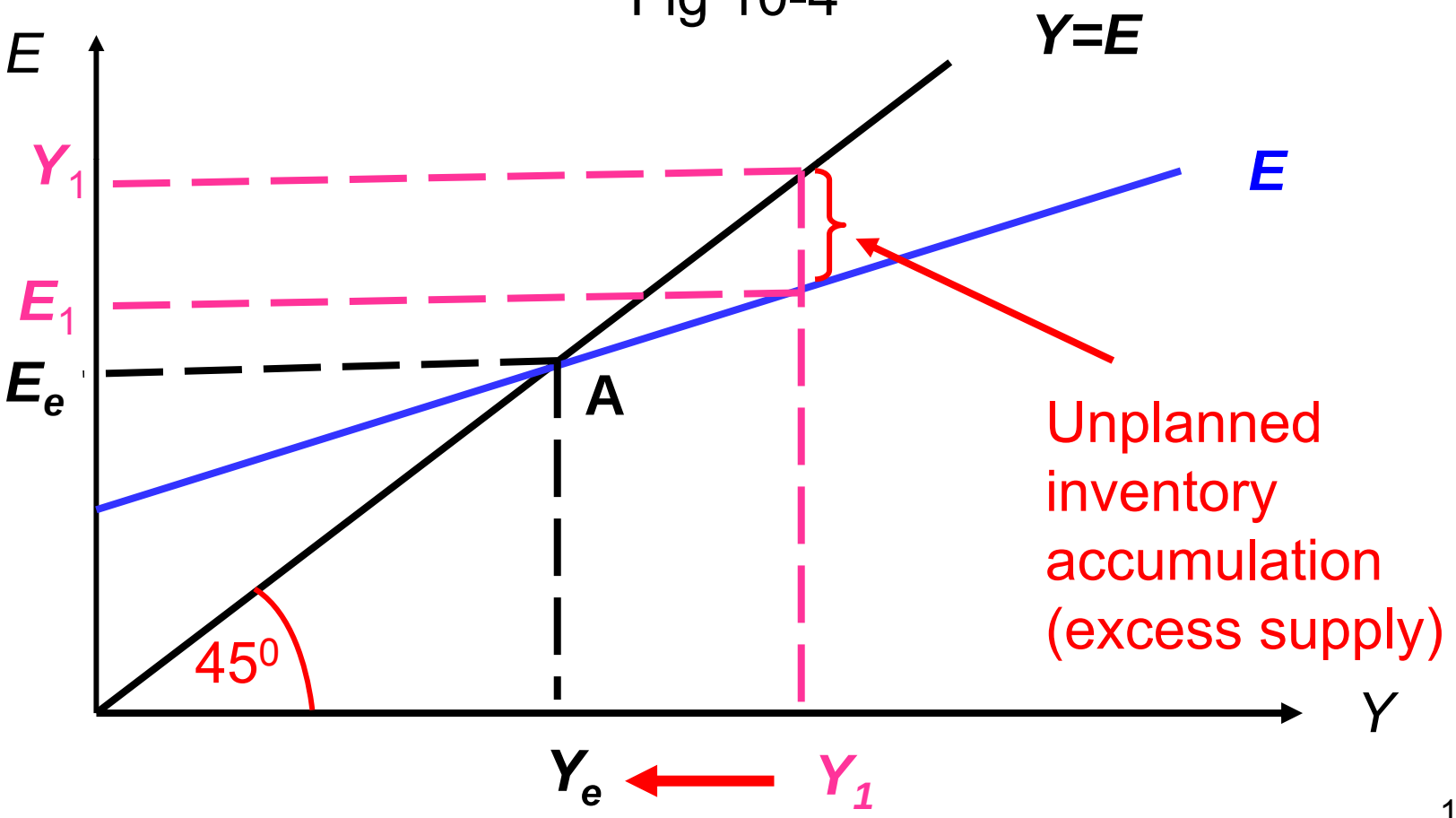
Fig. 10-3



5. The process of adjustment to equilibrium.

- Suppose, initially, $Y = Y_1 > Y_e$, where Y_e is the equilibrium value of Y.

Fig 10-4



- When $Y = Y_1$, $E = E_1 < Y_1$. Firms are selling less than they are producing. Unsold output results in ***unplanned inventory accumulation***

- Firms react to this unplanned inventory build-up by ***reducing*** production levels to match demand:

$Y \Downarrow$ until $Y = E$.

