Chapter 11: Aggregate Demand I – Building the *IS-LM* Model

Context

- Chapter 10 introduced the model of aggregate demand and aggregate supply.
- Long run
  - flexible prices
  - output determined by factors of production & technology
  - unemployment equals its natural rate
- Short run
  - prices fixed
  - output determined by aggregate demand
  - unemployment is negatively related to output

Context

- This chapter develops the *IS-LM* model, the theory that yields the aggregate demand curve and is used for the discussion of monetary and fiscal policies.
- We focus on the short run and assume the price level is fixed.
- Chapters 11 and 12 focus on the closed-economy case. Chapter 13 presents the open-economy case.

The Keynesian Cross

- A simple closed economy model in which income is determined by expenditure.
  (due to John Maynard Keynes)
- Notation:
  I = *planned* investment
  E = ***C*** + ***I*** + ***G*** = planned expenditure
  Y = real GDP = actual expenditure
- Difference between actual & planned expenditure（计划支出）: unplanned inventory investment

Elements of the Keynesian Cross

consumption function: $C = C(Y - T)$

Gov't policy variables: $G = \bar{G}, \quad T = \bar{T}$

for now,
investment is exogenous: $I = \bar{I}$

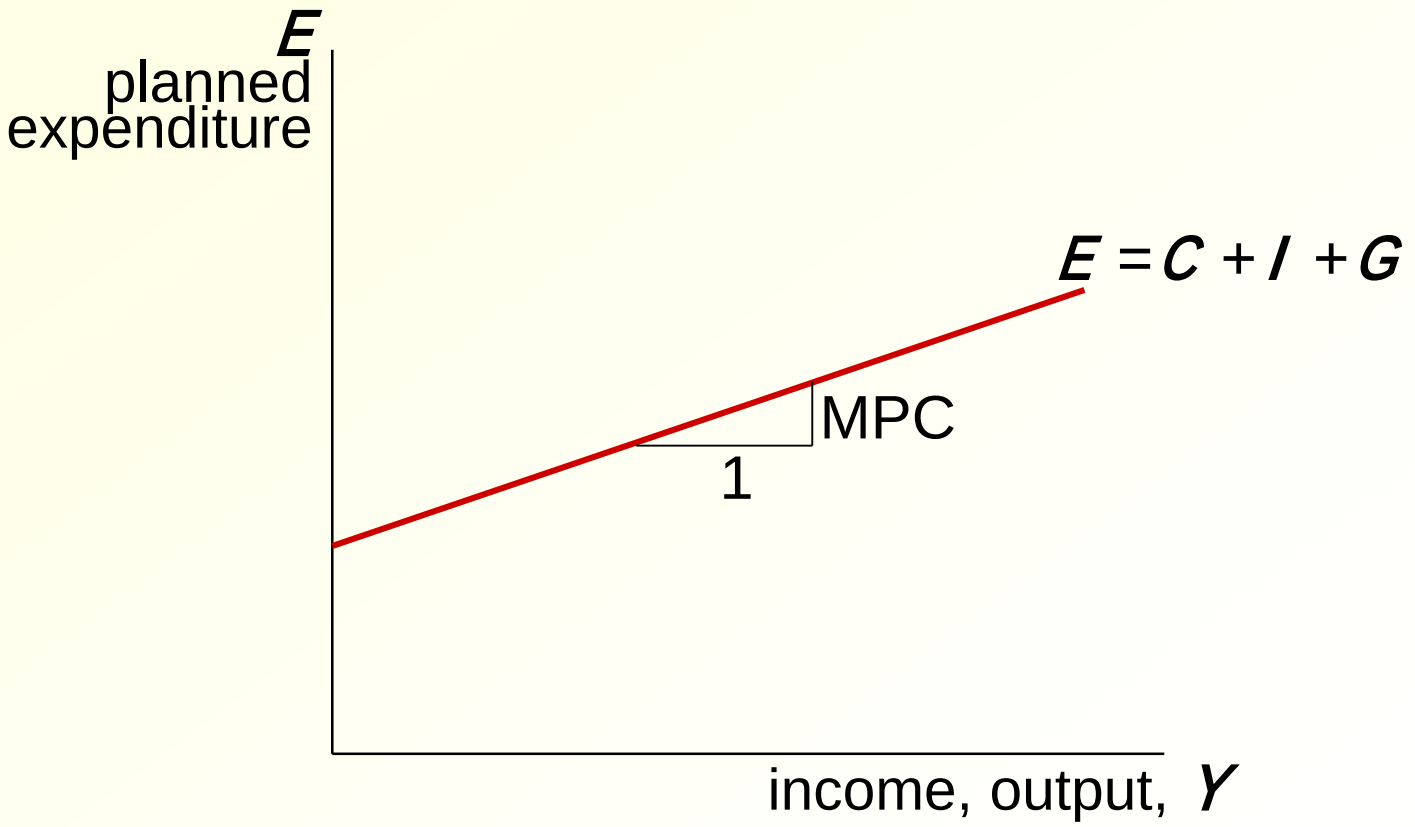
planned expenditure: $E = C(Y - \bar{T}) + \bar{I} + \bar{G}$

Equilibrium condition:

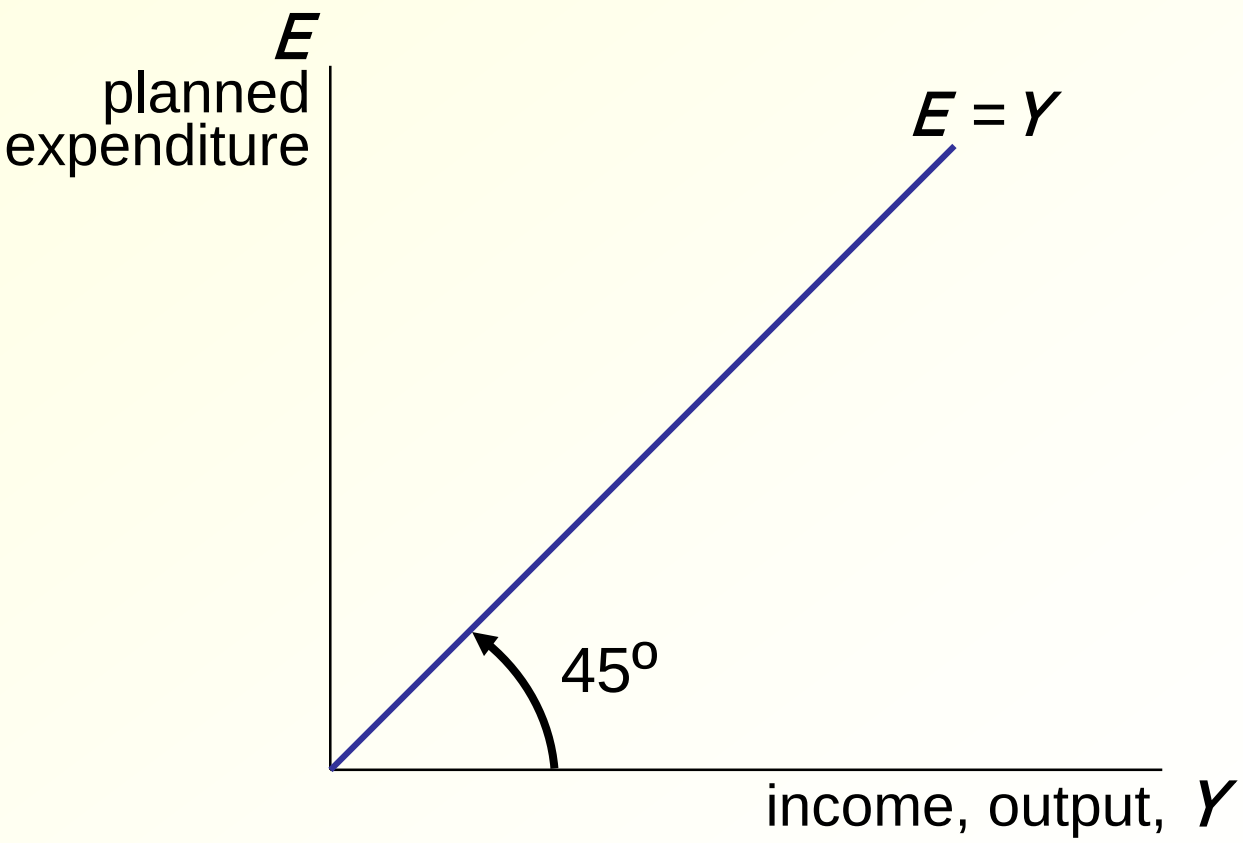
Actual expenditure = Planned expenditure

