C H A P T E R

10

Aggregate Demand I: Building the *IS-LM* Model

MACROECONOMICS SIXTH EDITION

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PowerPoint® Slides by Ron Cronovich

In this chapter, you will learn…

- the *IS* curve, and its relation to
    - the Keynesian cross
    - the loanable funds model

- the *LM* curve, and its relation to
    - the theory of liquidity preference

- how the *IS-LM* model determines income and the interest rate in the short run when **P** is fixed

Context

- Chapter 9 introduced the model of aggregate demand and aggregate supply.

- Long run
  - prices flexible
  - output determined by factors of production & technology
  - unemployment equals its natural rate

- Short run
  - prices fixed
  - output determined by aggregate demand
  - unemployment negatively related to output

Context

- This chapter develops the *IS-LM* model, the basis of the aggregate demand curve.

- We focus on the short run and assume the price level is fixed (so, *SRAS* curve is horizontal).

- This chapter (and chapter 11) focus on the closed-economy case.
  Chapter 12 presents the open-economy case.

The Keynesian Cross

- A simple closed economy model in which income is determined by expenditure.
  (due to J.M. Keynes)

- Notation:

  I = planned investment

  $E = C + I + G$ = planned expenditure

  Y = real GDP = actual expenditure

- Difference between actual & planned expenditure = unplanned inventory investment

Elements of the Keynesian Cross

consumption function:

$$C = C(Y - T)$$

govt policy variables:

$$G = \overline{G}, \quad T = \overline{T}$$

for now, planned
investment is exogenous:

$$I = \overline{I}$$

planned expenditure:

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

equilibrium condition:

actual expenditure = planned expenditure
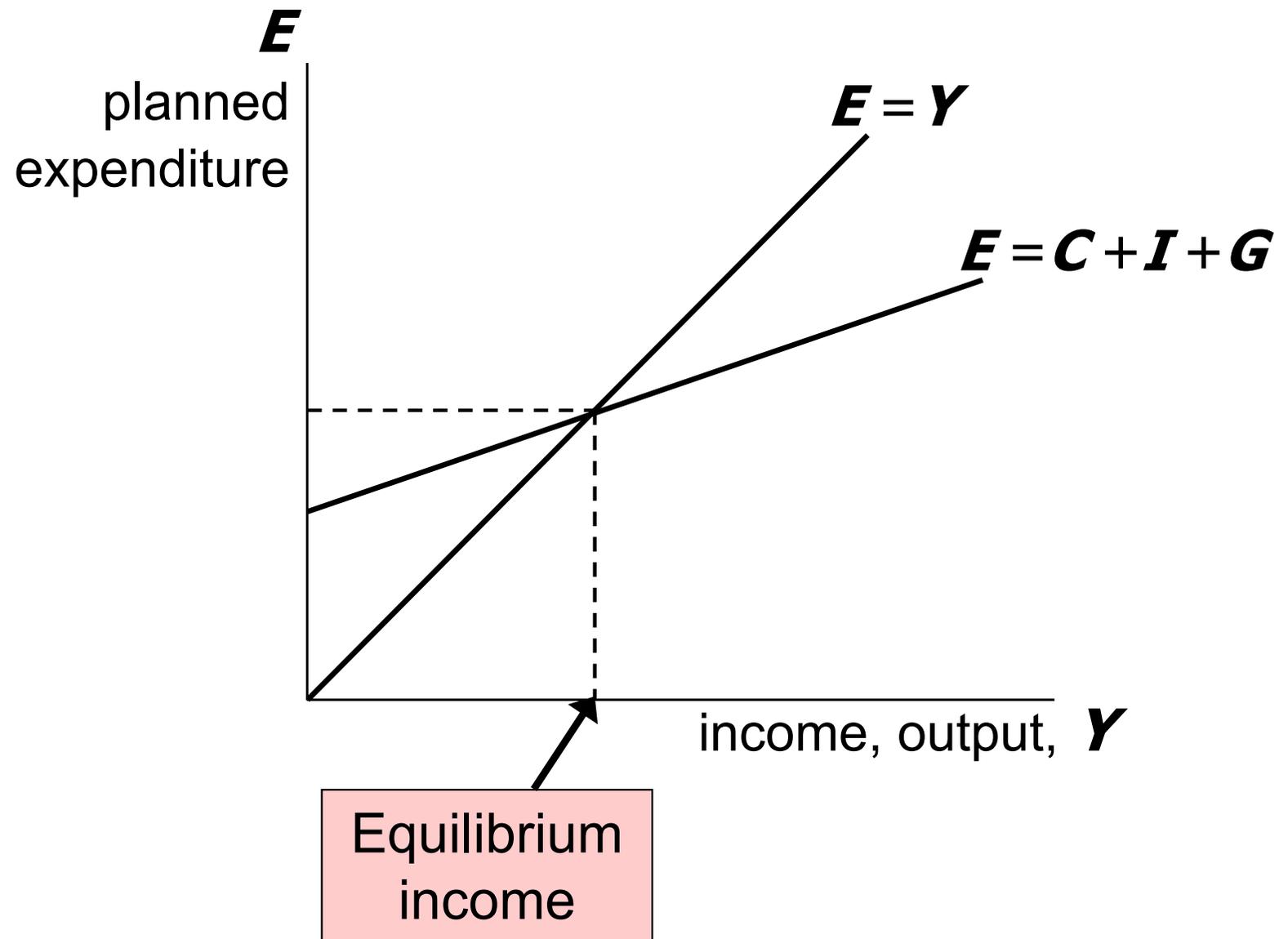
$$Y = E$$