- At home: analyse what happens when $Y = Y_1 < Y_e$

6. Analysis of various changes.

- We will always start initially in equilibrium at point A where:

$$Y = Y_1 = E$$

A) An increase in *G*

$\Uparrow \overline{G}$ ➔ $\Uparrow E$ $(\Delta E = \Delta \overline{G})$

➔ $E > Y_1$

➔ unplanned inventory drop

➔ firms react by producing more

➔ $Y \Uparrow$

➔ $C \Uparrow$ [ΔC = MPC 👍 $\Delta Y < \Delta Y$]

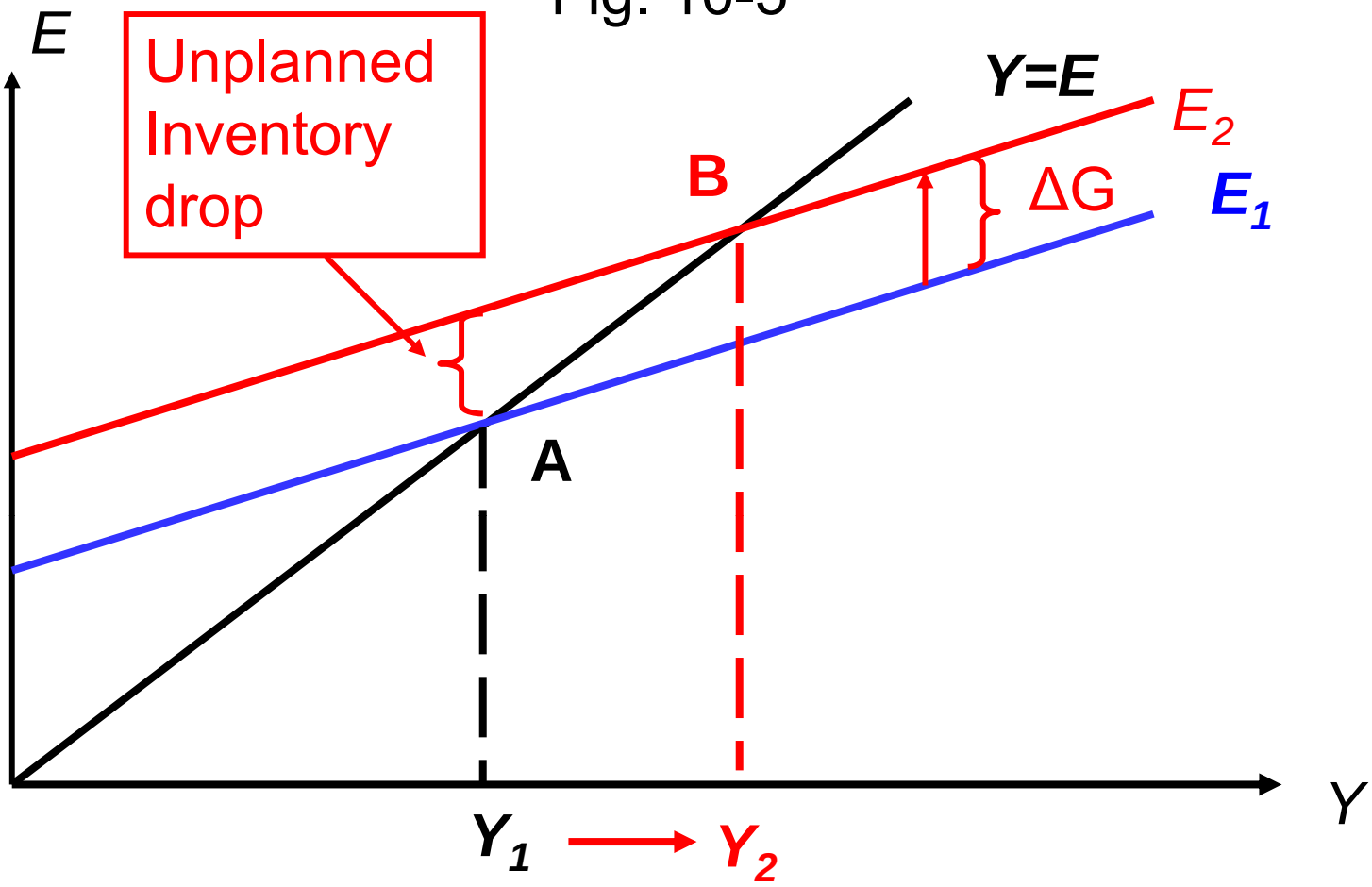
➔ $E \Uparrow$ [$\Delta E = \Delta C < \Delta Y$]

➔ both $Y \Uparrow$ and $E \Uparrow$ but Y rises faster

.....

until $Y = Y_2 = E_2$

Fig. 10-5



- The government purchases multiplier.

  - The initial increase in $\overline{G}$ raises output by the same amount;

  - as Y ⇧, consumption rises as well, increasing *Y* further;