$Y = E$

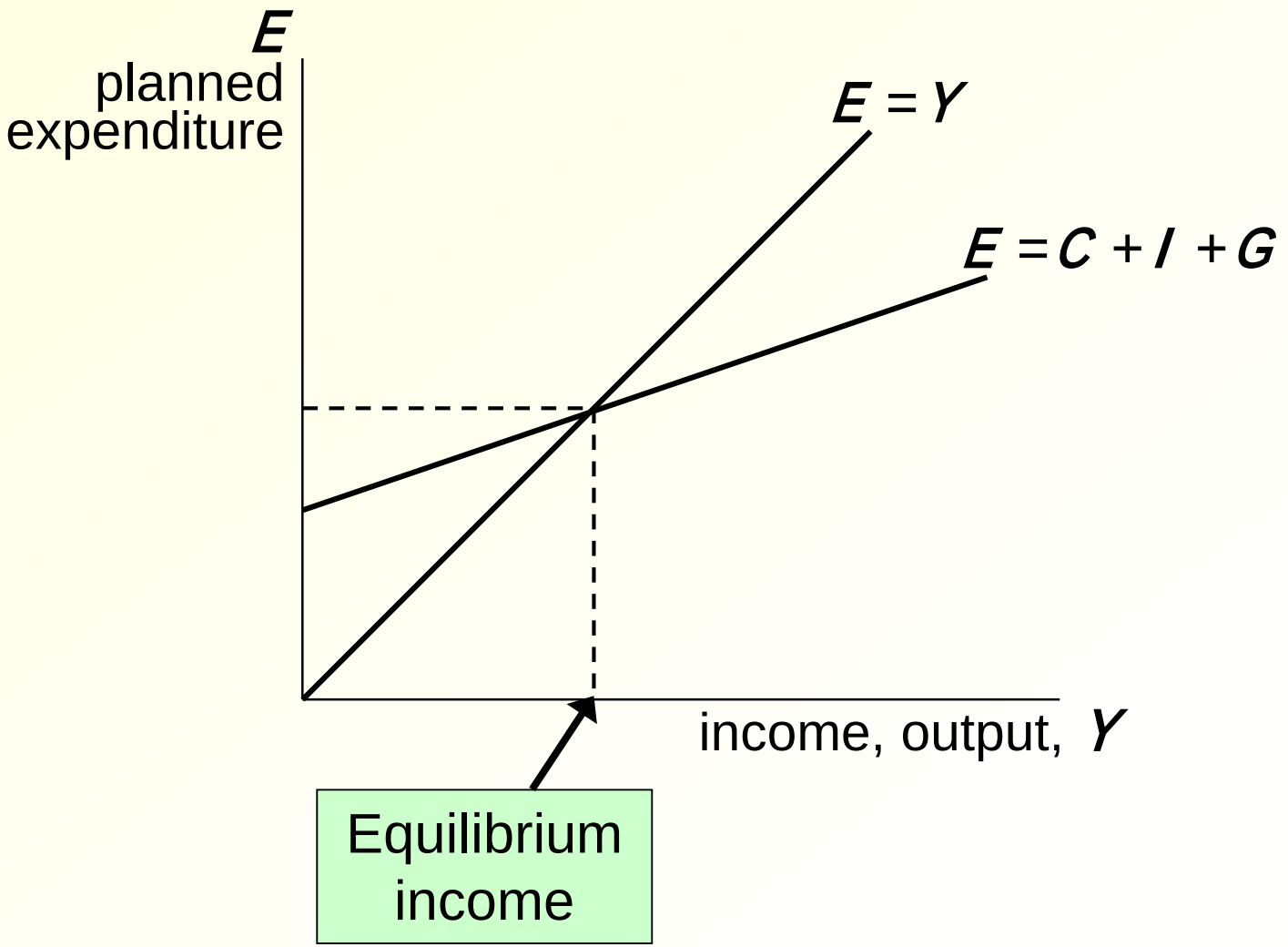
Graphing planned expenditure



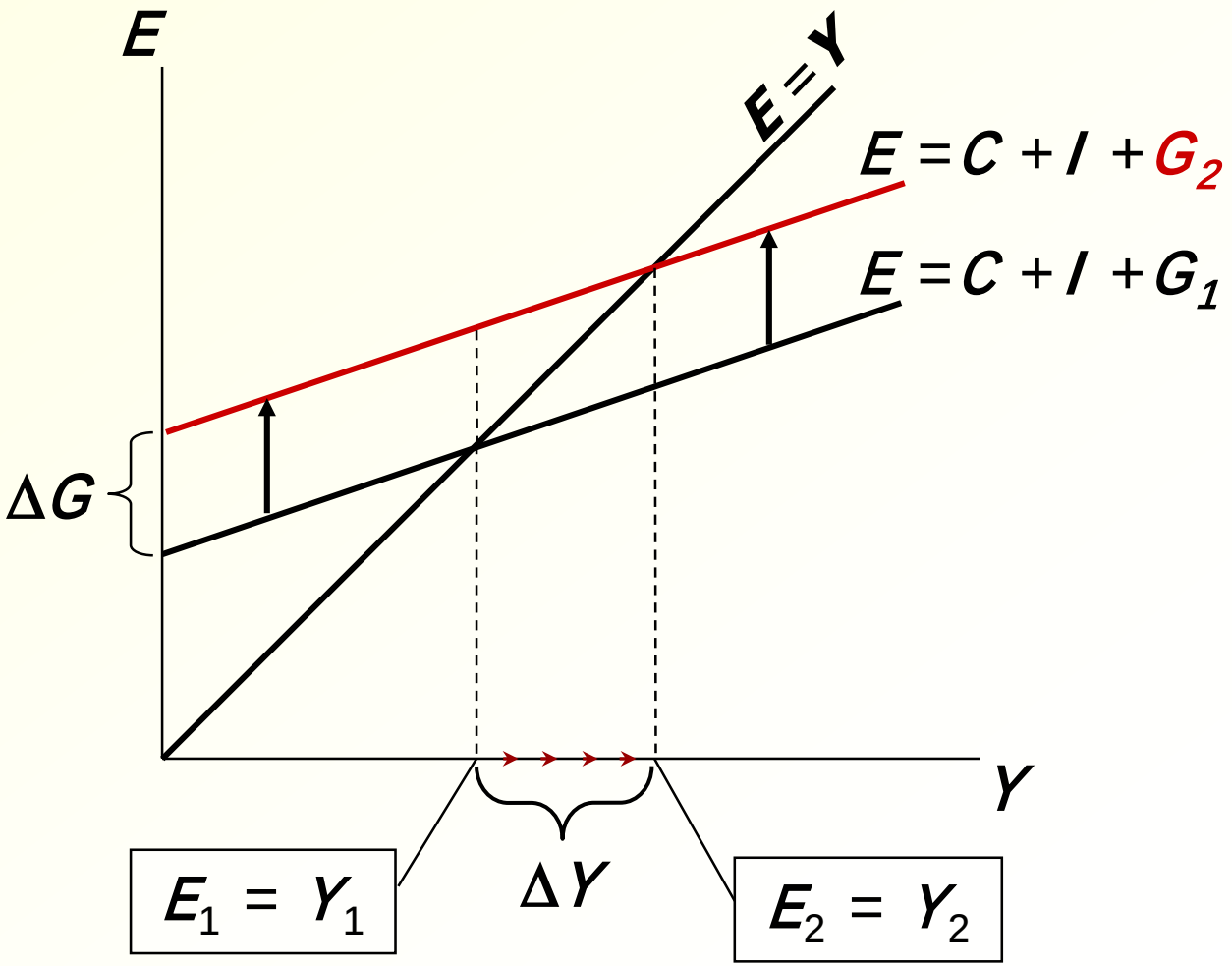
Graphing the equilibrium condition



The equilibrium value of income



An increase in government purchases



…so firms increase output, and income rises toward a new equilibrium

Solving for ΔY

$$Y = C + I + G \quad \text{equilibrium condition}$$

$$\Delta Y = \Delta C + \Delta I + \Delta G \quad \text{in changes}$$

$$= \Delta C + \Delta G \quad \text{because } I \text{ exogenous}$$

$$= \text{MPC} \times \Delta Y + \Delta G \quad \text{because } \Delta C = \text{MPC}\ \Delta Y$$

Collect terms with ΔY on the left side of the equals sign:

$$(1 - \text{MPC}) \times \Delta Y = \Delta G$$

Finally, solve for ΔY :

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

The government purchases multiplier

Example: MPC = 0.8

$$\Delta Y = \frac{1}{1 - \text{MPC}} \Delta G$$

$$= \frac{1}{1 - 0.8} \Delta G = \frac{1}{0.2} \Delta G = 5 \Delta G$$

The increase in ***G*** causes income to increase by 5 times as much!

The government purchases multiplier (政府购买乘数）

Definition: the increase in income resulting from a $1 increase in ***G***.

