9. ISLM model

In this lecture, you will learn…

- an introduction to business cycle and aggregate demand

- 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

Short run

- In the following lectures, we will study the short-run fluctuations of the economy (business cycles)

- We focus on three models:
  - ISLM model (lecture 9)
  - Mudell-Fleming model (lecture 10)
  - Model AS-AD
    - AD (lectures 9 and 10)
    - AS (lectures 11)

Facts about the business cycle

- GDP growth averages 3–3.5 percent per year over the long run with large fluctuations in the short run.

- Consumption and investment fluctuate with GDP, but consumption tends to be less volatile and investment more volatile than GDP.

- Unemployment rises during recessions and falls during expansions.

- **Okun's Law**: the negative relationship between GDP and unemployment.

Time horizons in macroeconomics

- Long run:
  Prices are flexible, respond to changes in supply or demand.

- Short run:
  Many prices are "sticky" at some predetermined level.

> *The economy behaves much differently when prices are sticky.*

When prices are sticky...

...output and employment also depend on demand, which is affected by

- fiscal policy (G and T)
- monetary policy (M)
- other factors, like exogenous changes in C or I.

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: $\qquad C = C(Y - T)$

govt policy variables: $\qquad G = \overline{G}, \quad T = \overline{T}$

for now, planned
investment is exogenous: $\qquad I = \overline{I}$

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

equilibrium condition:

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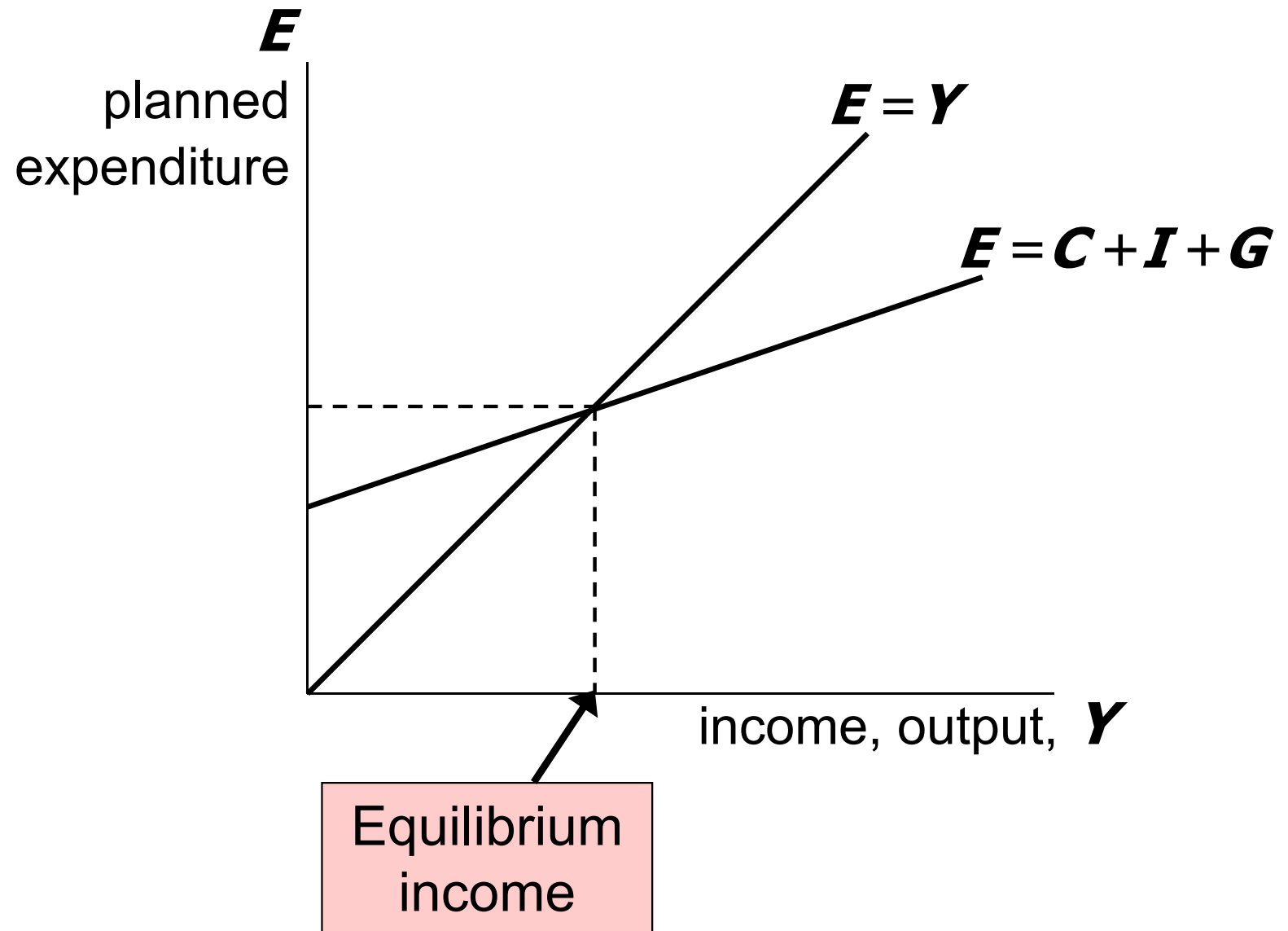
$$Y = E$$