  - So: final increase in *Y* exceeds the initial increase in $\overline{G}$

- **Def: *The govt. purchases multiplier is the amount by which equilibrium Y changes, following a one-unit increase in G*:**

$$\text{Govt. purchases multiplier} = \frac{\Delta Y_e}{\Delta \overline{G}}$$

- Deriving the multiplier:

$$Y_e = C(Y_e - \bar{T}) + \bar{I} + \bar{G}$$

After an increase in $\bar{G}$:

$$\Delta Y_e = MPC \cdot \Delta Y_e + \Delta \bar{G}$$

$$\Delta Y_e (1 - MPC) = \Delta \bar{G}$$

$$\Delta Y_e = \frac{\Delta \bar{G}}{(1 - MPC)}$$

$$\boxed{\frac{\Delta Y_e}{\Delta \bar{G}} = \frac{1}{(1 - MPC)}}$$

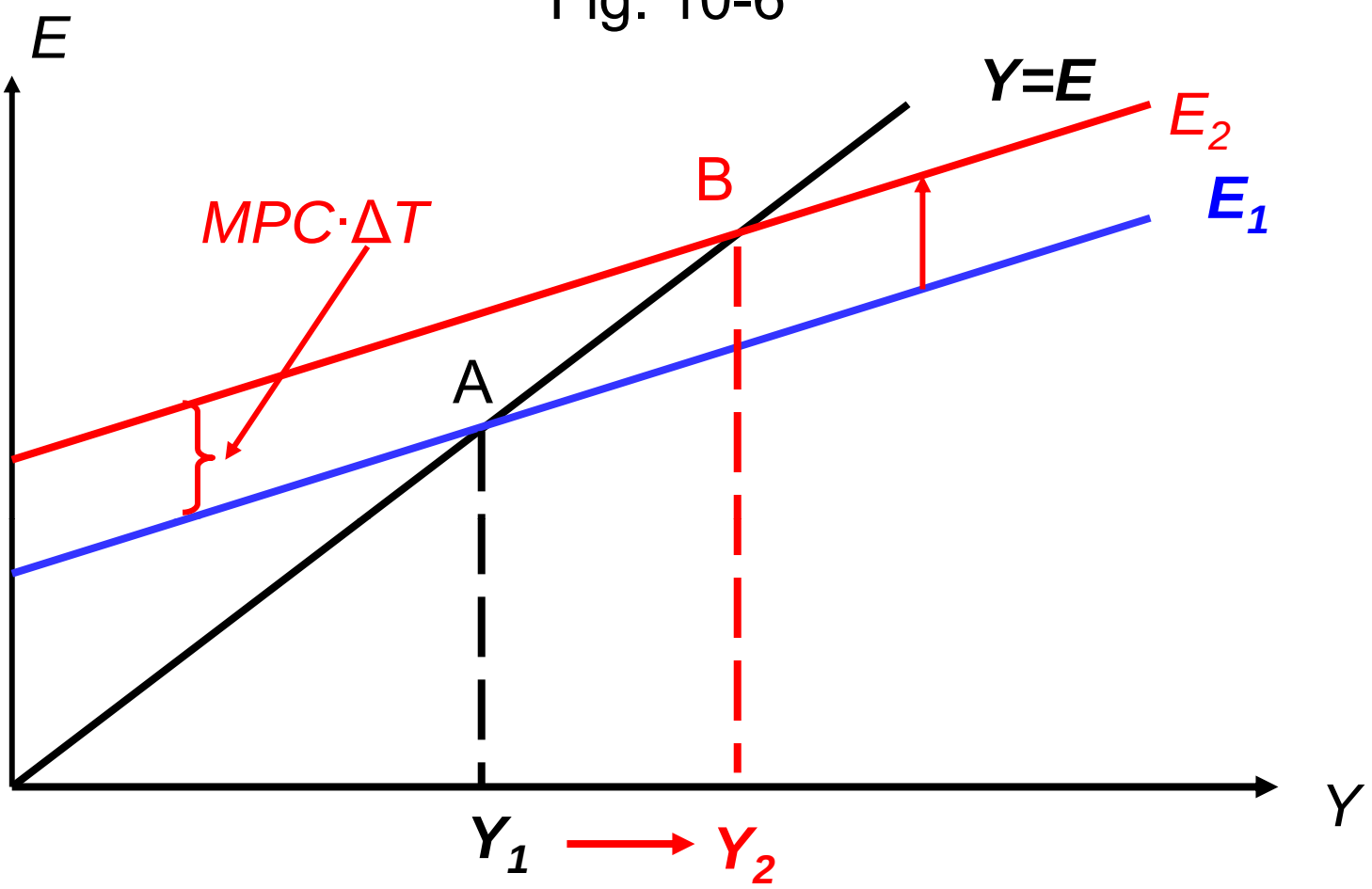
- The larger [smaller] is the MPC the larger [smaller] is the multiplier of equilibrium income with respect to a change in govt. spending.

B). A decrease in taxes.

- A drop in taxes raises consumption at each level of Y by $MPC \cdot \Delta\bar{T}$

- A tax cut of \$1.00 has the same effect on Y_e as an increase in $\bar{G}$ equal to $MPC \cdot \$1$

Fig. 10-6



Deriving the tax multiplier:

We have: $Y_e = C(Y_e - \bar{T}) + \bar{I} + \bar{G}$

After an increase in $\bar{T}$:

$$\Delta Y_e = MPC \cdot \Delta Y_e - MPC \cdot \Delta \bar{T}$$

$$\Delta Y_e (1 - MPC) = -MPC \cdot \Delta \bar{T}$$

$$\Delta Y_e = \frac{-MPC \cdot \Delta \bar{T}}{(1 - MPC)}$$

$$\boxed{\frac{\Delta Y_e}{\Delta \bar{T}} = \frac{-MPC}{(1 - MPC)}}$$

❑ The multiplier in practice.