In this model, the ***G*** multiplier equals

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - \text{MPC}}$$

In the example with MPC = 0.8,

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - 0.8} = 5$$

Why the multiplier is greater than 1

- Initially, the increase in ***G*** causes an equal increase in ***Y:*** $\Delta Y = \Delta G$.
- But $\uparrow Y \Rightarrow \uparrow C$

  $\Rightarrow$ further $\uparrow Y$

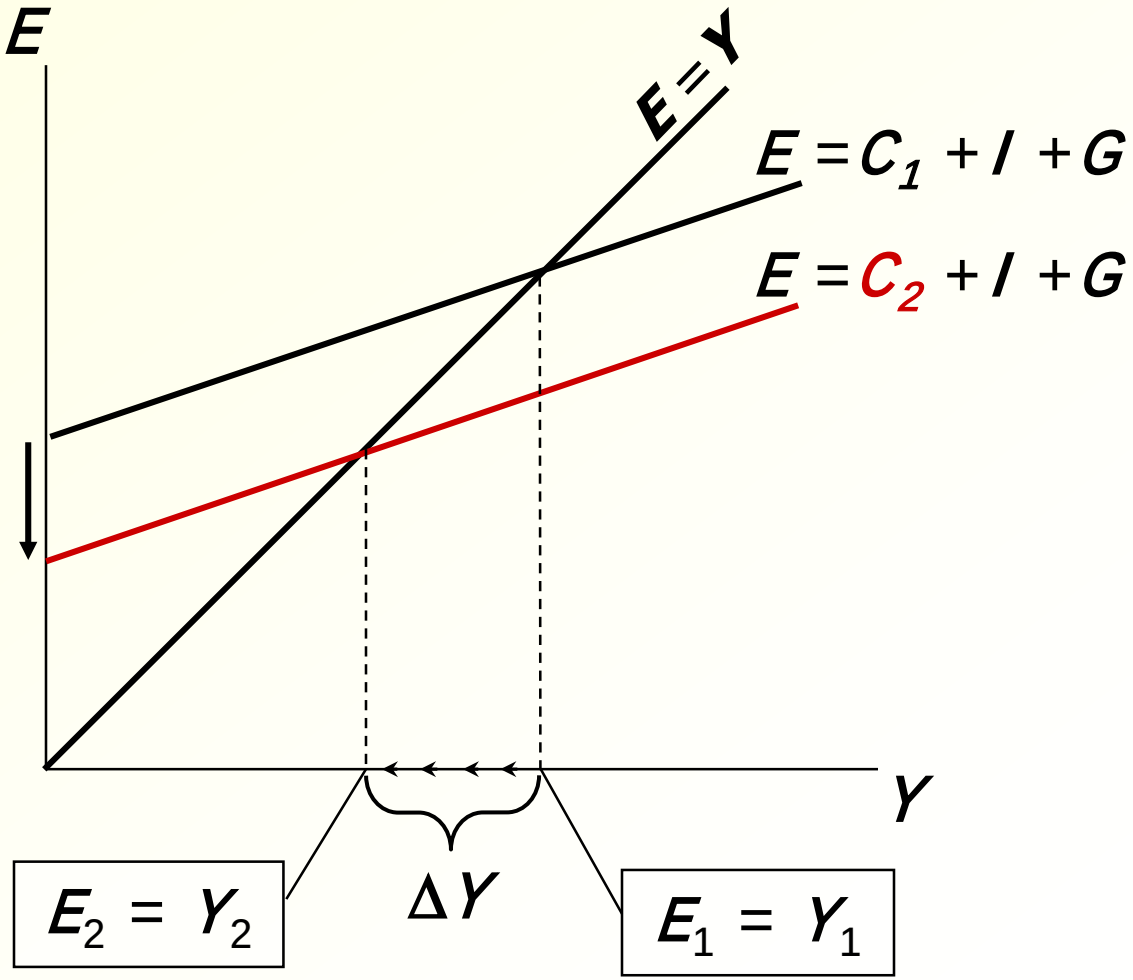
  $\Rightarrow$ further $\uparrow C$

  $\Rightarrow$ further $\uparrow Y$
- So the final impact on income is much bigger than the initial ΔG.

An increase in taxes

Initially, the tax increase reduces consumption, and therefore E:

$\Delta C = -\text{MPC}\,\Delta T$



…so firms reduce output, and income falls toward a new equilibrium

Solving for ΔY

$$\Delta Y = \Delta C + \Delta I + \Delta G$$

eq'm condition in changes

$$= \Delta C$$

I and G exogenous

$$= \text{MPC} \times (\Delta Y - \Delta T)$$

Solving for ΔY: $(1 - \text{MPC}) \times \Delta Y = -\text{MPC} \times \Delta T$

Final result:

$$\Delta Y = \left(\frac{-\text{MPC}}{1 - \text{MPC}} \right) \times \Delta T$$

The Tax Multiplier (税收乘数）

def: the change in income resulting from a \$1 increase in ***T*** :

$$\frac{\Delta Y}{\Delta T} = \frac{-\text{MPC}}{1-\text{MPC}}$$

If MPC = 0.8, then the tax multiplier equals

$$\frac{\Delta Y}{\Delta T} = \frac{-0.8}{1-0.8} = \frac{-0.8}{0.2} = -4$$

The Tax Multiplier

…is *negative:*
An increase in taxes reduces consumer spending, which reduces equilibrium income.

…is *greater than one if…* (*in absolute value*):
A change in taxes has a multiplier effect on income.

…is *smaller than the govt spending multiplier:*
Consumers save the fraction (1-MPC) of a tax cut, so the initial boost in spending from a tax cut is smaller than from an equal increase in ***G***.

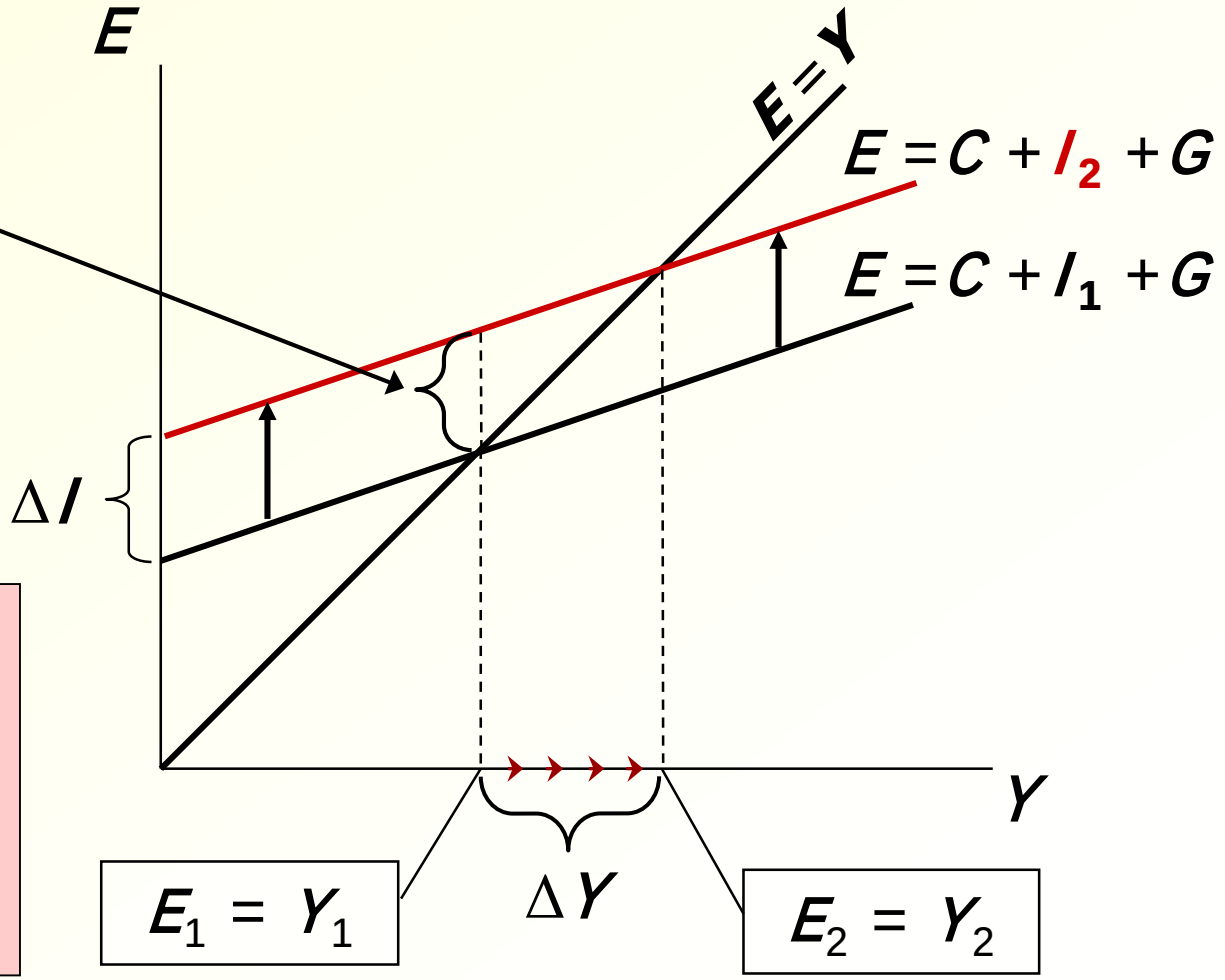
Exercise:

- Use a graph of the Keynesian Cross to show the impact of an increase in planned investment on the equilibrium level of income/output.

ANSWERS

Practice with the Keynesian cross

At Y_1,
there is now an unplanned drop in inventory…



…so firms increase output, and income rises toward a new equilibrium.