Graphing planned expenditure

E

planned expenditure

$$E = C + I + G$$

MPC

1
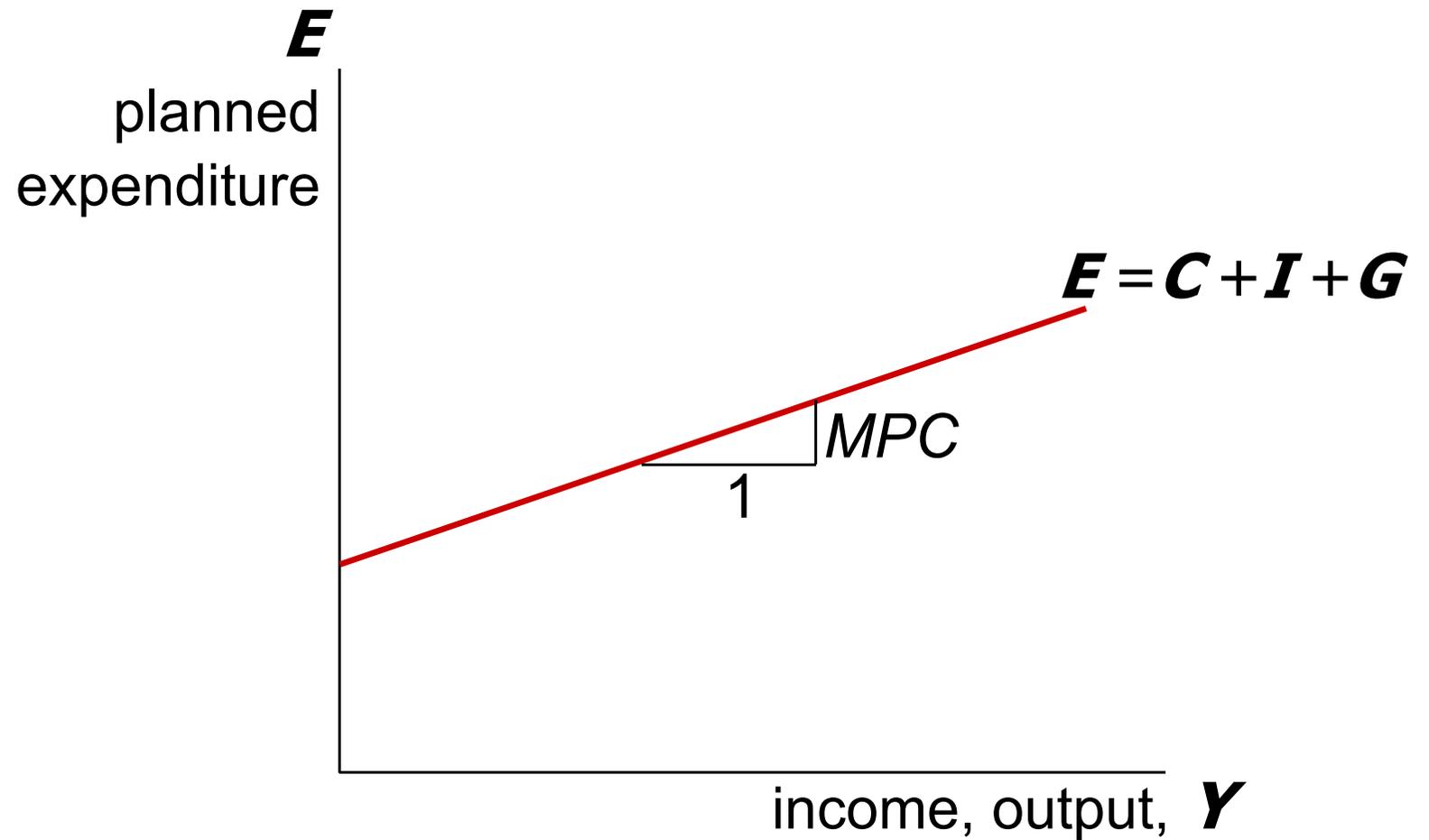
income, output, Y

Graphing the equilibrium condition

E

planned expenditure

$E = Y$

45°
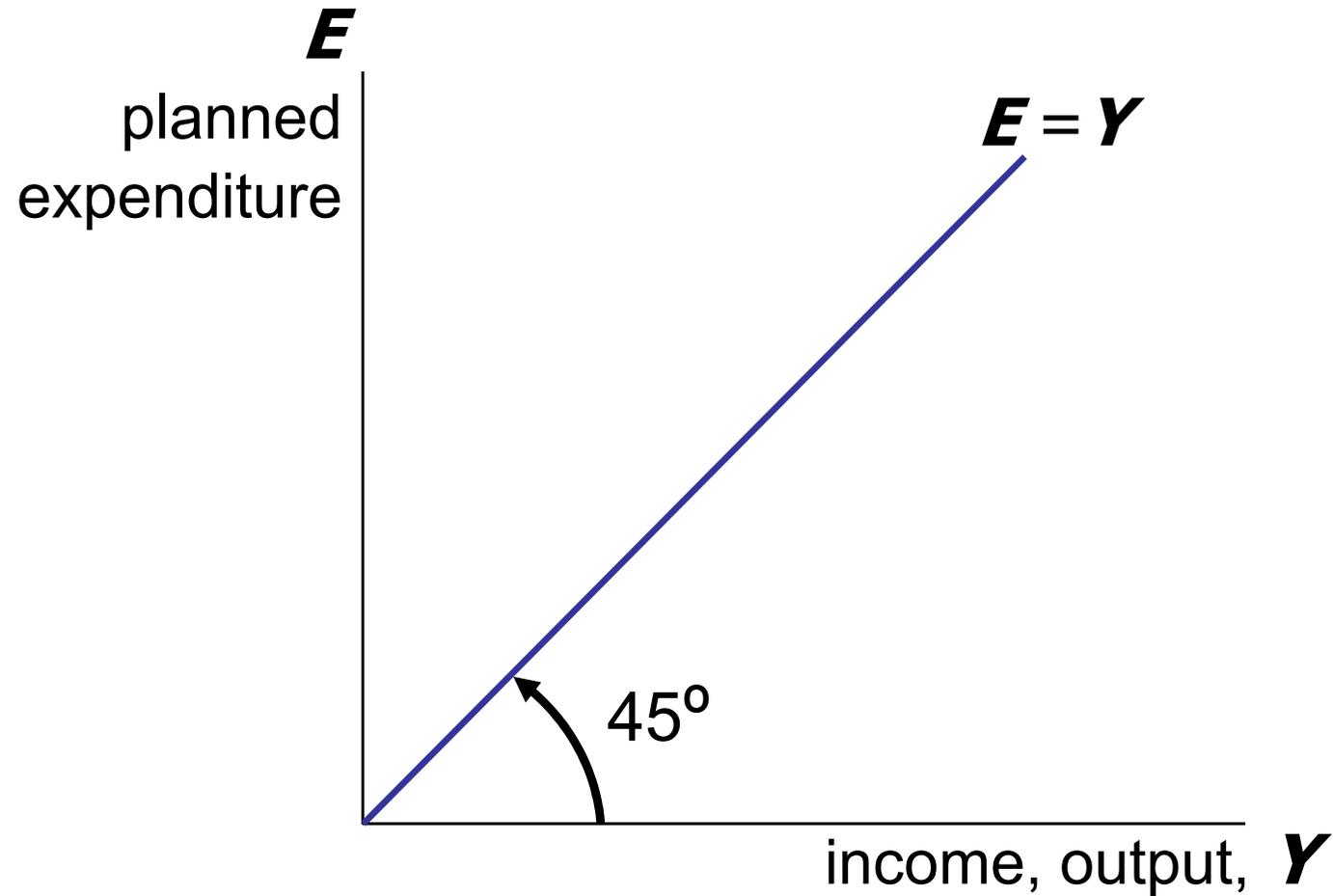
income, output, Y

The equilibrium value of income

E

planned expenditure

$E = Y$
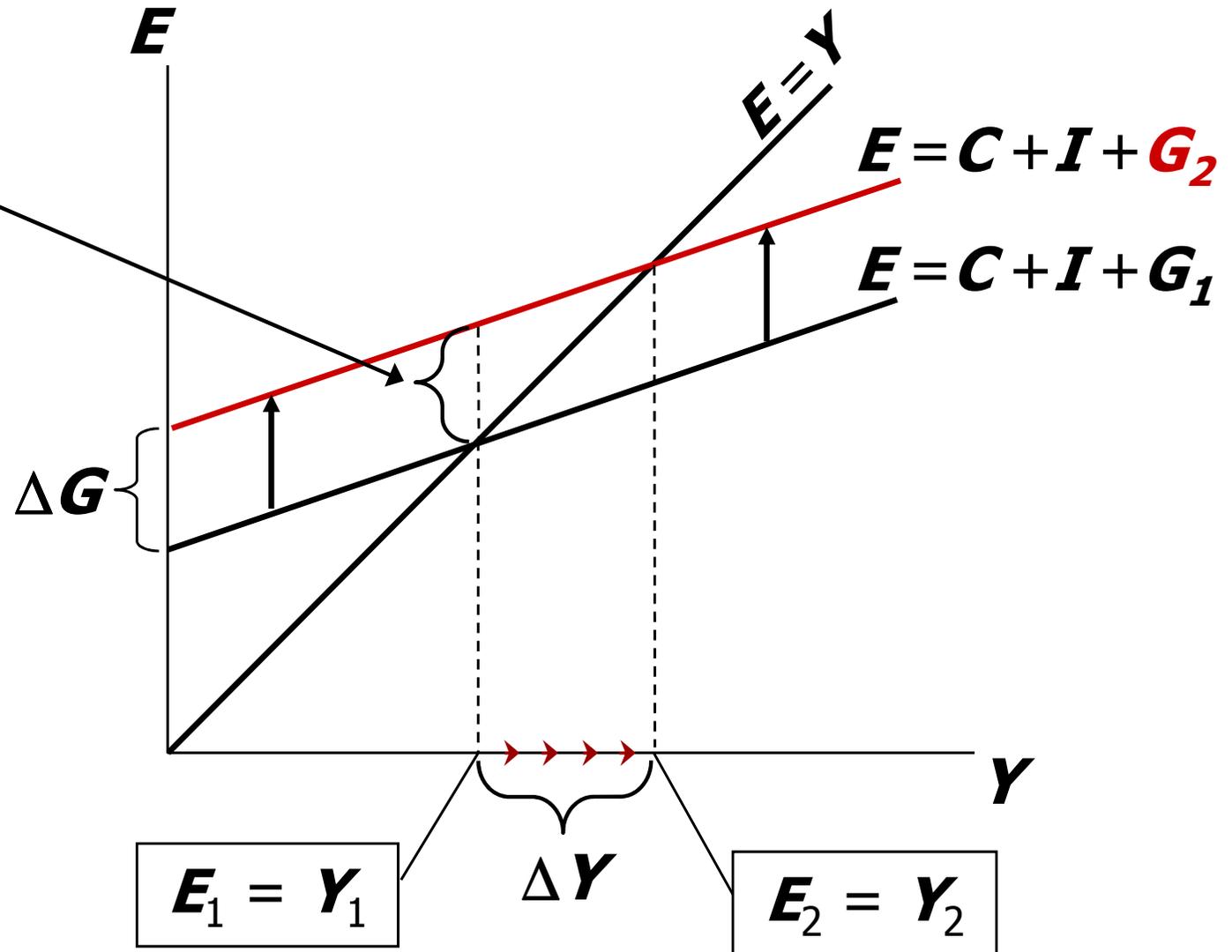
$E = C + I + G$

income, output, Y

Equilibrium income

An increase in government purchases

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

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

$E = Y$

$E = C + I + G_2$

$E = C + I + G_1$

ΔG

ΔY

$E_1 = Y_1$

$E_2 = Y_2$

Solving for ΔY

$$Y = C + I + G$$ equilibrium condition

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

$$= \Delta C + \Delta G$$ because I exogenous

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

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

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

Solve for ΔY :

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

The government purchases multiplier

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

In this model, the govt purchases multiplier equals

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

Example: If *MPC* = 0.8, then

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

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

Why the multiplier is greater than 1

- Initially, the increase in **G** causes an equal increase in **Y:** $\quad \Delta Y = \Delta G$.