- MPC for Canada = 0.75. So, by our simple formula: 1/(1-MPC)=4.

- But in fact the multiplier is considerably lower than that due to two factors which are ignored by our simple formula:

(a) Taxes are **not** constant but **increase with income**:

- ⇧*Y* by \$1 ✡ ⇧*T* by \$0.4 (taxes increase by \$0.25, subsidies fall by \$0.15)

- So: if *Y*⇧ by \$1 ✡ (*Y*-*T*)⇧ by 60 cents only

(b) Part of the extra spending is on **imports**:

- 75 cents of each $1⇧ in (*Y*-*T*) is spent,
  but only 75% of that increased spending is on
  Canadian-produced output, with 25% on imports.

- Overall: The effect of an increase in *Y* by $1 on aggregate expenditure is:

  0.60 x 0.75 x 0.75 = 0.34

- So the multiplier is 1/(1-0.34) = 1.5

III. The IS Curve.

- We will now develop the **IS-LM model**.
- The Keynesian- cross is the basis for IS curve which shows the equilibrium in the goods market.
- To obtain - replace the assumption of exogenous investment with the investment function.

1. The investment function.

$I = I(r)$, where: ⇧r ➔⇩I

2. Planned expenditure and the interest rate.

- The **NEW** expenditure function is:

$$E = C(Y - \overline{T}) + I(r) + \overline{G}$$

- With Y, G, and T held constant:

$$r \Uparrow \rightarrow I(r) \Downarrow \rightarrow E \Downarrow$$

3. DEF: *The IS curve shows combinations of r and Y for which there is equilibrium in the output market of the economy in the sense that output [Y] equals planned expenditure [E] (for given values of the fiscal variables G and T).*