The *IS* curve

def: a graph of all combinations of ***r*** and ***Y*** that result in goods market equilibrium,

i.e. actual expenditure (output)
= planned expenditure

The equation for the *IS* curve is:

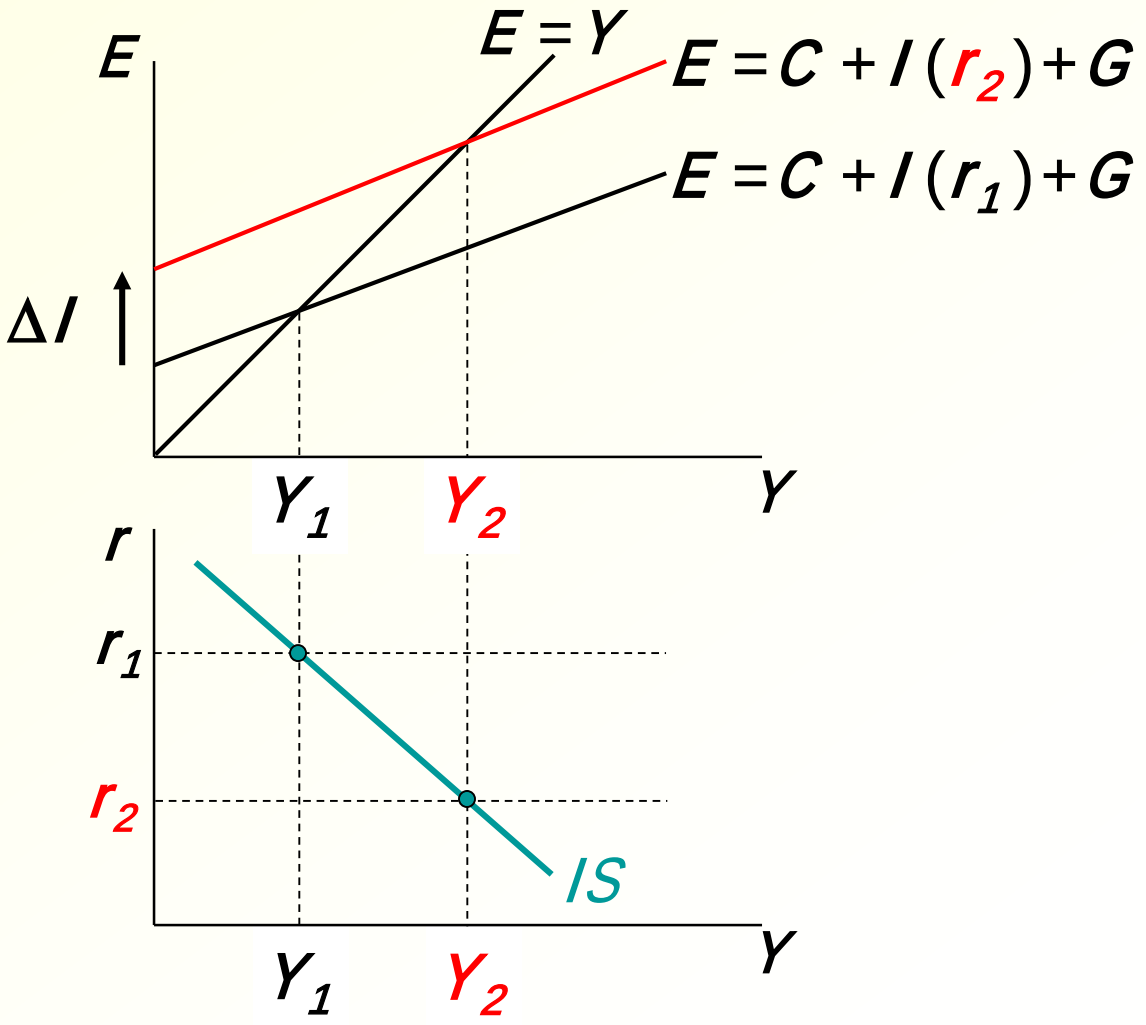
$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

Deriving the *IS* curve

$\downarrow r \Rightarrow \uparrow I$

$\Rightarrow \uparrow E$

$\Rightarrow \uparrow Y$



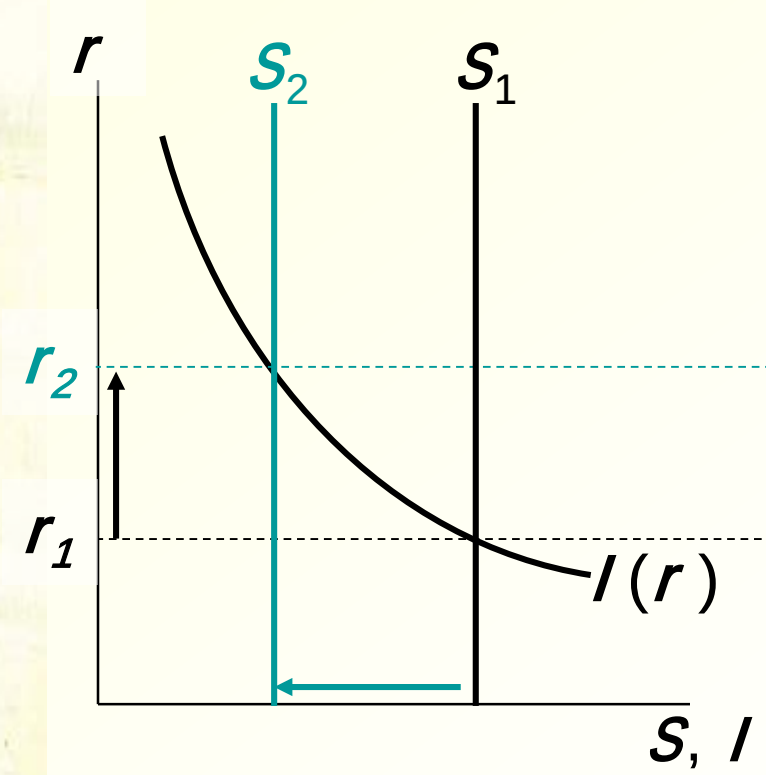
Understanding the *IS* curve's slope

- The *IS* curve is negatively sloped.
- Intuition:
  A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending (***E***).

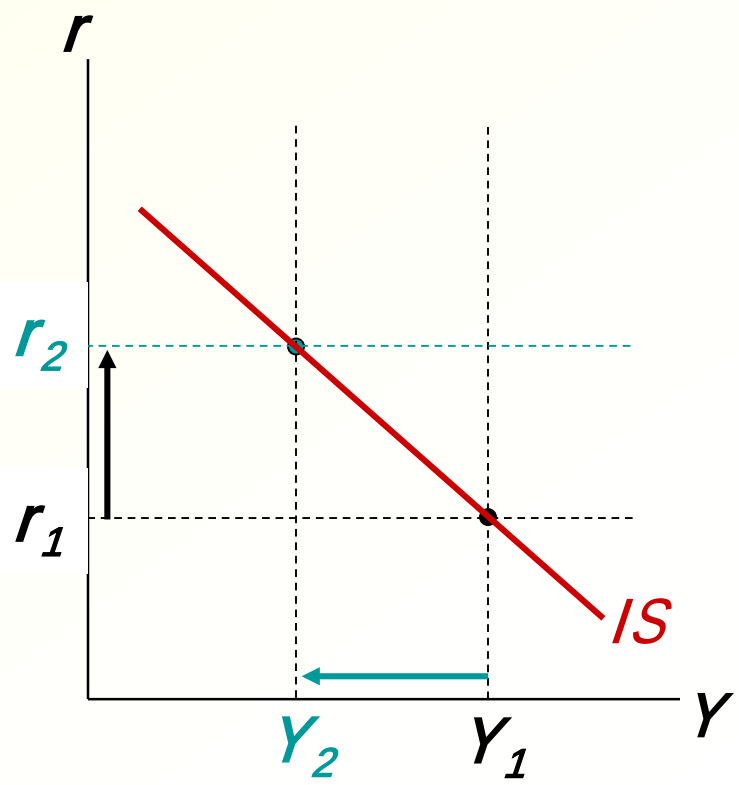
  To restore equilibrium in the goods market, output (***Y***) must increase.

The IS curve and the Loanable Funds model： A decrease in income from Y1 to Y2 causes a fall in national saving.

(a) The L.F. model



(b) The *IS* curve



Fiscal Policy and the *IS* curve

- We can use the *IS-LM* model to see how fiscal policy (***G*** and ***T***) can affect aggregate demand and output.
- Let's start by using the Keynesian Cross to see how fiscal policy shifts the *IS* curve…