- But $\uparrow Y \Rightarrow \uparrow C$

$$\Rightarrow \text{further } \uparrow Y$$

$$\Rightarrow \text{further } \uparrow C$$

$$\Rightarrow \text{further } \uparrow Y$$

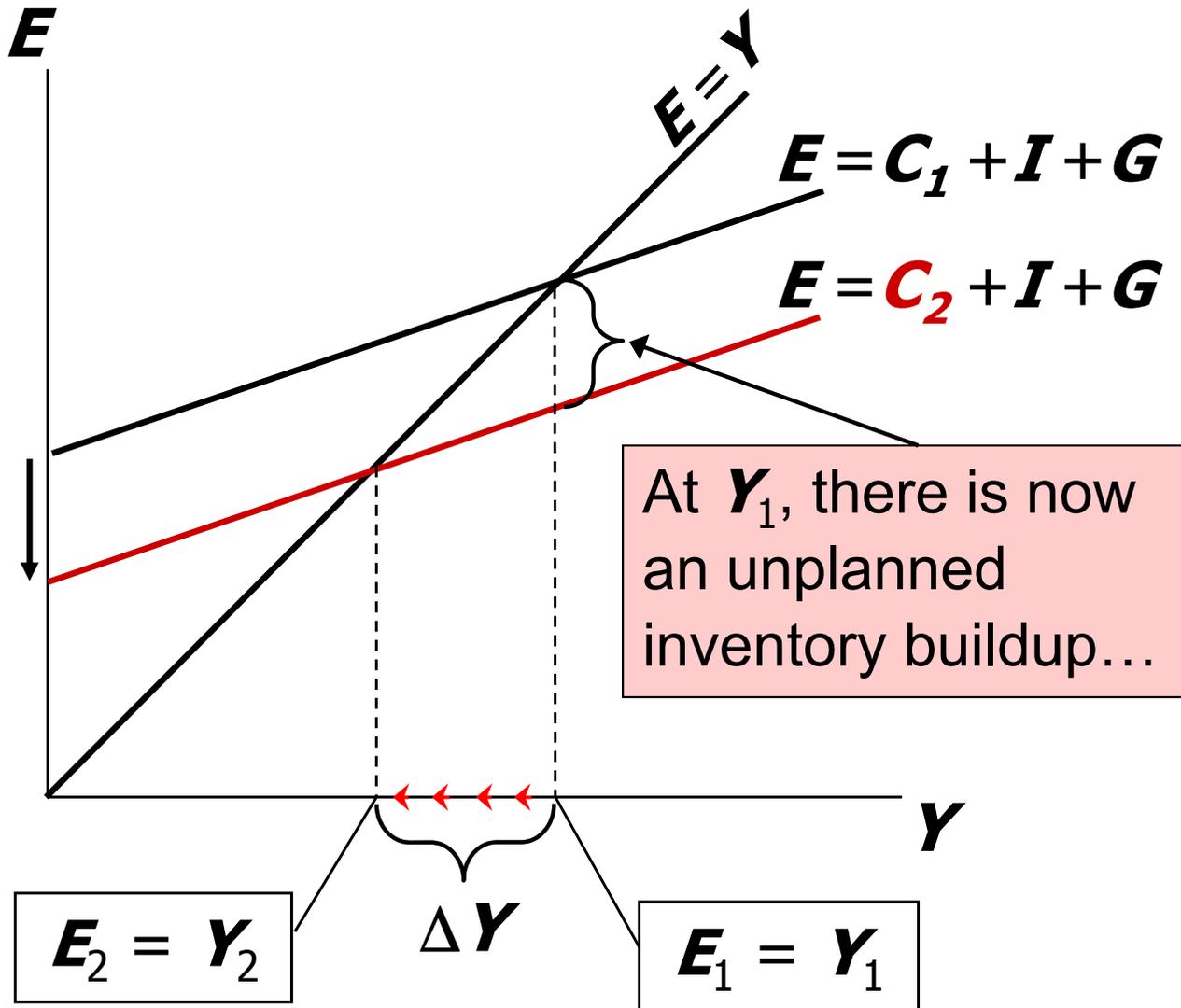- So the final impact on income is much bigger than the initial ΔG.

An increase in taxes

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

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

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

At Y_1, there is now an unplanned inventory buildup…

$E = Y$

$E = C_1 + I + G$

$E = C_2 + I + G$

$E_2 = Y_2$

ΔY

$E_1 = Y_1$

Solving for ΔY

$$\Delta Y = \Delta C + \Delta I + \Delta G \qquad \text{eq'm condition in changes}$$

$$= \Delta C \qquad\qquad I \text{ and } G \text{ exogenous}$$

$$= MPC \times (\Delta Y - \Delta T)$$

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

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

The tax multiplier

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

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

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:*
A tax increase reduces **C**, which reduces income.

…is *greater than one*
 (*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 effects of an increase in planned investment on the equilibrium level of income/output.

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:

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

Deriving the *IS* curve

$$\downarrow r \Rightarrow \uparrow I$$

$$\Rightarrow \uparrow E$$

$$\Rightarrow \uparrow Y$$

E

$E = Y$

$E = C + I(r_2) + G$

$E = C + I(r_1) + G$

ΔI

$Y_1 \quad Y_2 \qquad Y$

r

r_1

r_2

IS

$Y_1 \quad Y_2 \qquad Y$
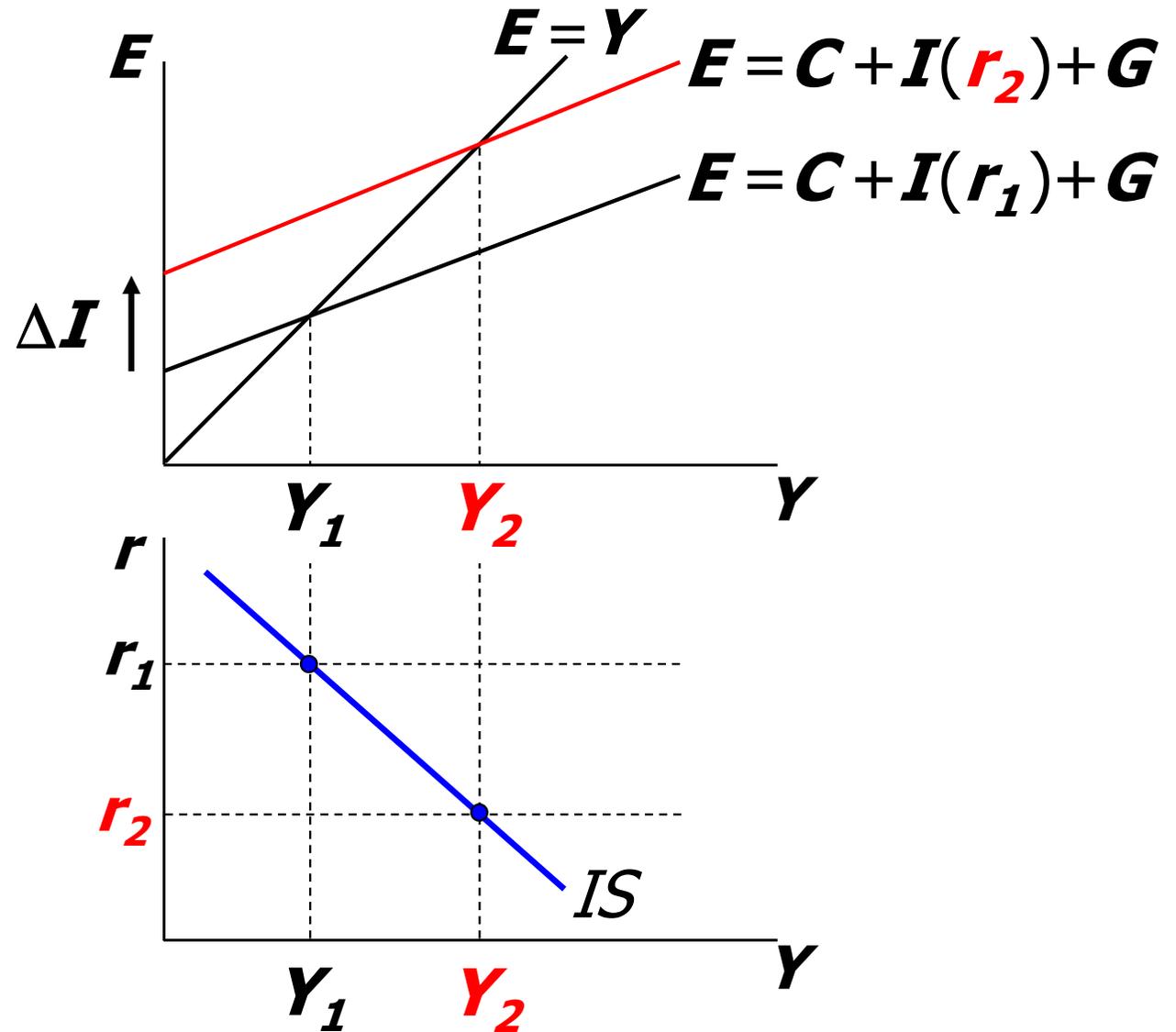
Why the *IS* curve is negatively sloped

- 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 (*a.k.a.* actual expenditure, **Y**) must increase.