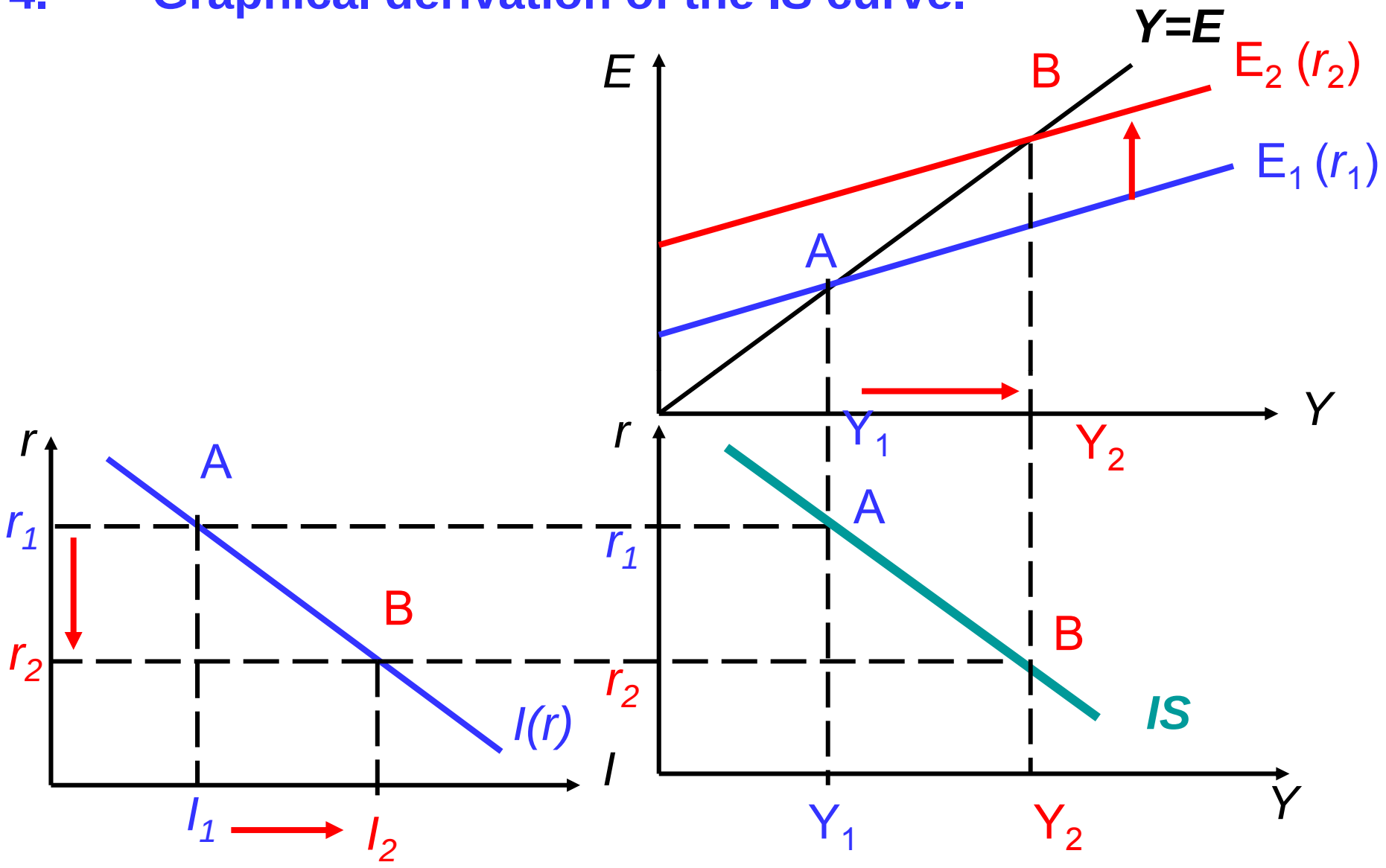
WARNING

In what follows we will **NOT** be talking about the equilibrium level of income. We will be talking about the level of income needed for **equilibrium in the goods market only.**

Equilibrium level of income will involve:
- equilibrium in the goods market
- equilibrium in the money market.

So - the discussion now is half of the story only.

4. Graphical derivation of the IS curve.



5. Slope of the IS curve.

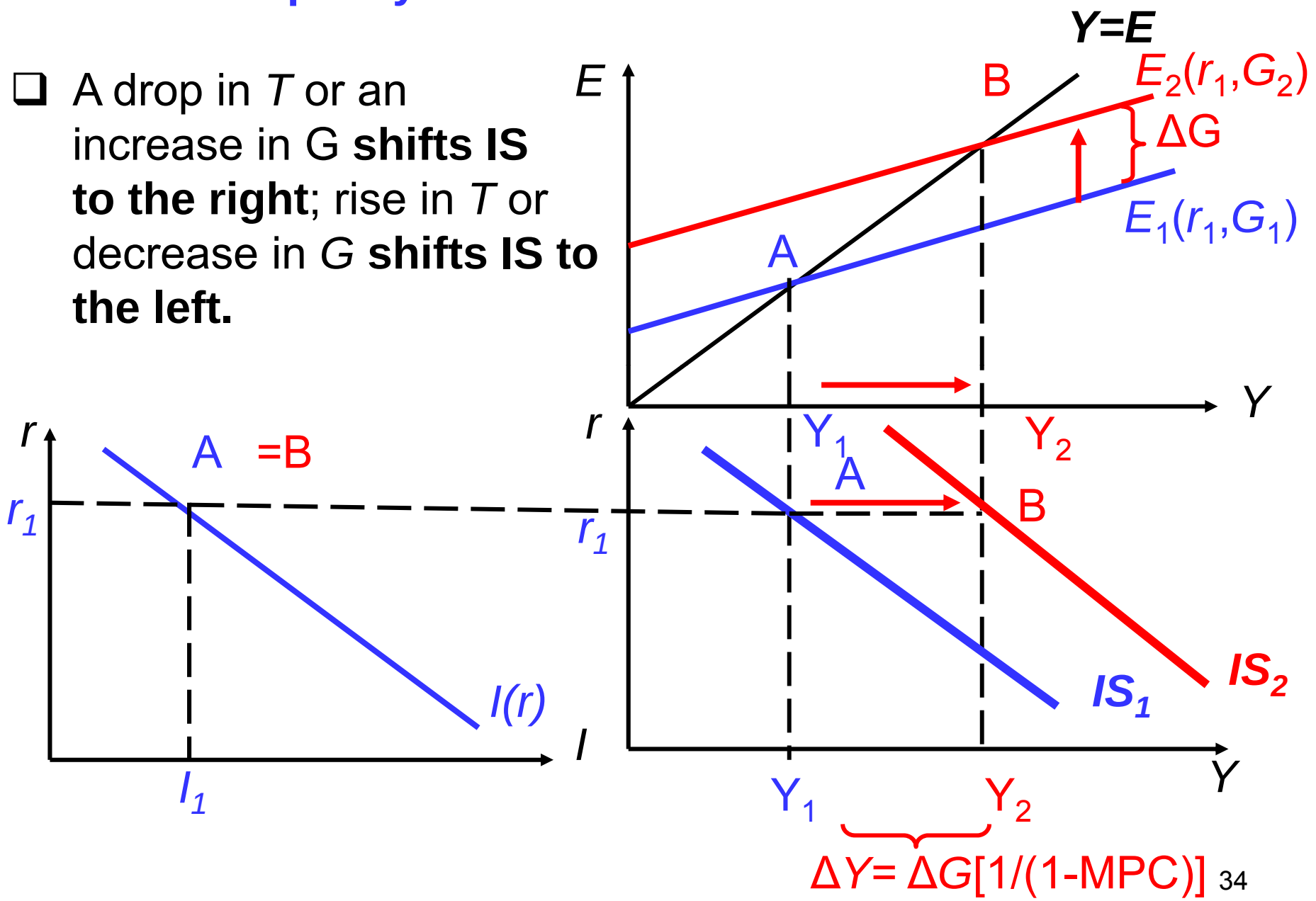
- IS - **negatively (downward) sloped** because when *r* decreases *I* and *E* increase which requires an increase in *Y* to keep *Y* =*E*.