Graphing planned expenditure

E

planned expenditure

$$E = C + I + G$$

MPC

1
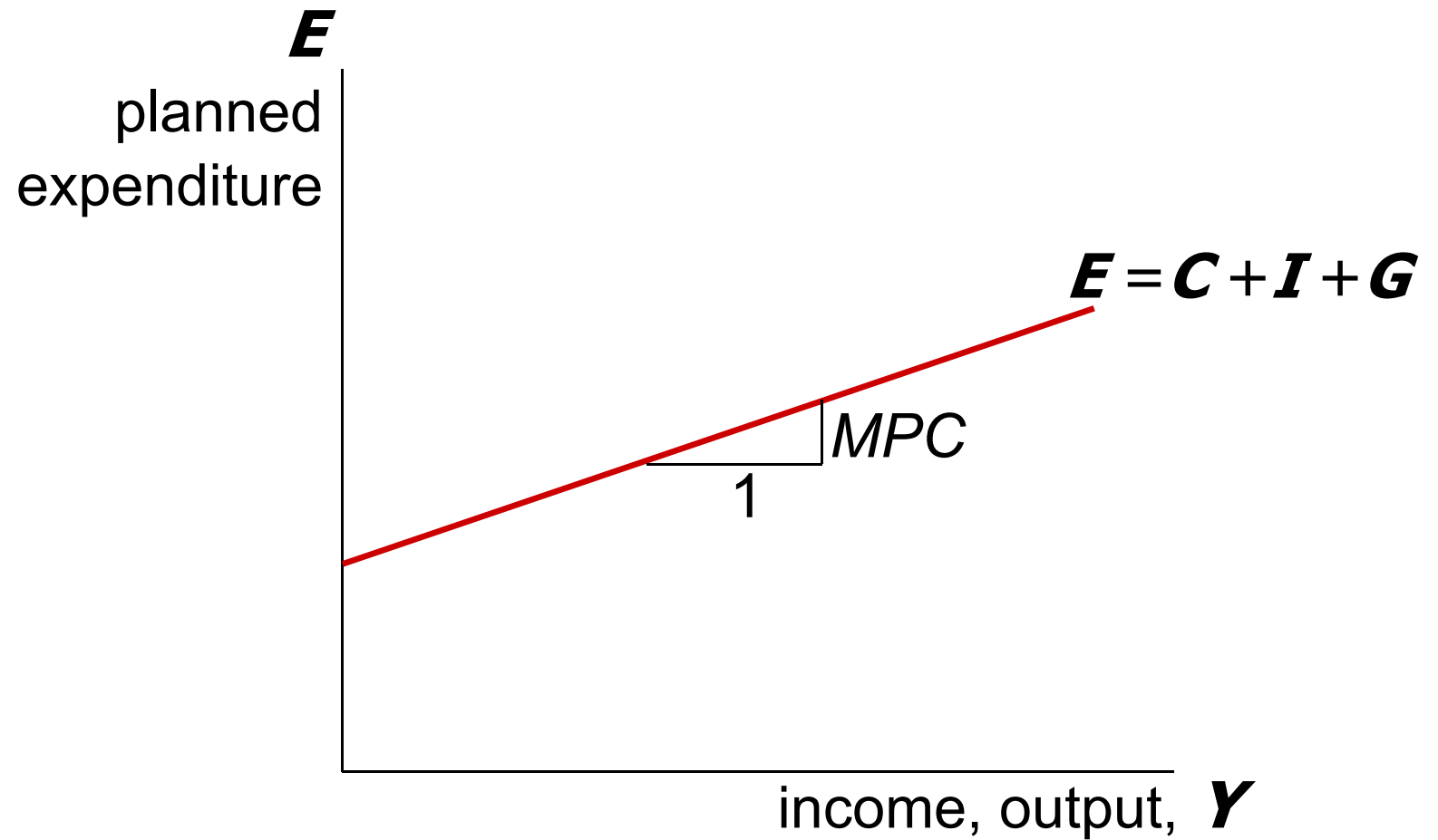