The *IS* curve and the loanable funds model

(a) The L.F. model
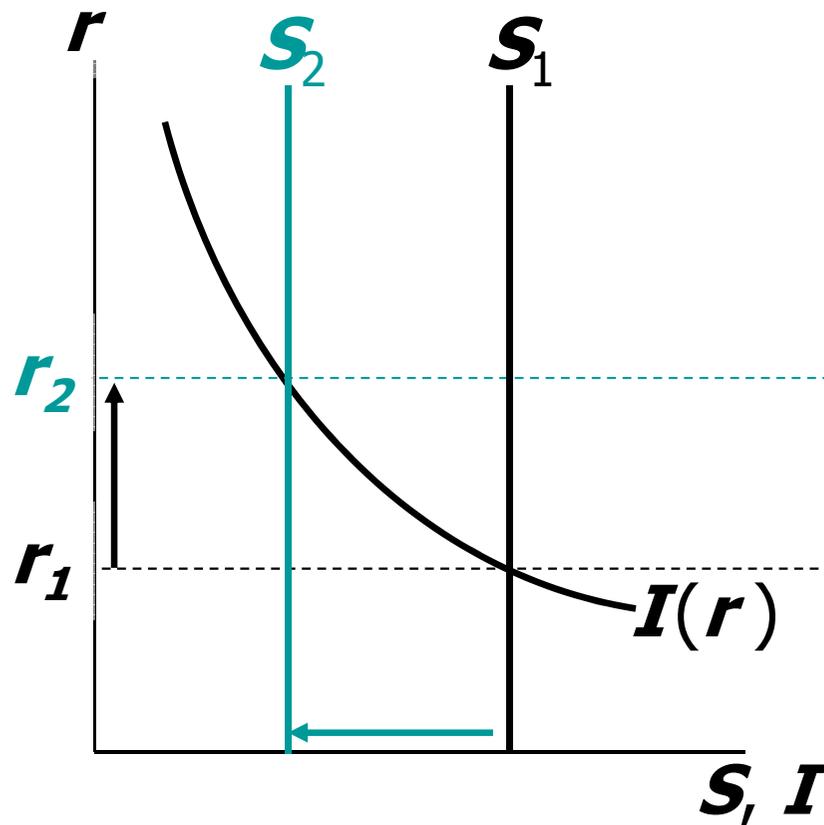
(b) The *IS* curve
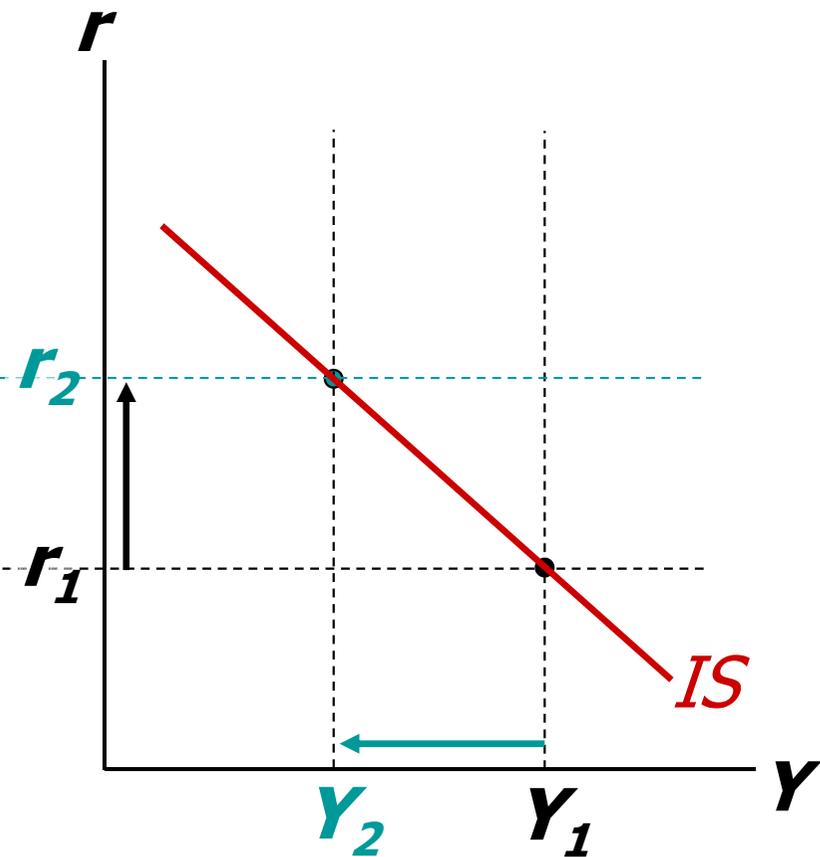
Fiscal Policy and the *IS* curve

- We can use the *IS-LM* model to see how fiscal policy (**G** and **T**) affects 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