Shifting the *IS* curve: ΔG

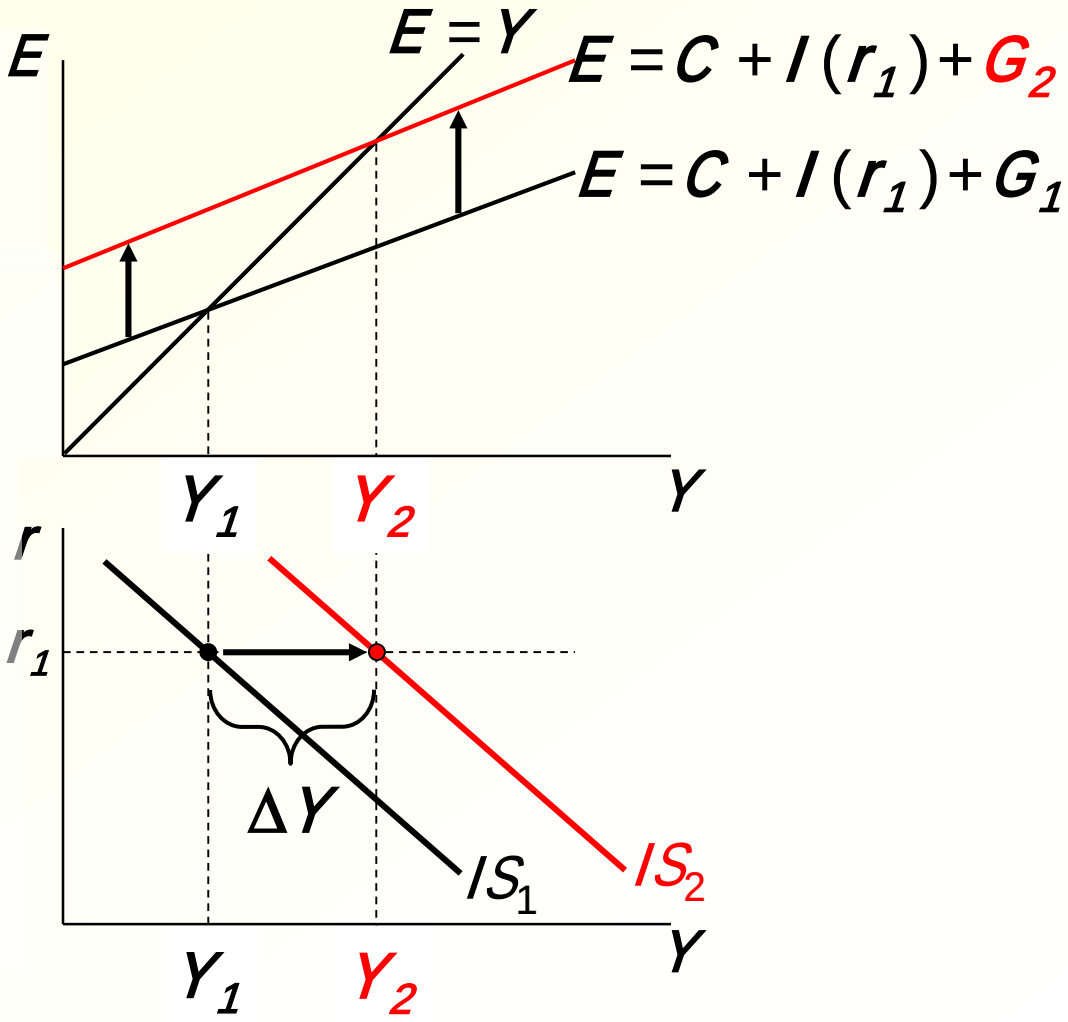
At any value of r,

$\uparrow G \Rightarrow \uparrow E \Rightarrow \uparrow Y$

…so the IS curve shifts to the right.

The horizontal distance of the IS shift equals

$$\Delta Y = \frac{1}{1-\text{MPC}} \Delta G$$



Exercise: Shifting the IS curve

- Use the diagram of the Keynesian Cross or Loanable Funds model to show how a decrease in taxes shifts the *IS* curve.

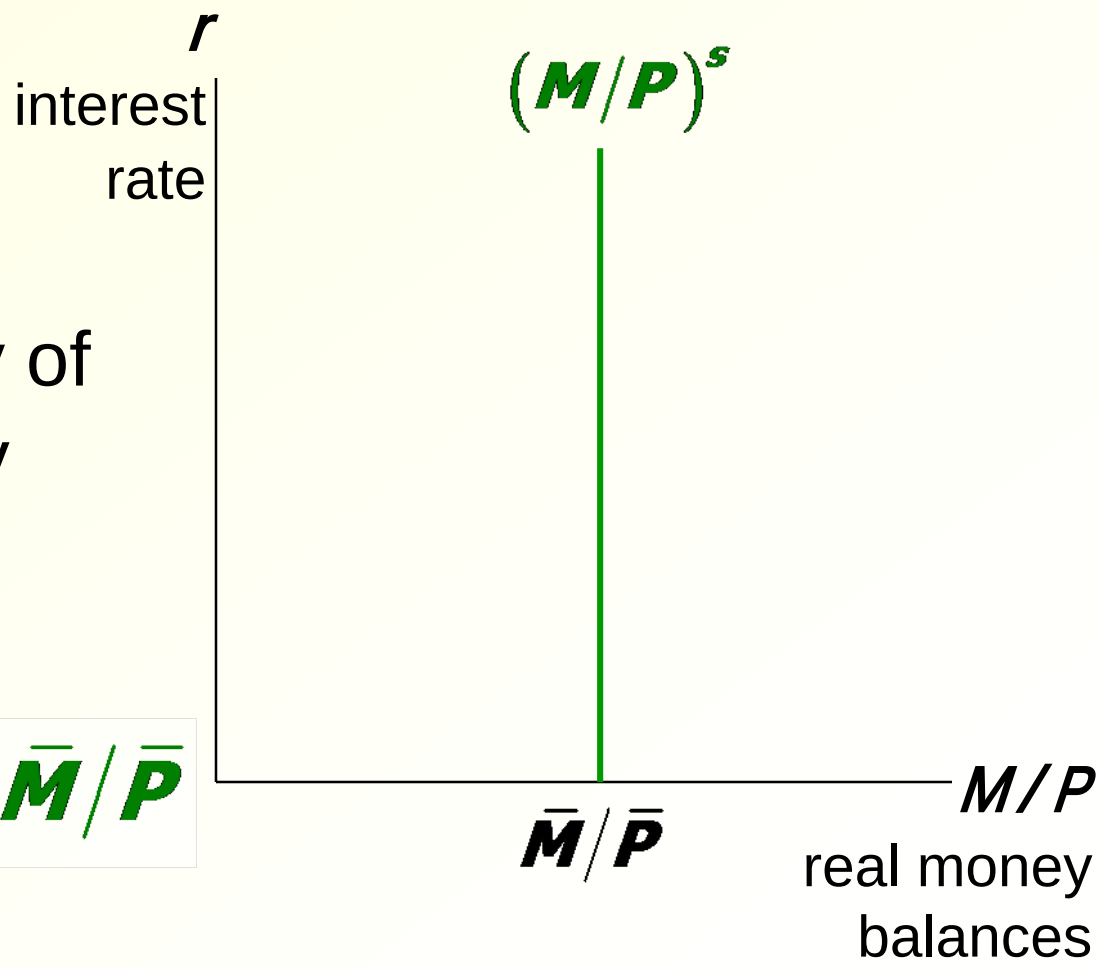
The Theory of Liquidity Preference （流动偏好理论）

- due to John Maynard Keynes.
- A simple theory in which the interest rate is determined by money supply and money demand.

Money Supply

The supply of real money balances is fixed:

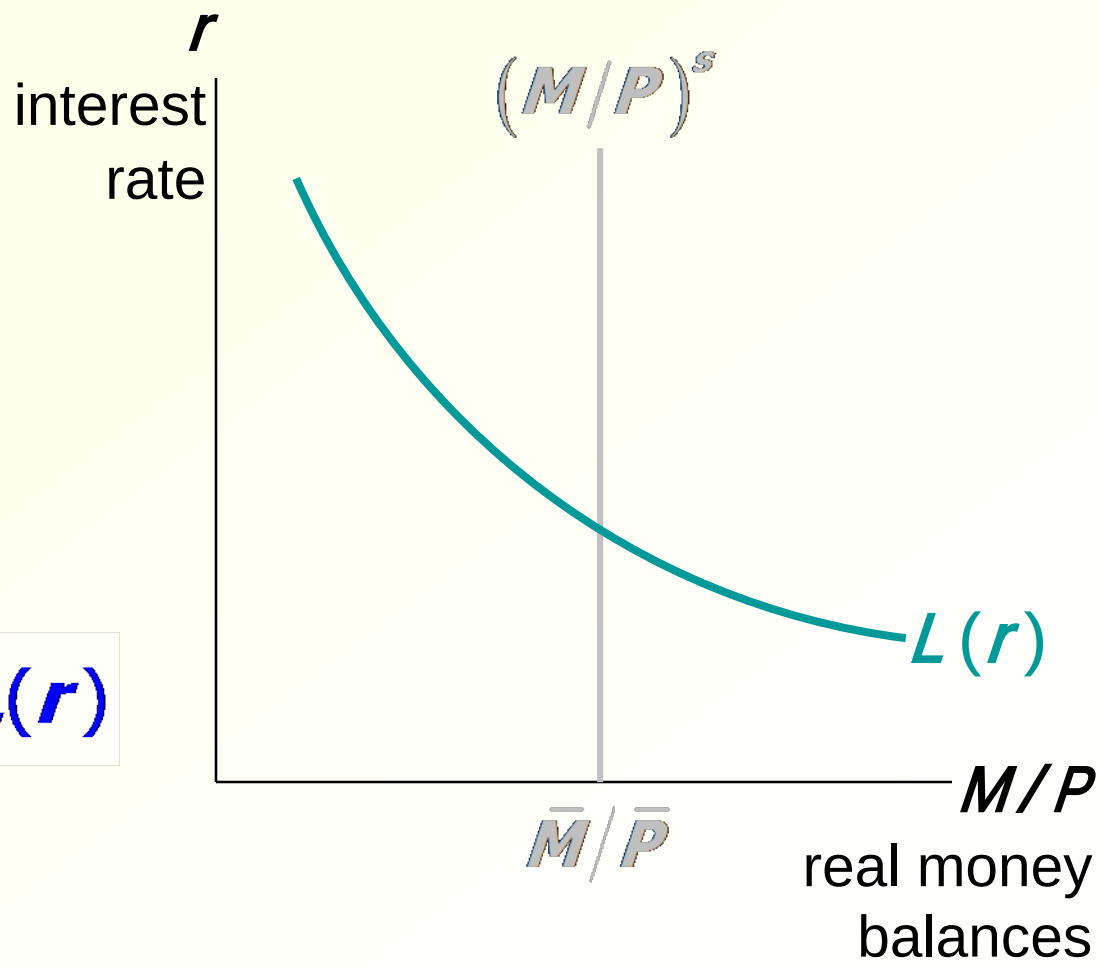
$$\left(M/P\right)^{s} = \bar{M}/\bar{P}$$