income, output, Y

Graphing the equilibrium condition

E

planned expenditure

E = Y

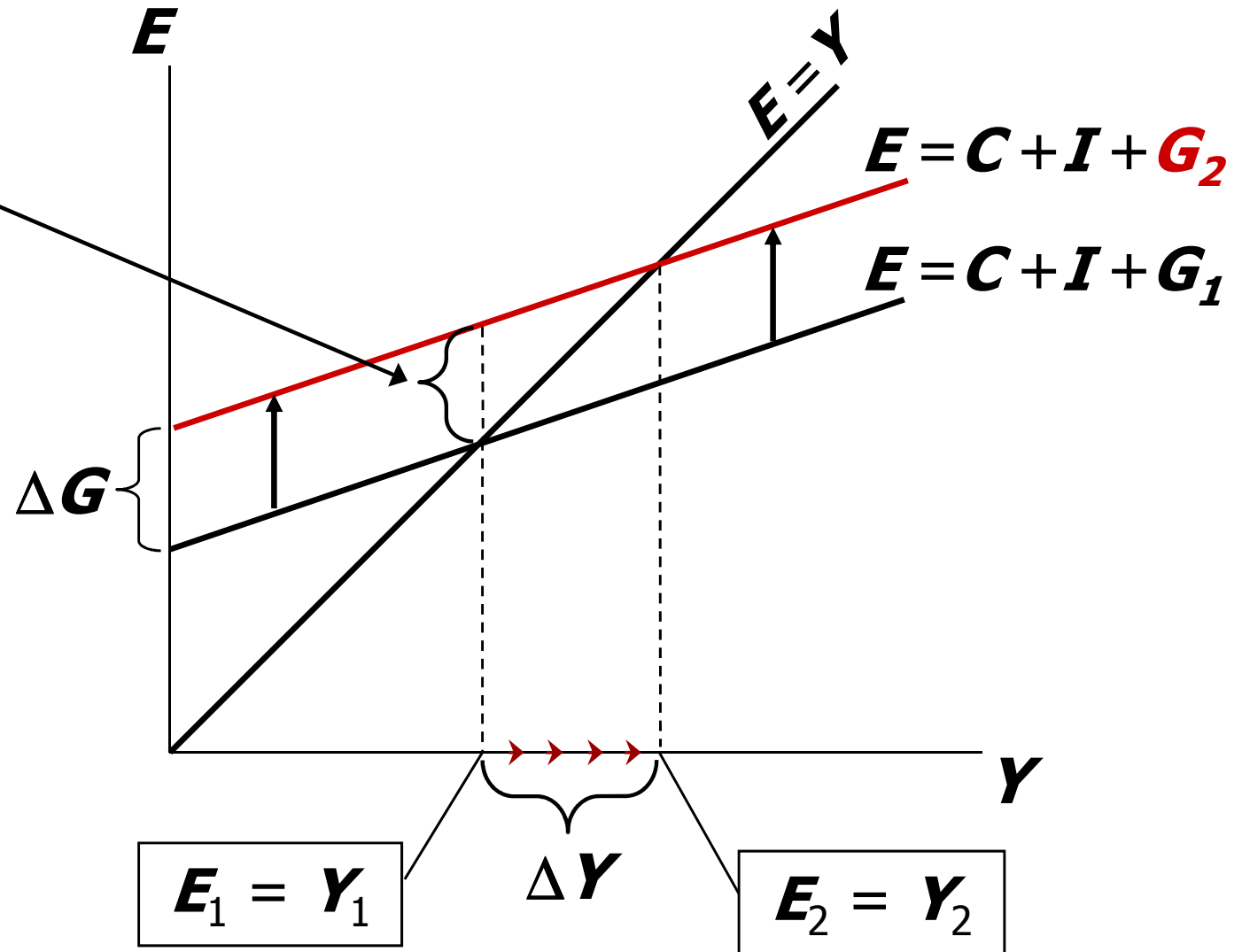45°
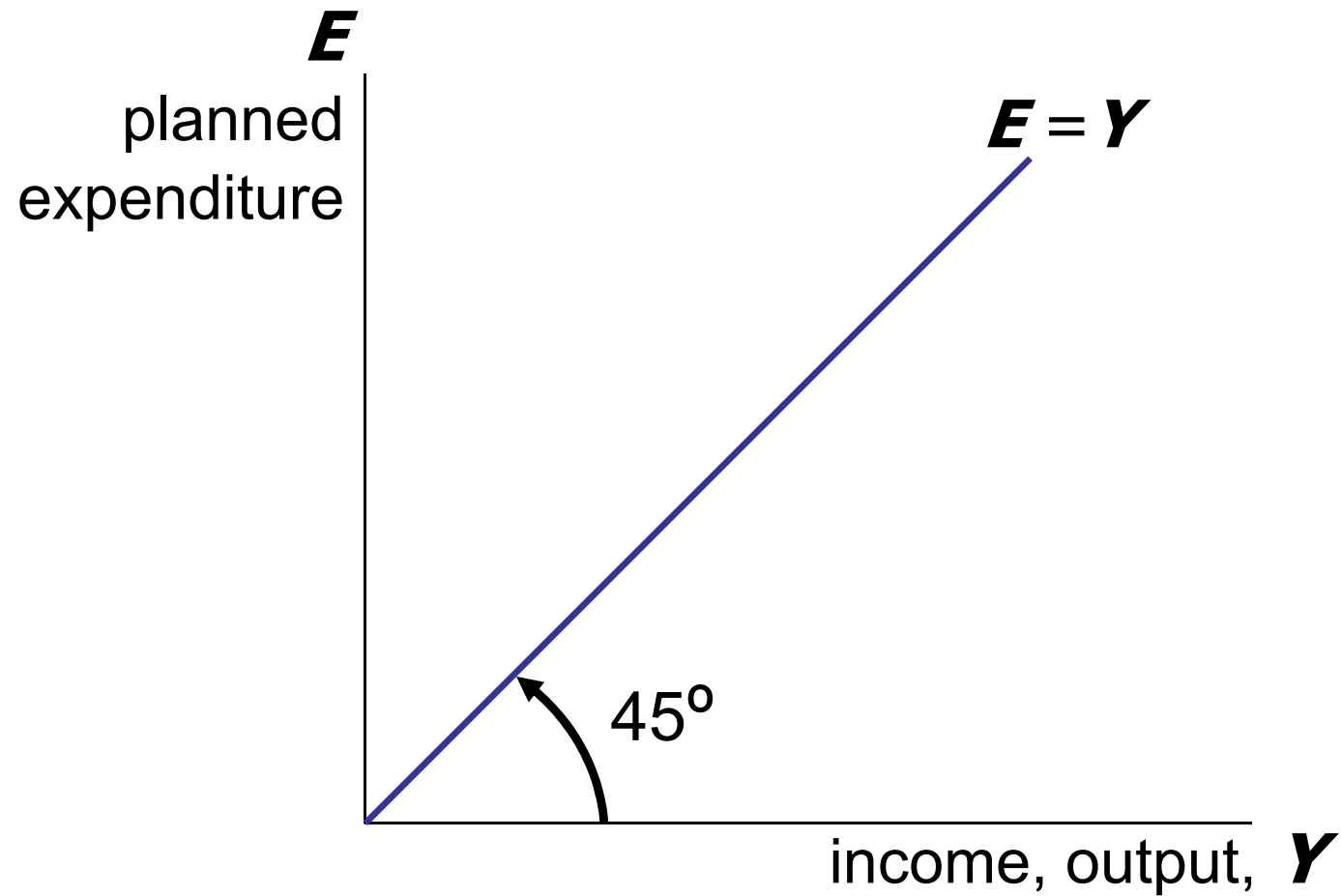
income, output, Y