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

$E = Y$

$E = C + I(r_1) + G_2$

$E = C + I(r_1) + G_1$

Y_1 Y_2

r_1

ΔY

IS_1 IS_2

Y_1 Y_2
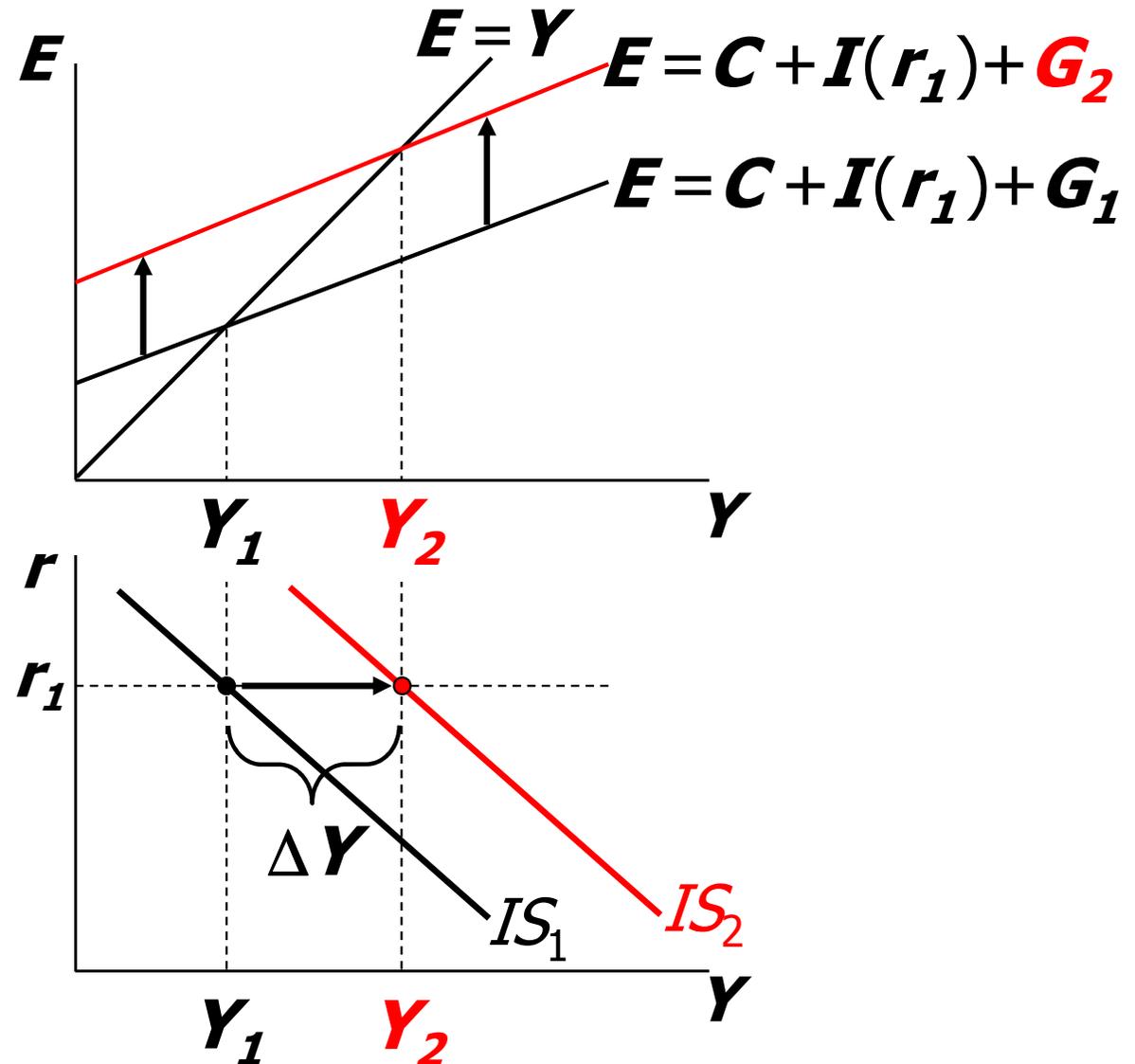
Exercise: Shifting the IS curve

- Use the diagram of the Keynesian cross or loanable funds model to show how an increase in taxes shifts the *IS* curve.
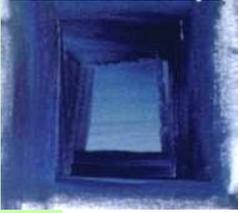
The Theory of Liquidity Preference

- Due to John Maynard Keynes.

- A simple theory in which the interest rate is determined by money supply and money demand.

Money supply
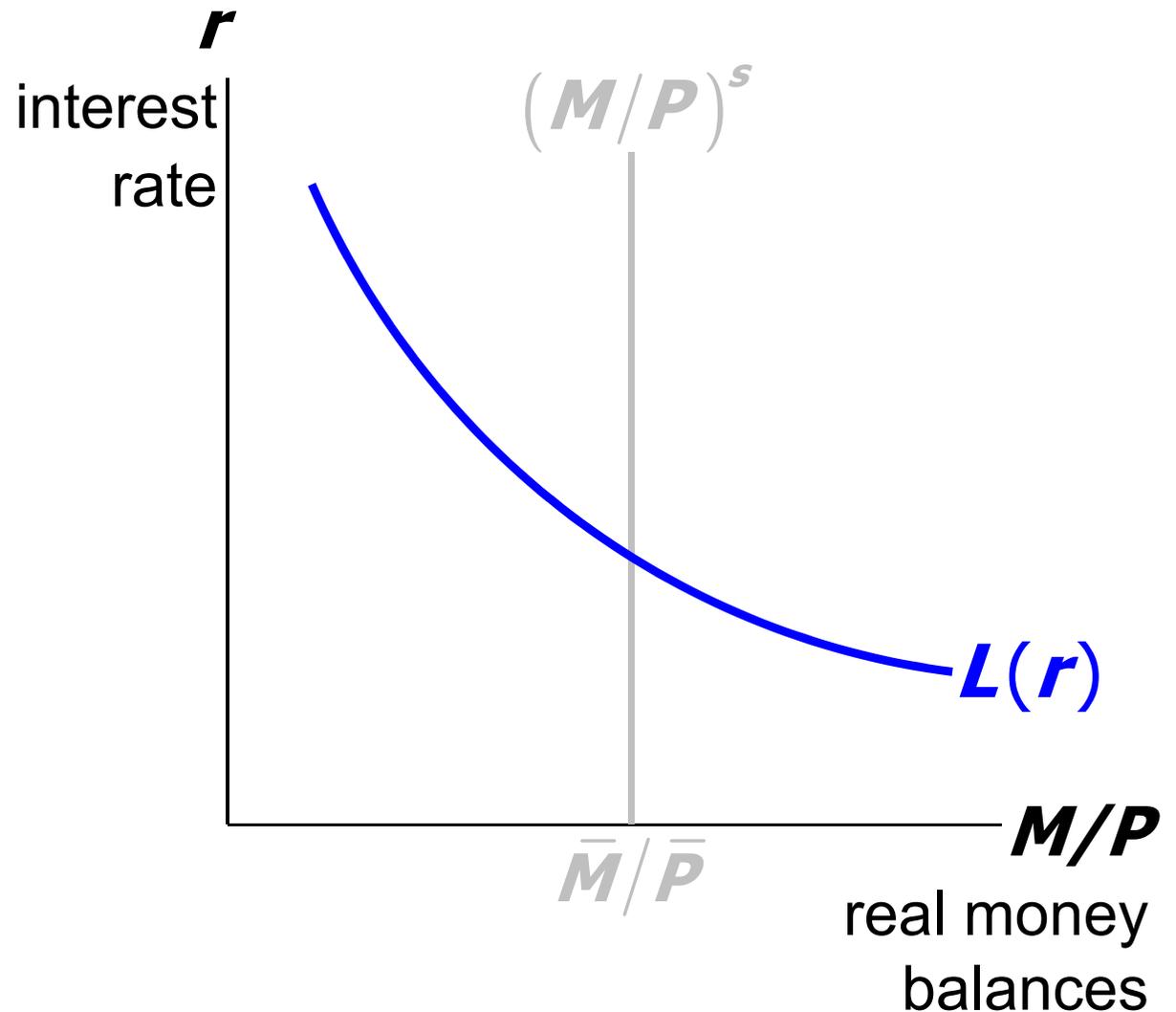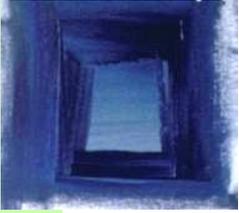
The supply of real money balances is fixed:

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

r

interest rate

$(M/P)^s$

$\overline{M}/\overline{P}$

M/P

real money balances
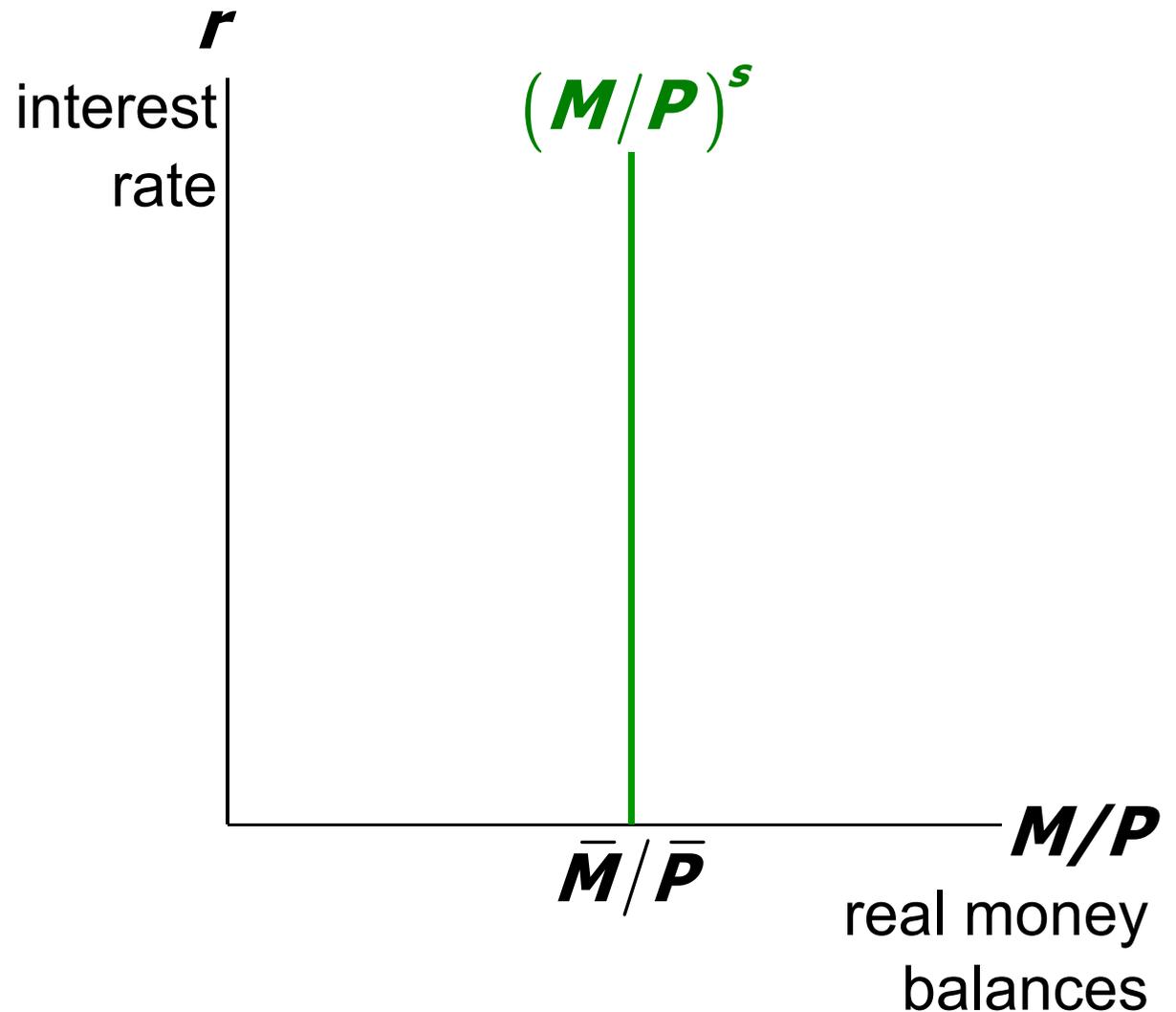
Money demand

Demand for real money balances:

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

Equilibrium

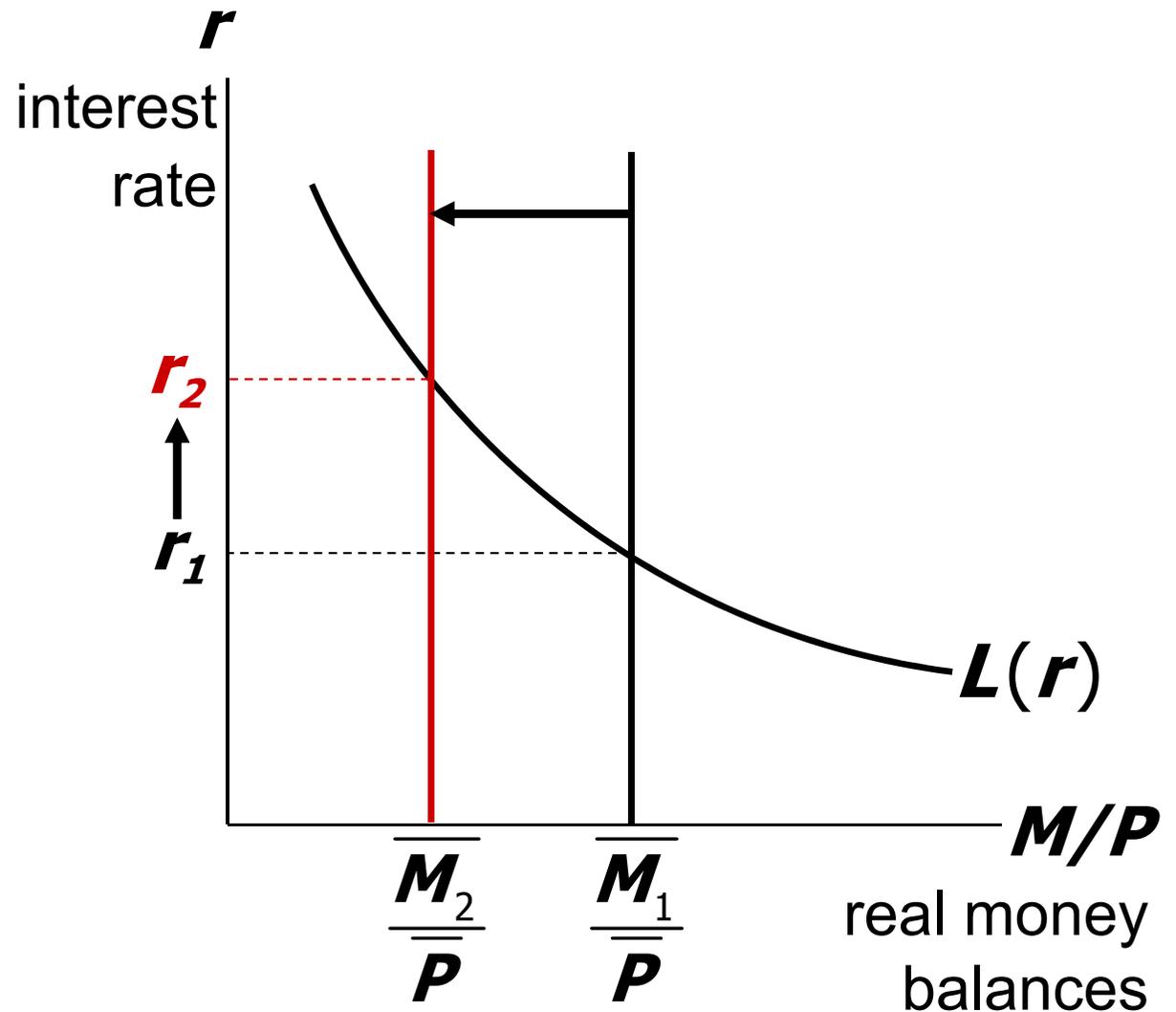The interest rate adjusts to equate the supply and demand for money:

$$\overline{M/P} = L(r)$$
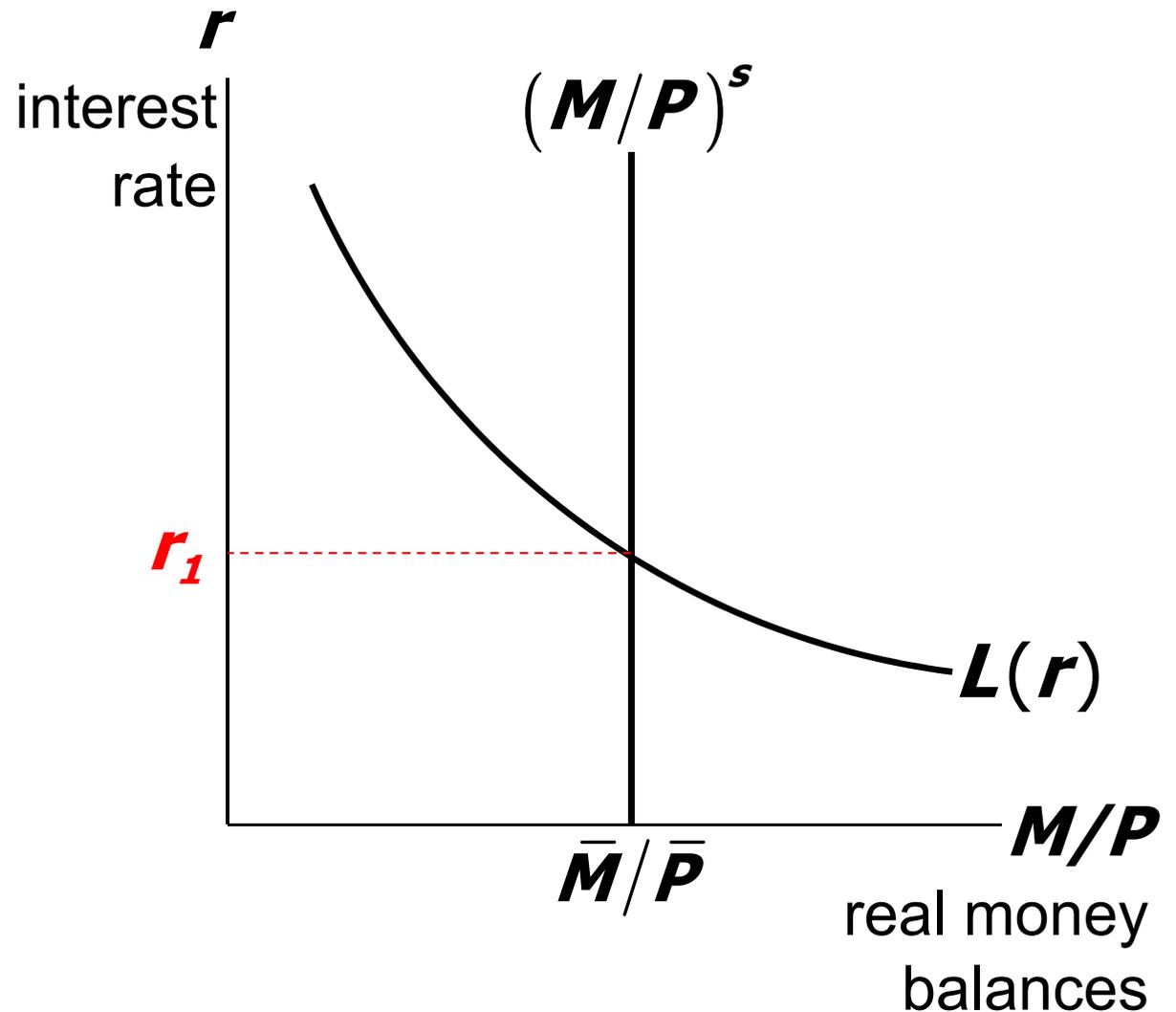
How the Fed raises the interest rate