Money Demand

Demand for real money balances:

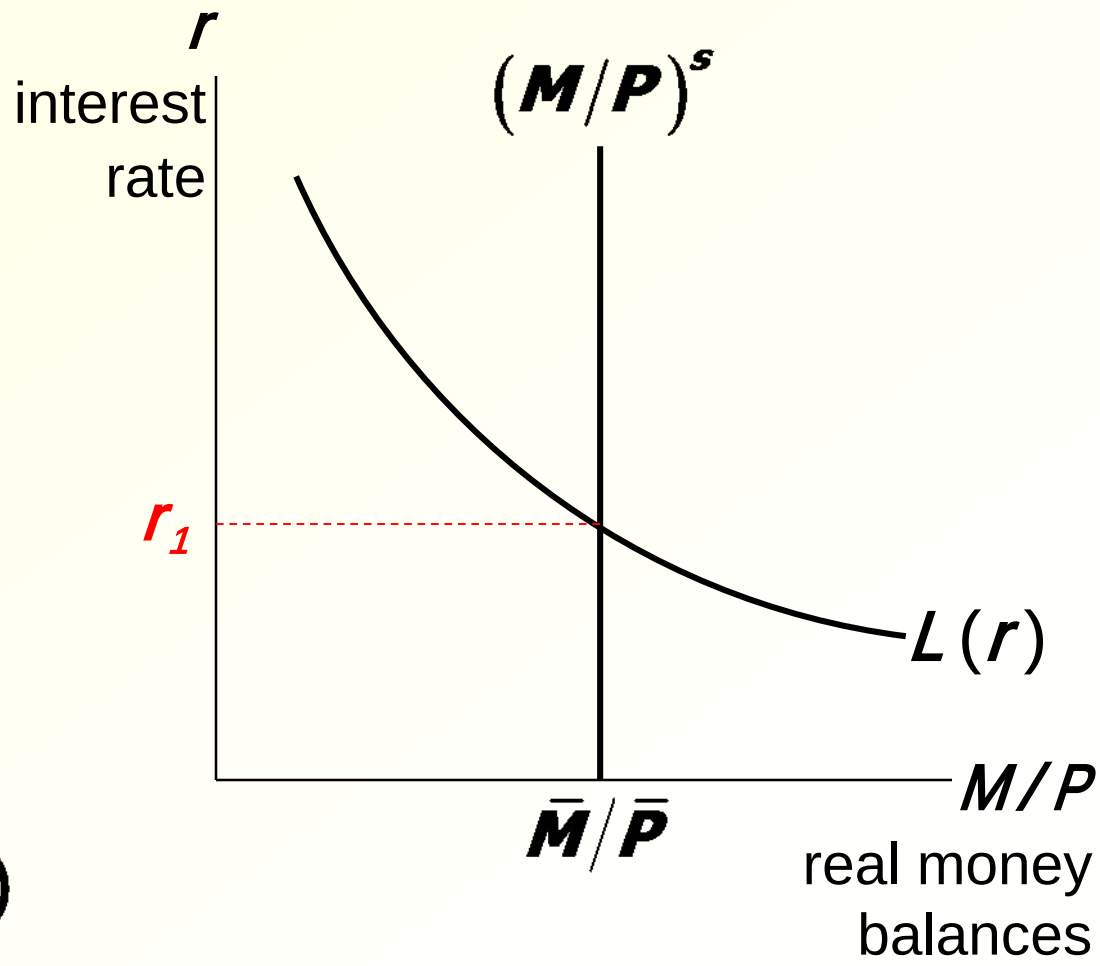
$$(M/P)^d = L(r)$$



Equilibrium

The interest rate adjusts to equate the supply and demand for money:

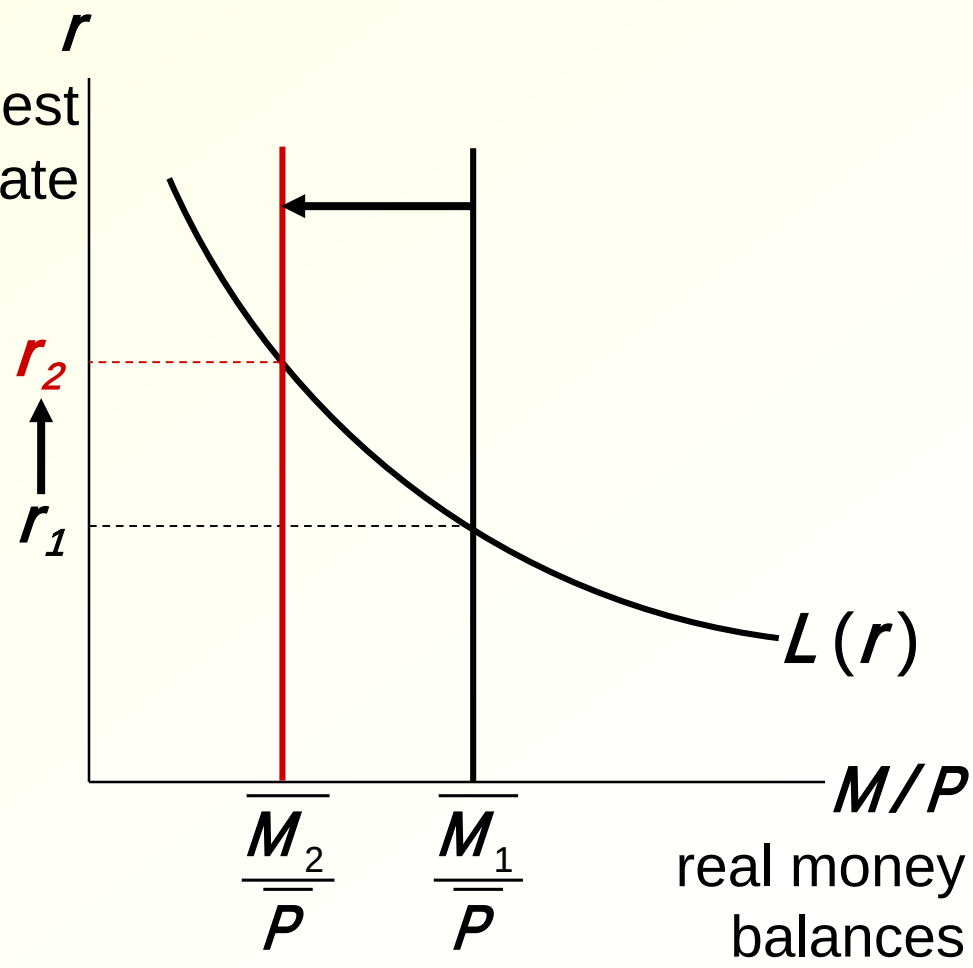
$$\overline{M}/\overline{P} = L(r)$$



How the central bank raises the interest rate

To increase ***r***,

the central bank reduces ***M***



CASE STUDY:

Monetary Tightening & Interest Rates

- Late 1970s: π > 10%
- Oct 1979: Fed Chairman Paul Volcker announces that monetary policy would aim to reduce inflation
- Aug 1979–April 1980: Fed reduces ***M/P*** 8.0%
- Jan 1983: π = 3.7%

How do you think this policy change would affect nominal interest rates?

Monetary Tightening & Interest Rates, *cont.*

The effects of a monetary tightening on nominal interest rates		
	short run	*long run*
model	liquidity preference *(Keynesian)*	Quantity theory, Fisher effect *(Classical)*
prices	sticky	flexible
prediction	$\Delta i > 0$	$\Delta i < 0$
actual outcome	8/1979: i = 10.4% 4/1980: i = 15.8%	8/1979: i = 10.4% 1/1983: i = 8.2%

The *LM* curve

Now let's put Y back into the money demand function:

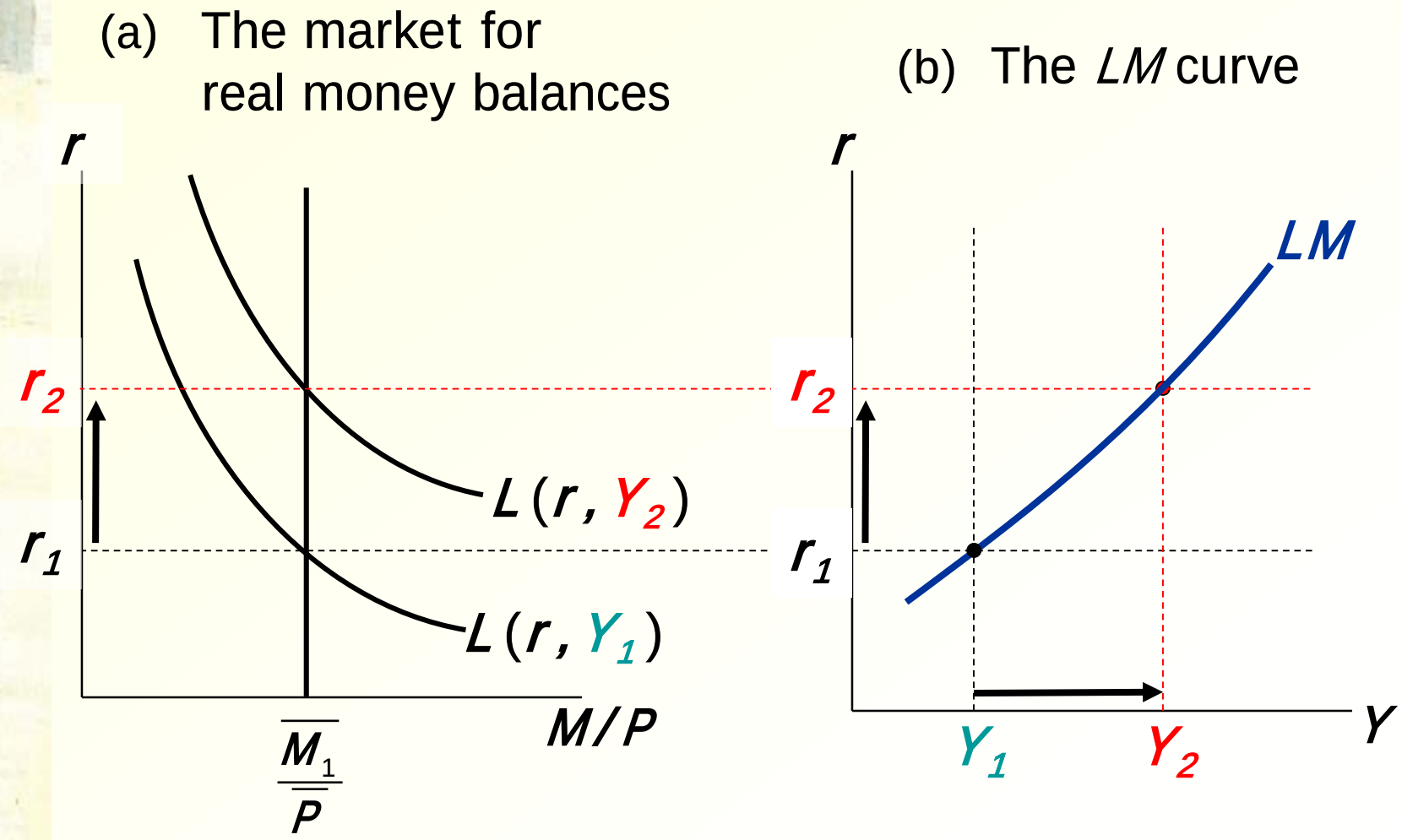
$$(M/P)^d = L(r, Y)$$

The ***LM* curve** is a graph of all combinations of r and Y that equate the supply and demand for real money balances.

The equation for the *LM* curve is:

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

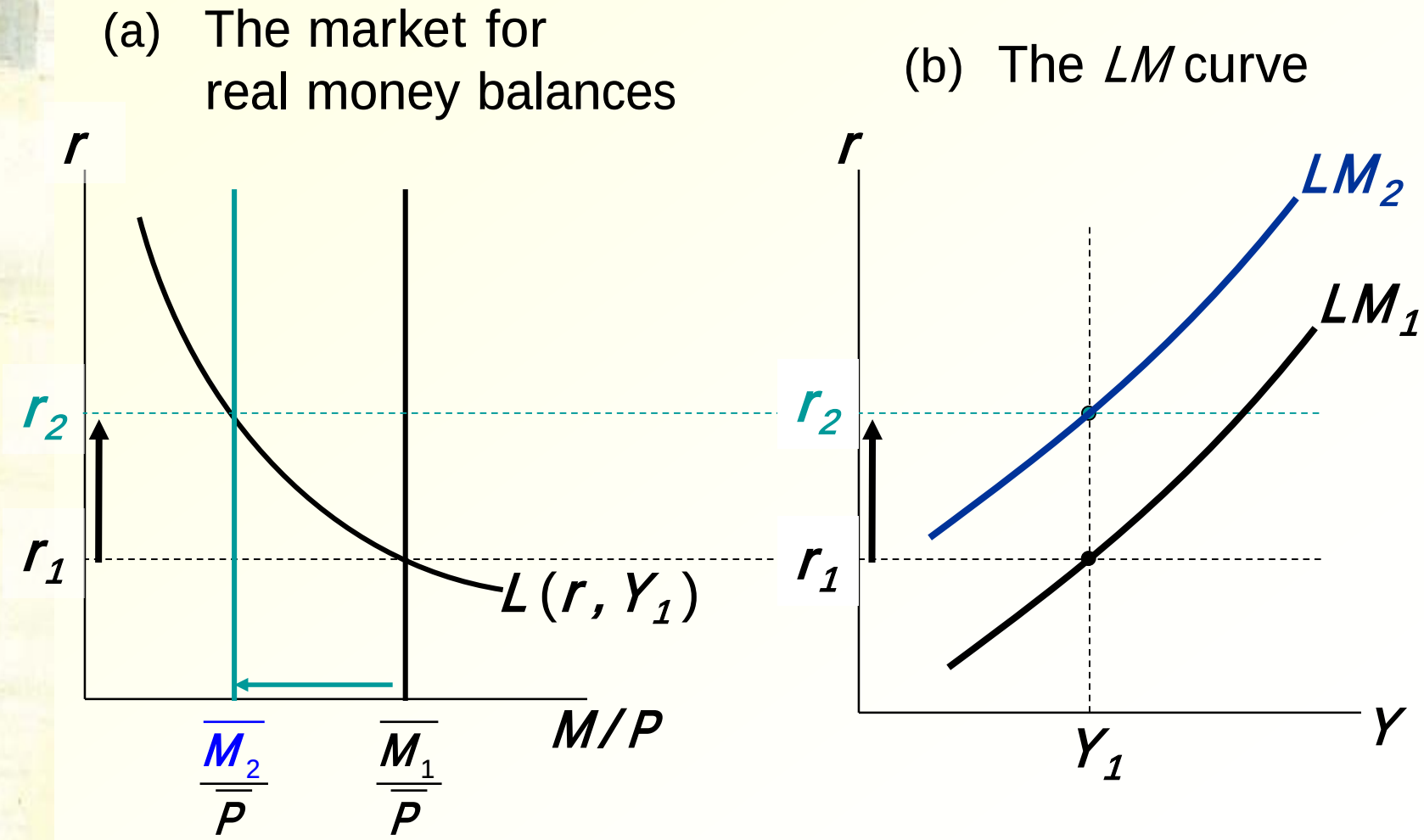
Deriving the *LM* curve



Understanding the slope of the *LM* curve

- The *LM* curve is positively sloped.
- Intuition:
  An increase in income raises money demand.
  Since the supply of real balances is fixed, there is now excess demand in the money market at the initial interest rate.
  The interest rate must rise to restore equilibrium in the money market.