The equilibrium value of income

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

E

Y

$E_1 = Y_1$

ΔY

$E_2 = Y_2$

Solving for ΔY

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

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

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

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

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

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

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:** $\Delta Y = \Delta G$.

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

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

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

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

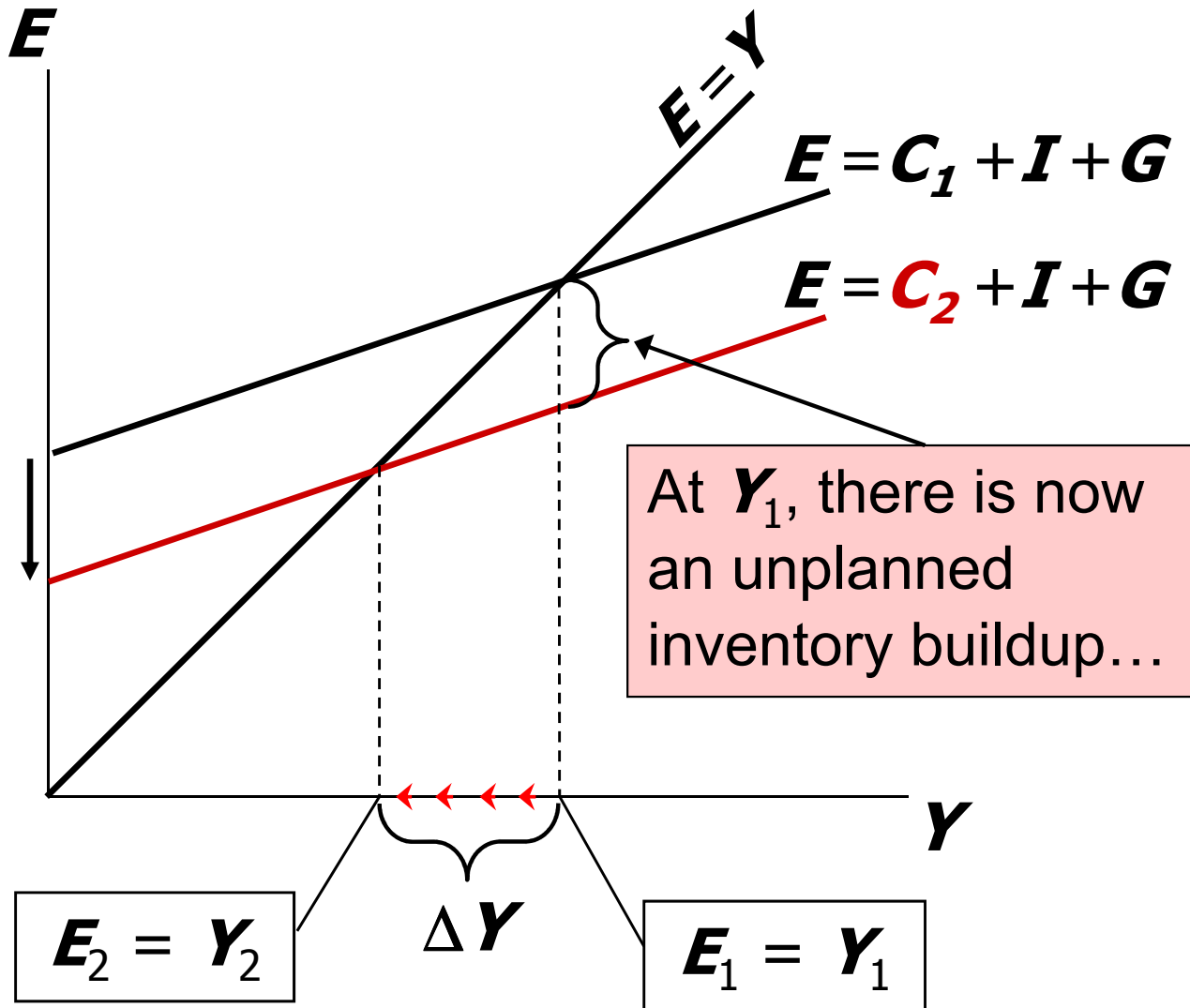- So the final impact on income is much bigger than the initial ΔG.

An increase in taxes

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

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

…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

$E_1 = Y_1$

E

Y

Solving for ΔY

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

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

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

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

Final result:

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

The tax multiplier

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**.
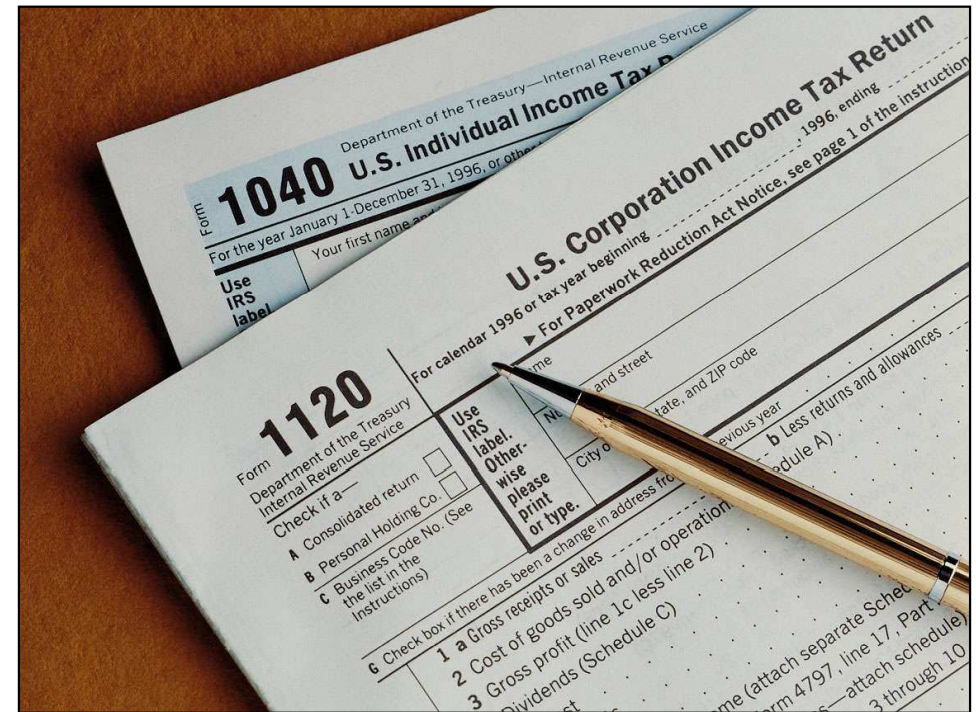
The *IS* curve