To increase r,
Fed 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 & 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.
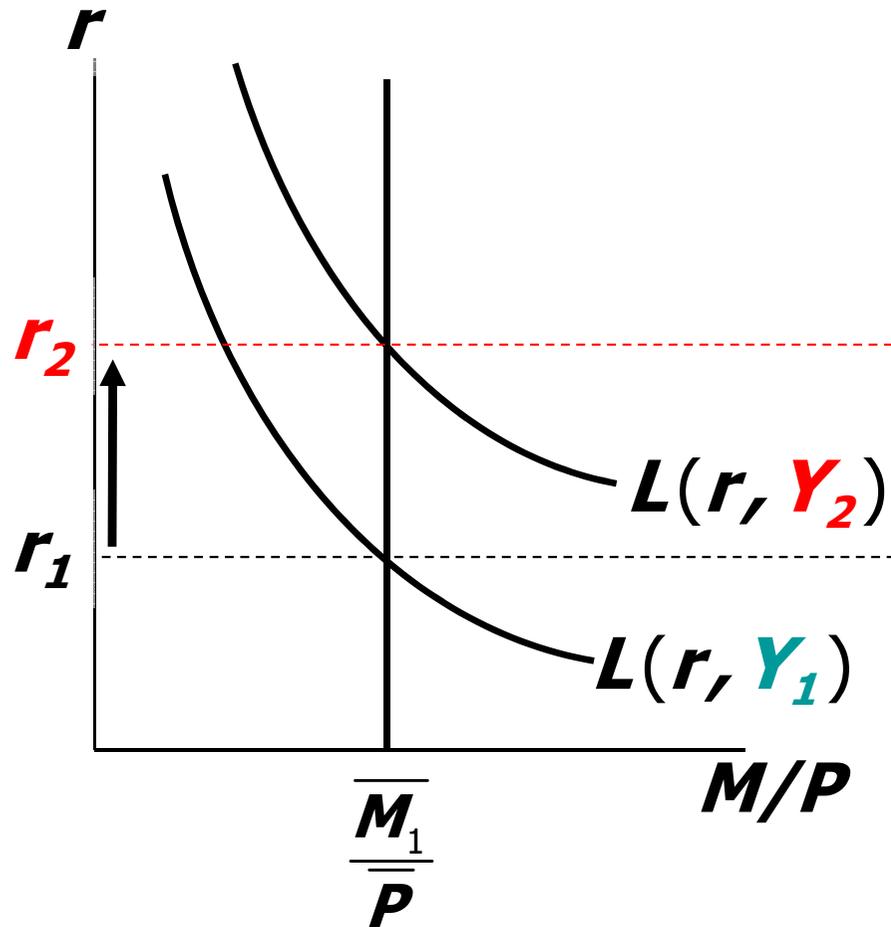
The equation for the *LM* curve is:
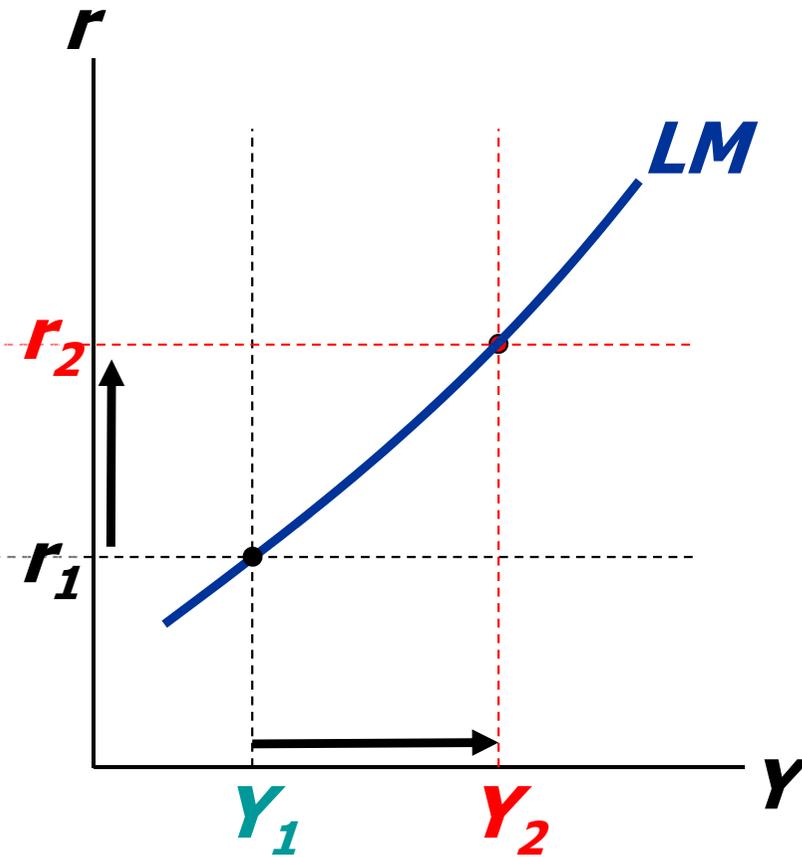
$$\overline{M}/\overline{P} = L(r,Y)$$

Deriving the *LM* curve

(a) The market for real money balances

(b) The *LM* curve

Why the *LM* curve is upward sloping

- 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.

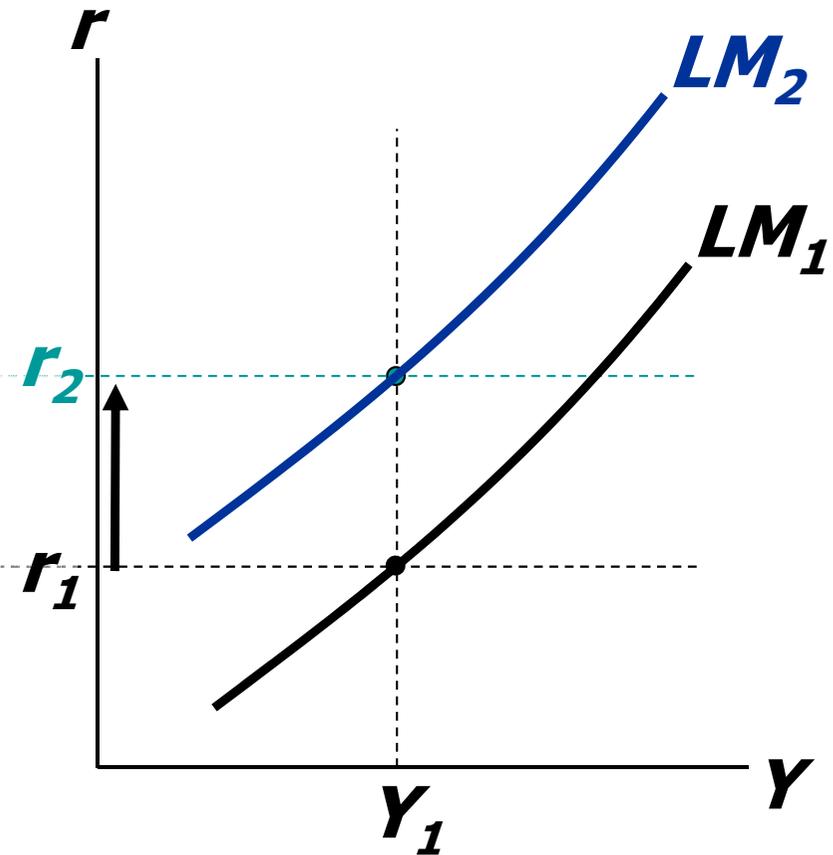- The interest rate must rise to restore equilibrium in the money market.