How ΔM shifts the *LM* curve

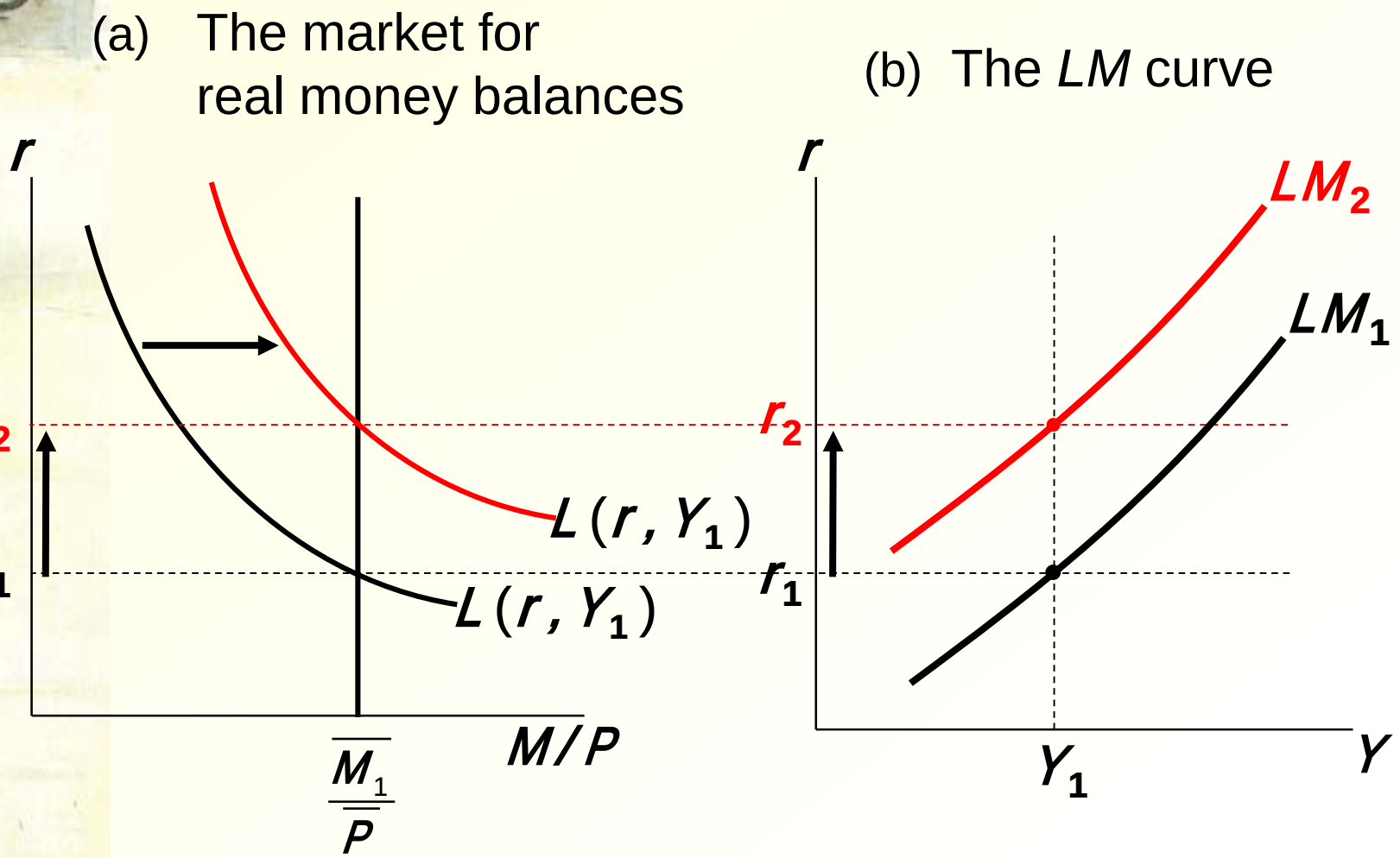


Exercise: Shifting the LM curve

- Suppose a wave of credit card fraud causes consumers to use cash more frequently in transactions.
- Use the Liquidity Preference model to show how these events shift the *LM* curve.
- This causes an increase in money demand. In the Liquidity Preference diagram, the money demand curve shifts up. As a result, the LM curve shifts up.

ANSWERS

Shifting the *LM* curve

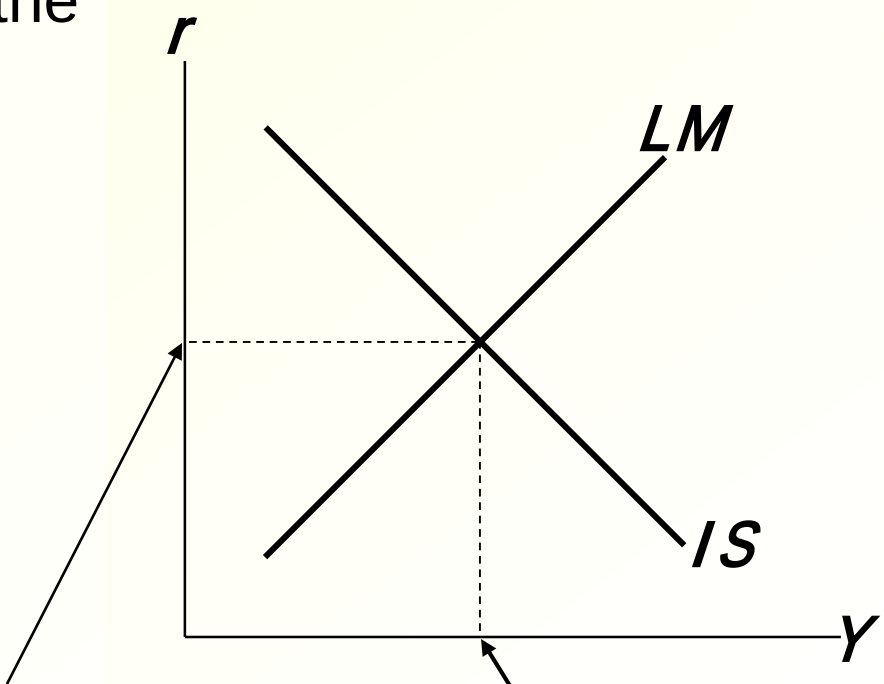


The short-run equilibrium

The short-run equilibrium is the combination of r and Y that simultaneously satisfies the equilibrium conditions in the goods & money markets:

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

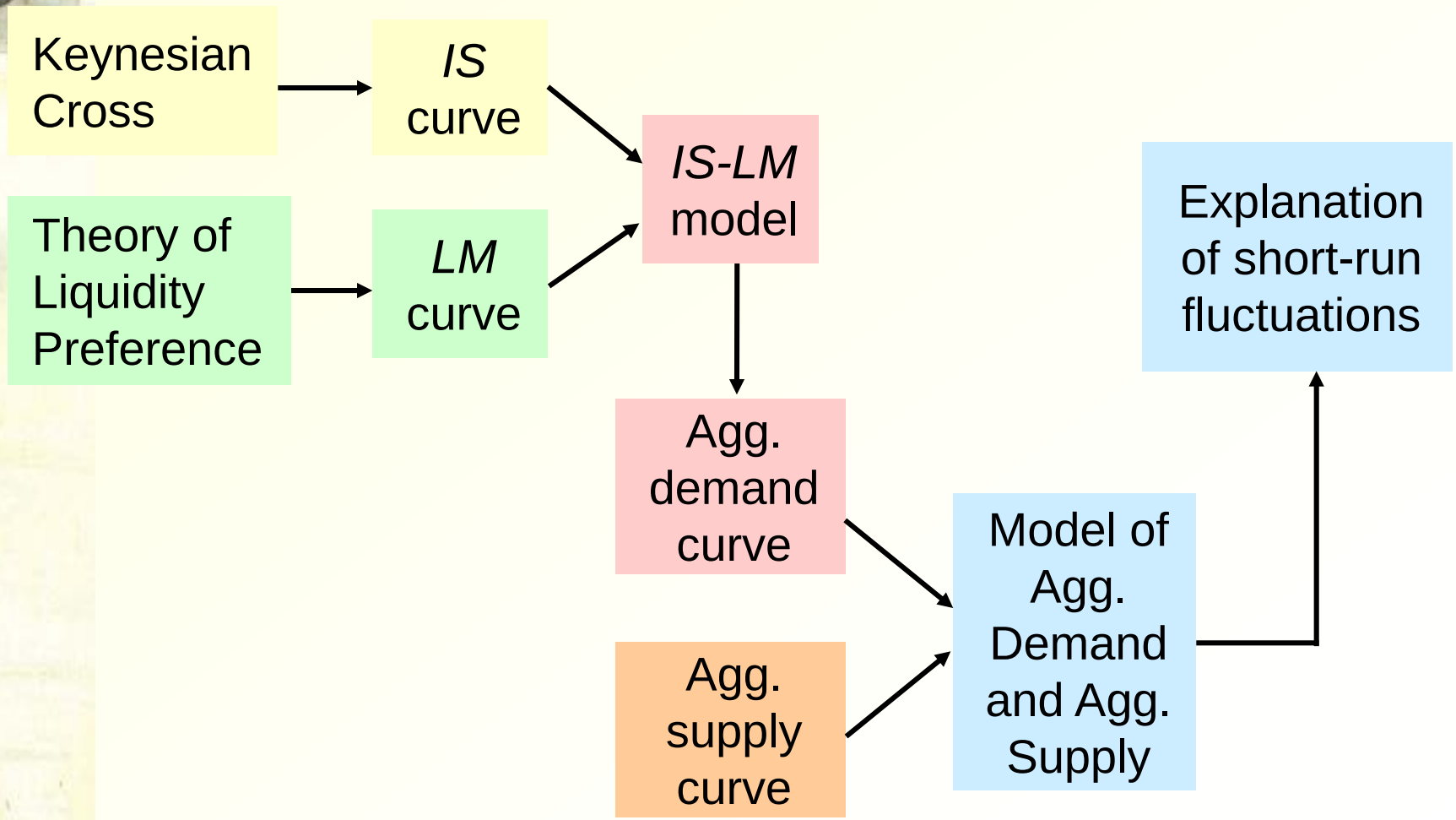
$$\bar{M}/\bar{P} = L(r, Y)$$



Equilibrium interest rate

Equilibrium level of income

The Big Picture



Chapter summary

1. Keynesian Cross
   - basic model of income determination
   - takes fiscal policy & investment as exogenous
   - fiscal policy has a multiplied impact on income.
2. *IS* curve
   - comes from Keynesian Cross: planned investment depends negatively on interest rate
   - shows all combinations of ***r*** and ***Y*** that equate planned expenditure with actual expenditure on goods & services

Chapter summary

3. Theory of Liquidity Preference
   (流动偏好理论）
   - basic model of interest rate determination
   - takes money supply & price level as exogenous
   - an increase in the money supply lowers the interest rate

3. *LM* curve
   - comes from Liquidity Preference Theory when money demand depends positively on income
   - shows all combinations of ***r*** and ***Y*** that equate demand for real money balances with supply

Chapter summary

5. *IS-LM* model
   - Intersection of *IS* and *LM* curves shows the unique point (***Y***, ***r***) that satisfies equilibrium in **both** the goods and money markets.

Preview of Chapter 12

In Chapter 12, we will

- use the *IS-LM* model to analyze the impact of policies and shocks
- learn how the aggregate demand curve comes from *IS-LM*
- use the *IS-LM* and *AD-AS* models together to analyze the short-run and long-run effects of shocks
- learn about the Great Depression using our models