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

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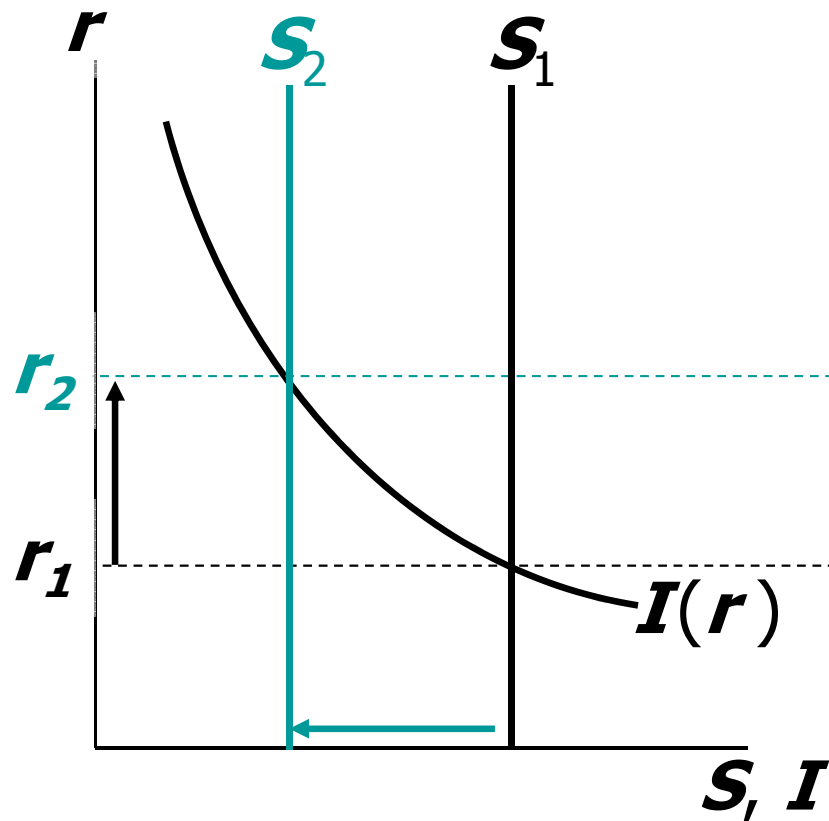
$\Rightarrow \uparrow E$