- IS will be **flatter** the **more responsive is *I* to a change in *r***:

  - If investment is **very responsive** to changes in *r* then when *r* decreases a large change in *Y* will be required to restore *Y* = *E*; so IS will be **flat.**

6. Fiscal policy and shifts in IS

- A drop in *T* or an increase in G **shifts IS to the right**; rise in *T* or decrease in *G* **shifts IS to the left.**



IV. The LM Curve.

1. The supply of money.

- **Def**: ***Supply of money = the amount of money in circulation***.
  - **Nominal** money supply (M^s) = actual supply;
  - **Real** money supply $(M/P)^s$ = nominal money supply divided by the price level.
- M^s is an **exogenous** variable - determined by the Bank of Canada:

$$M^S = \overline{M}$$

- In the IS-LM model the price level is also an exogenous variable:

$$P = \overline{P}$$

- Hence, the real money supply is an exogenous variable:

$$(M / P)^S = \overline{M} / \overline{P}$$

2. The demand for money.

- **Def**: ***Demand for money = the amount of money Canadians <u>wish</u> to hold*.**

  - **Nominal** money demand (M^d) = actual dollar demand;

  - **Real** money demand $(M/P)^d$ = nominal money demand divided by the price level.

- **The real demand for money depends on the interest rate and the level of income.**

  (a) **Higher interest rate** ➔ higher (opportunity) cost of holding money ➔ lower money demand (note: money bears no interest):

  $r \Uparrow \rightarrow (M/P)^d \Downarrow$

(b) **Higher income** ➔ more transactions ➔ higher money demand:

$$Y \Uparrow \rightarrow (M/P)^d \Uparrow$$

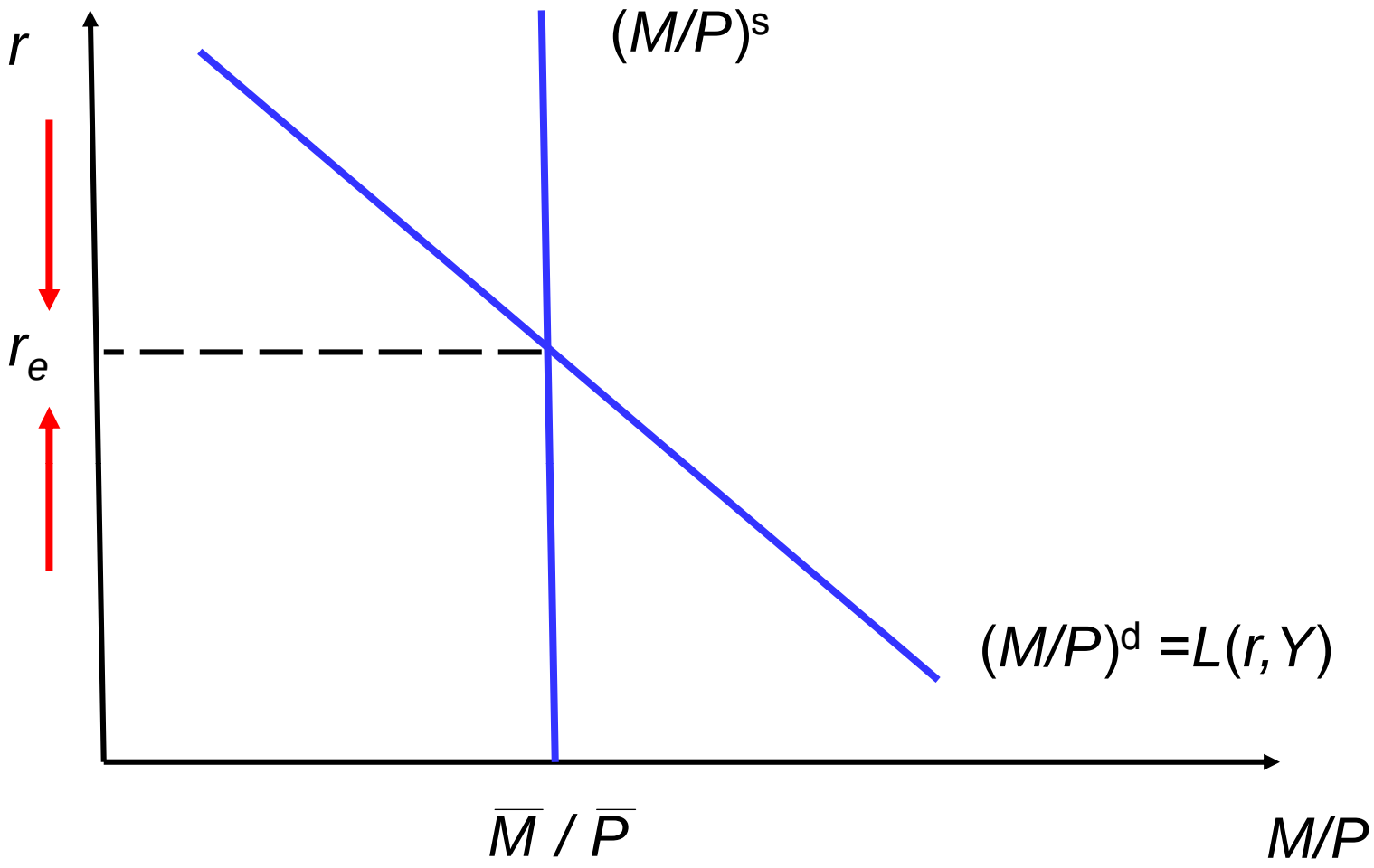
- The dependence of $(M/P)^d$ on Y and r is summarized by the ***money demand function L( )***:

$$(M/P)^d = L(r, Y)$$

3. The (Keynesian) liquidity preference theory of interest rates.

- The interest rate [r] is determined at the level which *equilibrates the money market* by equating the [aggregate] **demand for money** to the [aggregate] **supply of money**.

Fig. 10-10

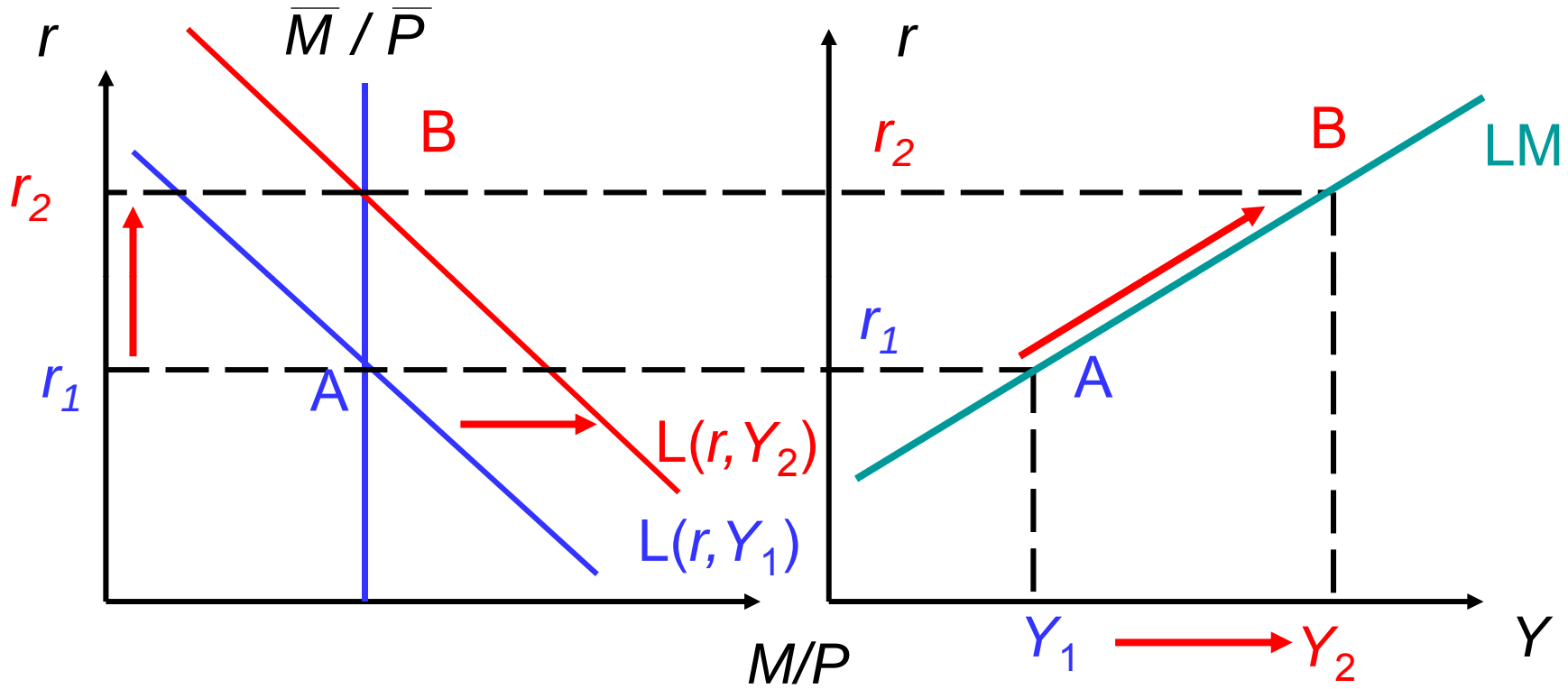


4. The effect of changes in *Y* on equilibrium *r* and the LM curve

- **Def**: ***LM curve shows combinations of r and Y such that there is equilibrium in the money market (demand for money = supply of money) for a given supply of money.***