How ΔM shifts the *LM* curve

(a) The market for
    real money balances
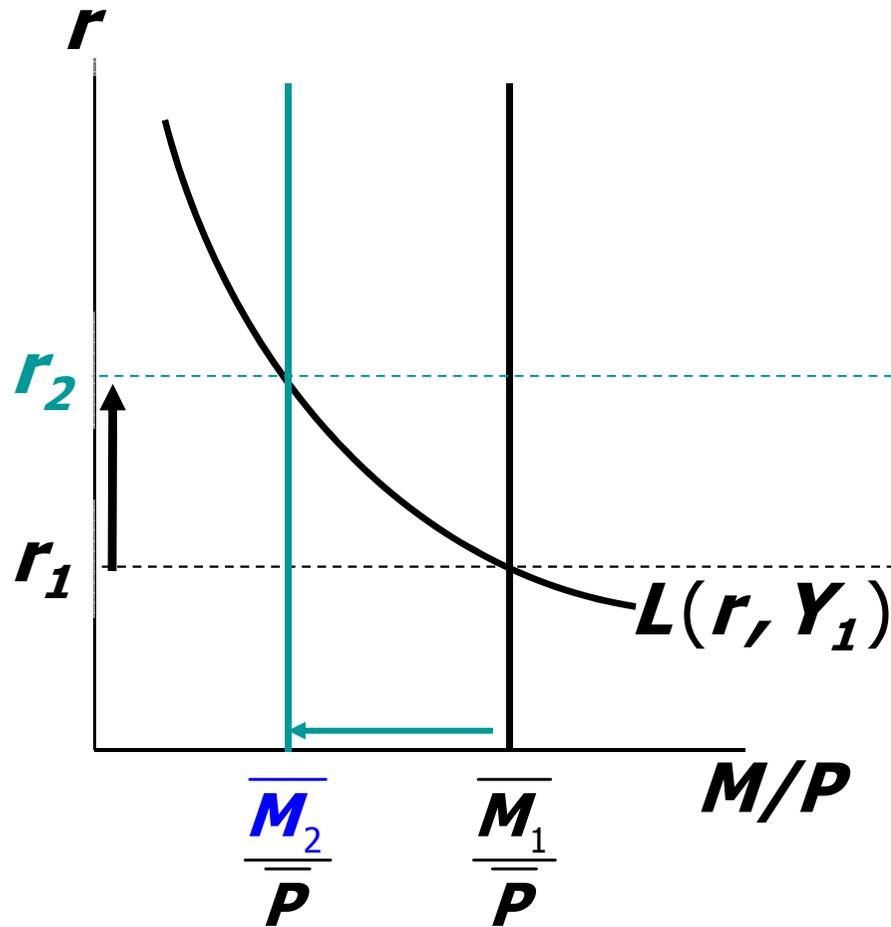
(b) The *LM* curve

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.
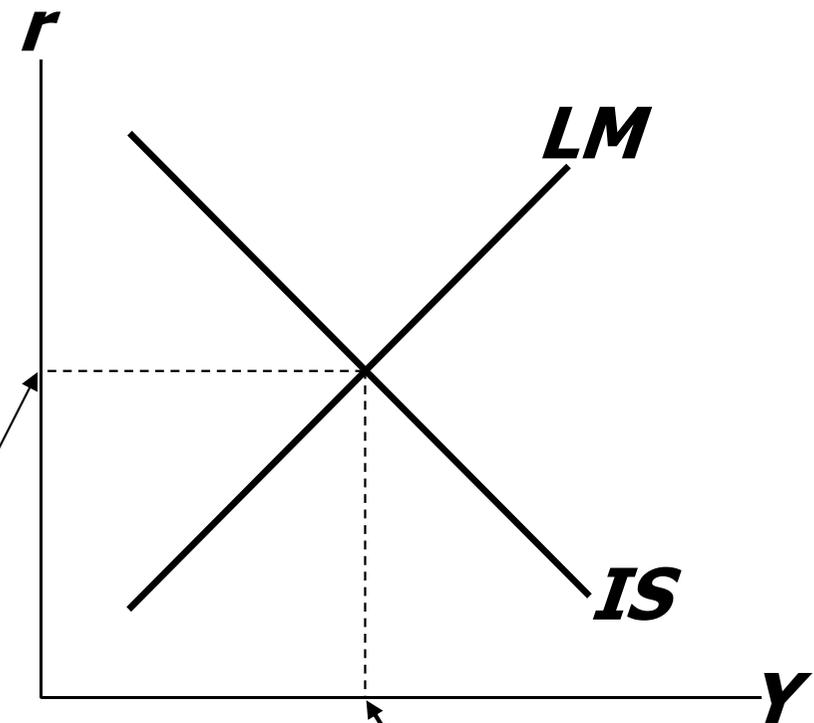
The short-run equilibrium

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

$$Y = C(Y - \overline{T}) + I(r) + \overline{G}$$
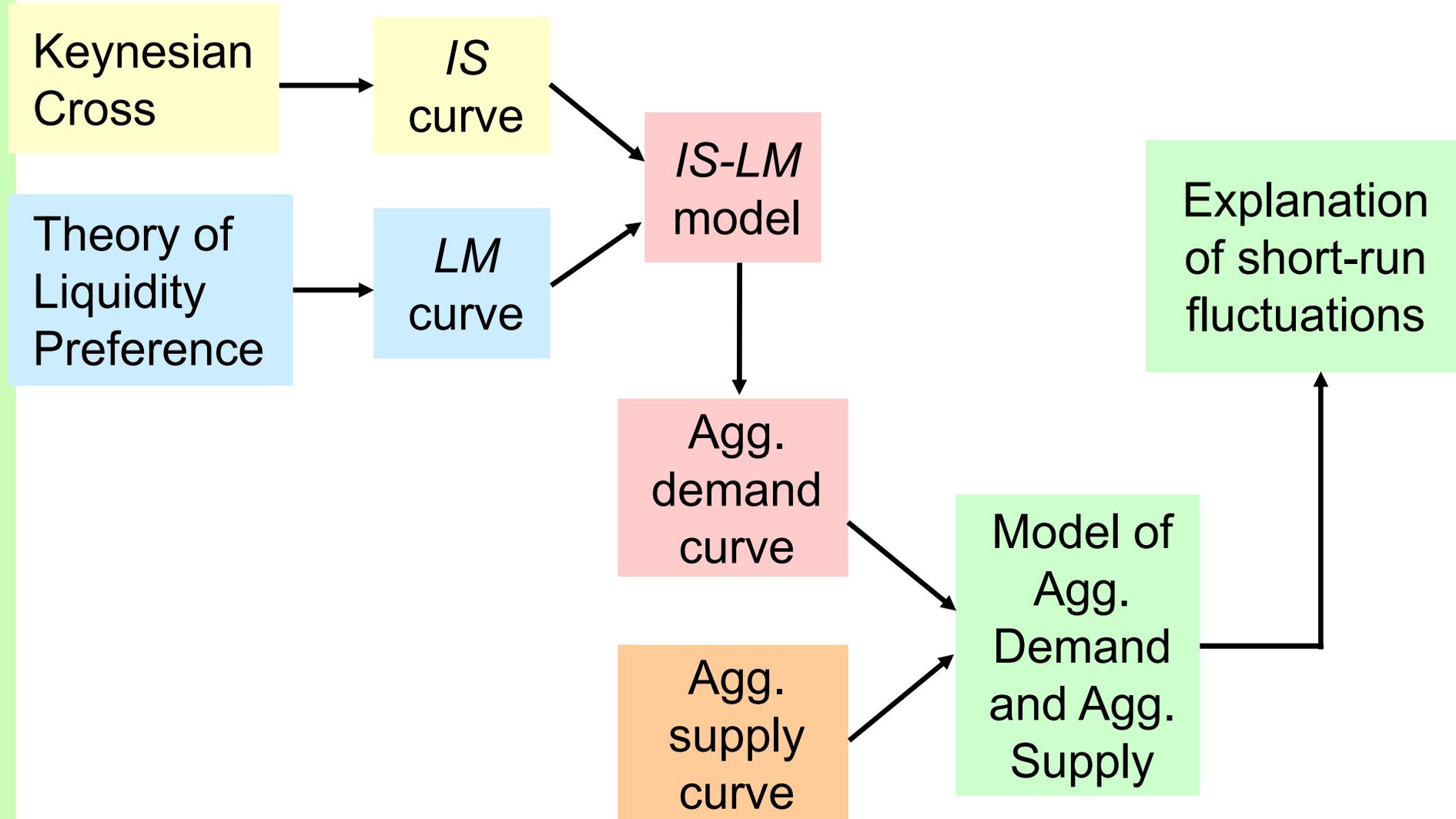
$$\overline{M}/\overline{P} = L(r, Y)$$

Equilibrium interest rate
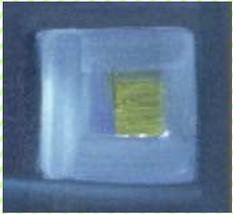
Equilibrium level of income

The Big Picture

Preview of Chapter 11

In Chapter 11, 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.

- use our models to learn about the Great Depression.

Chapter Summary

1. Keynesian cross

   - basic model of income determination

   - takes fiscal policy & investment as exogenous

   - fiscal policy has a multiplier effect on income.

2. *IS* curve

   - comes from Keynesian cross when planned investment depends negatively on interest rate

   - shows all combinations of *r* and *Y* that equate planned expenditure with actual expenditure on goods & services
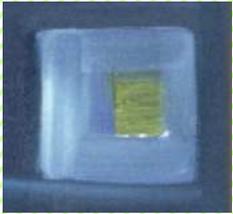
Chapter Summary

3. Theory of Liquidity Preference
   - basic model of interest rate determination
   - takes money supply & price level as exogenous
   - an increase in the money supply lowers the interest rate

4. *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.