$\Rightarrow \uparrow Y$

E

$E = Y$

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

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

ΔI

$Y_1 \quad Y_2$

Y

r

r_1

r_2

IS

$Y_1 \quad Y_2$

Y
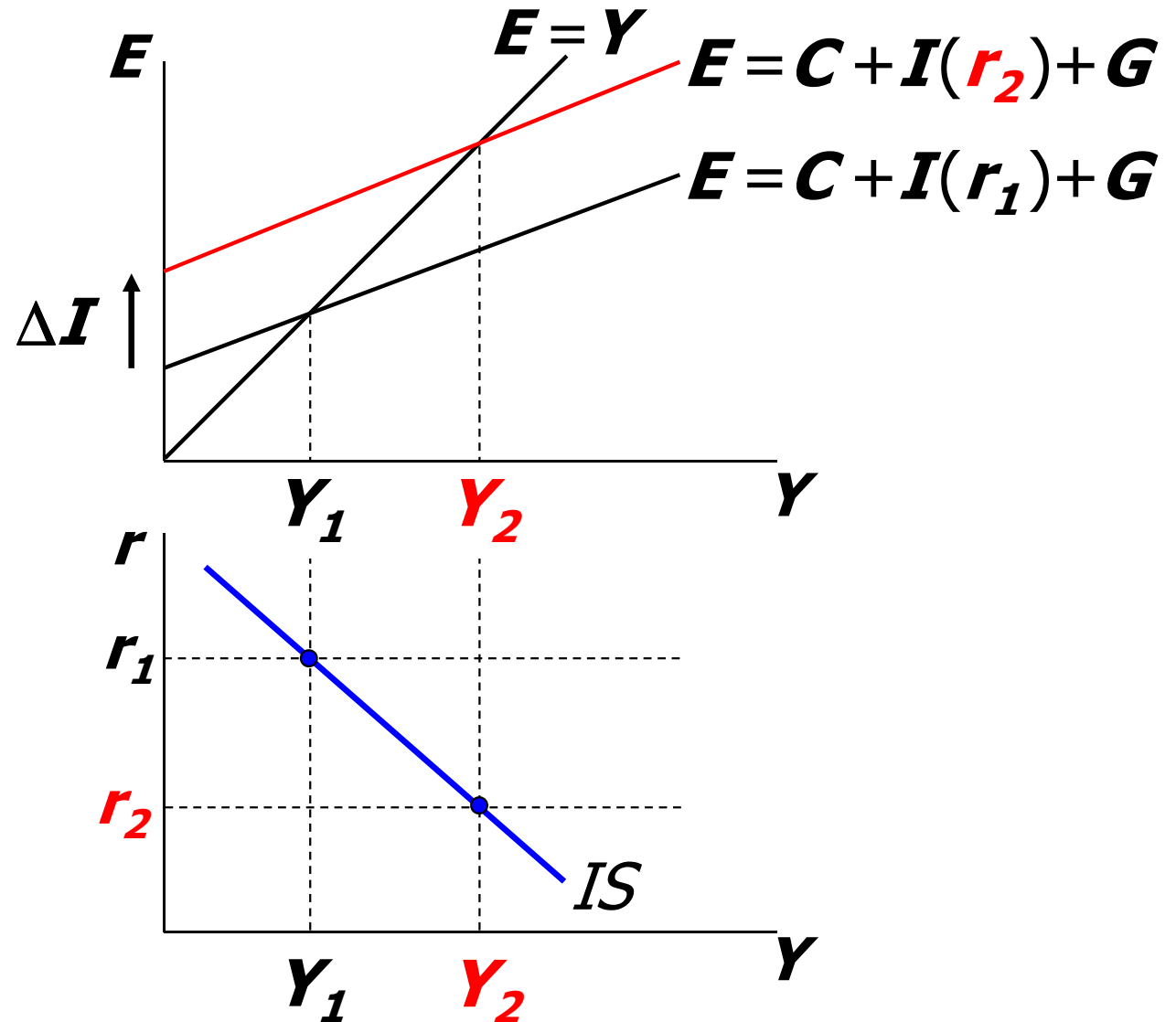
Why the *IS* curve is negatively sloped

- 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
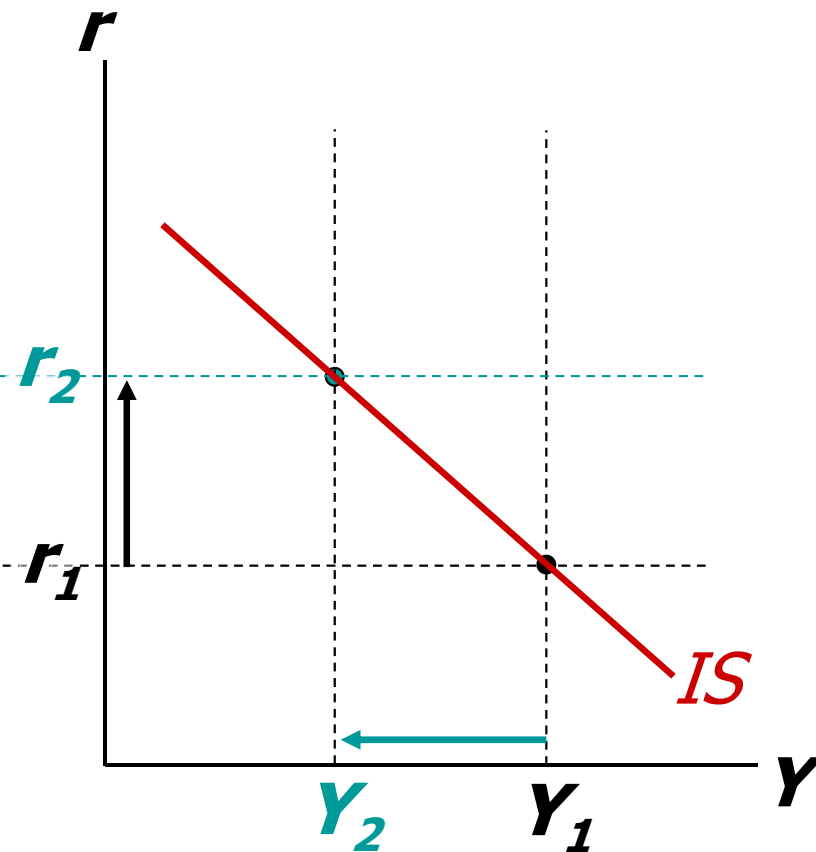
Fiscal Policy and the *IS* curve