5. Deriving the LM Curve.

Fig. 10 -12

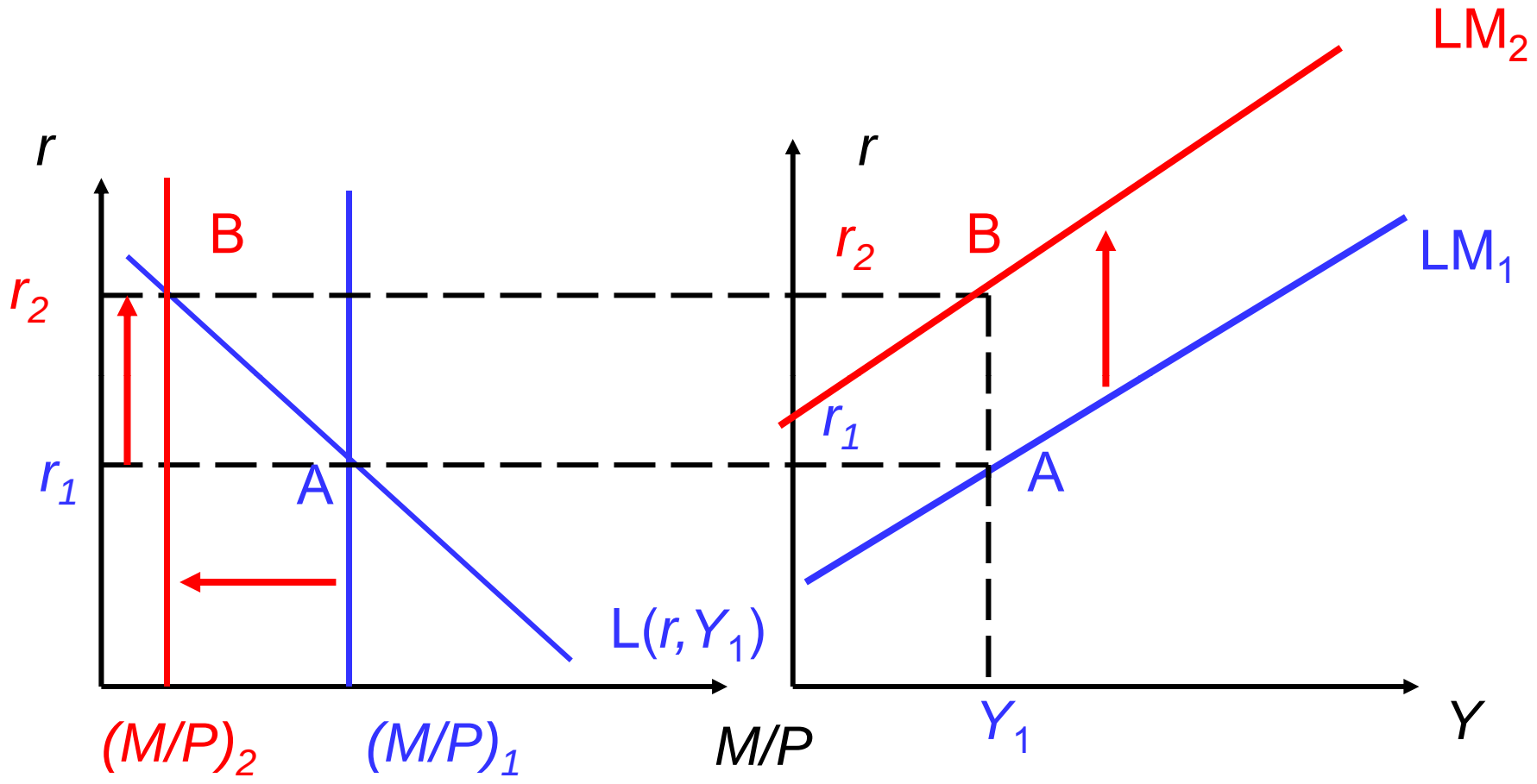


- LM is upward sloped because, at higher income, a higher interest rate is **needed for the money market equil:**

⇧Y ➔ ⇧$(M/P)^d$ ➔ ⇧r to keep $(M/P)^d = \overline{M} / \overline{P}$

6. Shifts of LM

Fig. 10 -13



- If real **money supply falls**, $\overline{M} / \overline{P} \downarrow$, **LM shifts UP**;
  if real **money supply rises**, $\overline{M} / \overline{P} \uparrow$, **LM shifts DOWN.**

V. The Full IS-LM Model.

- **Def.:** ***The IS-LM model is a short-run model of income and interest rate determination with prices fixed*.**

- Consists of two equations in two unknowns or endogenous variables:

IS: $$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

LM: $$\bar{M} / \bar{P} = L(r, Y)$$

- **Endogenous** variables: *r, Y*.

- **Exogenous** variables: $\bar{G}, \bar{T}, \bar{M} / \bar{P}$

- **The IS-LM diagram:** At the intersection of the two curves both markets are in equilibrium and we get equilibrium values of *Y* and *r.*

Fig. 10-14