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

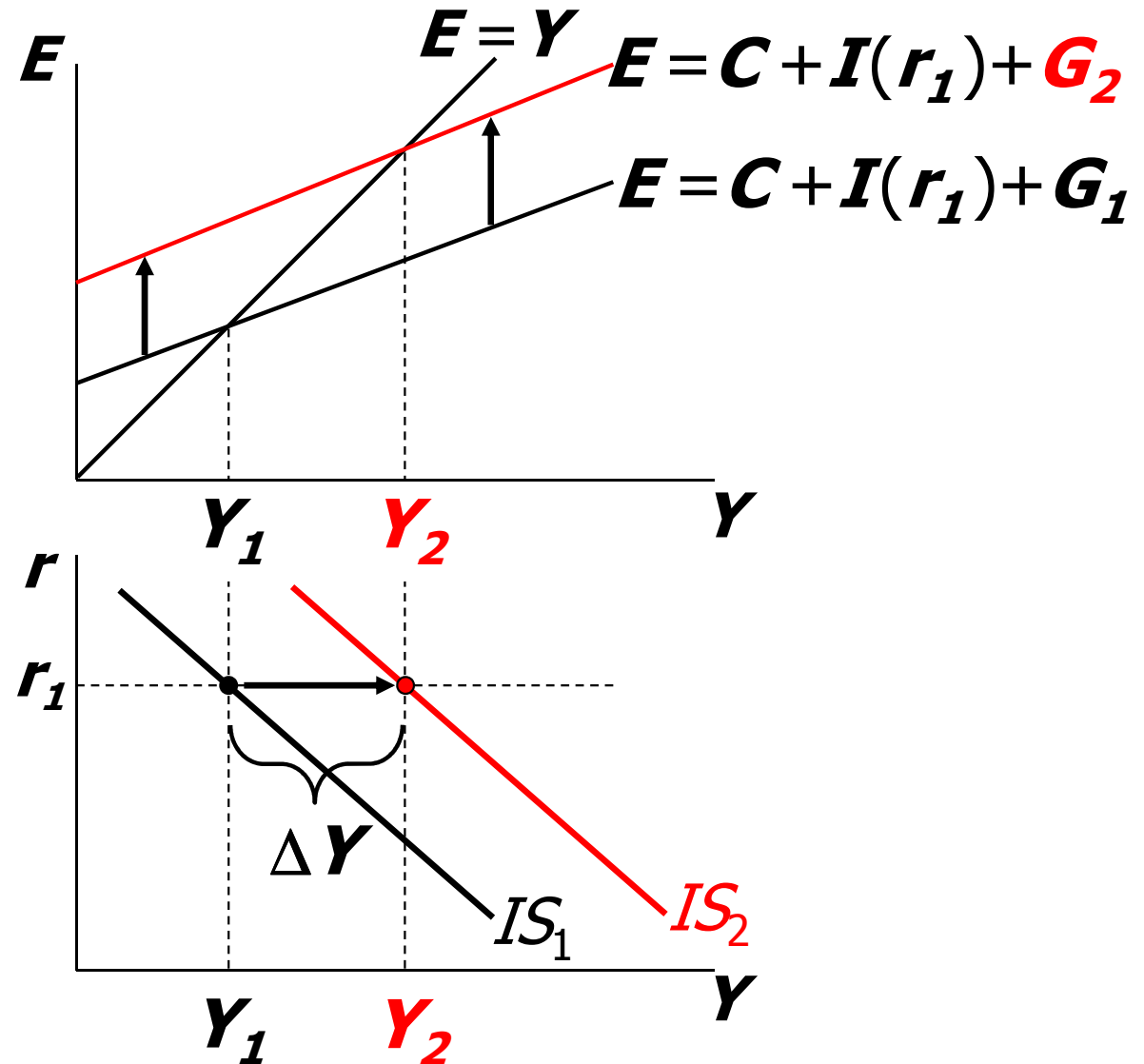- Let's start by using the Keynesian cross to see how fiscal policy shifts the *IS* curve…

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

$E = Y$

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

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

Y_1 Y_2 Y

r

r_1

ΔY

IS_1 IS_2

Y_1 Y_2 Y

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:
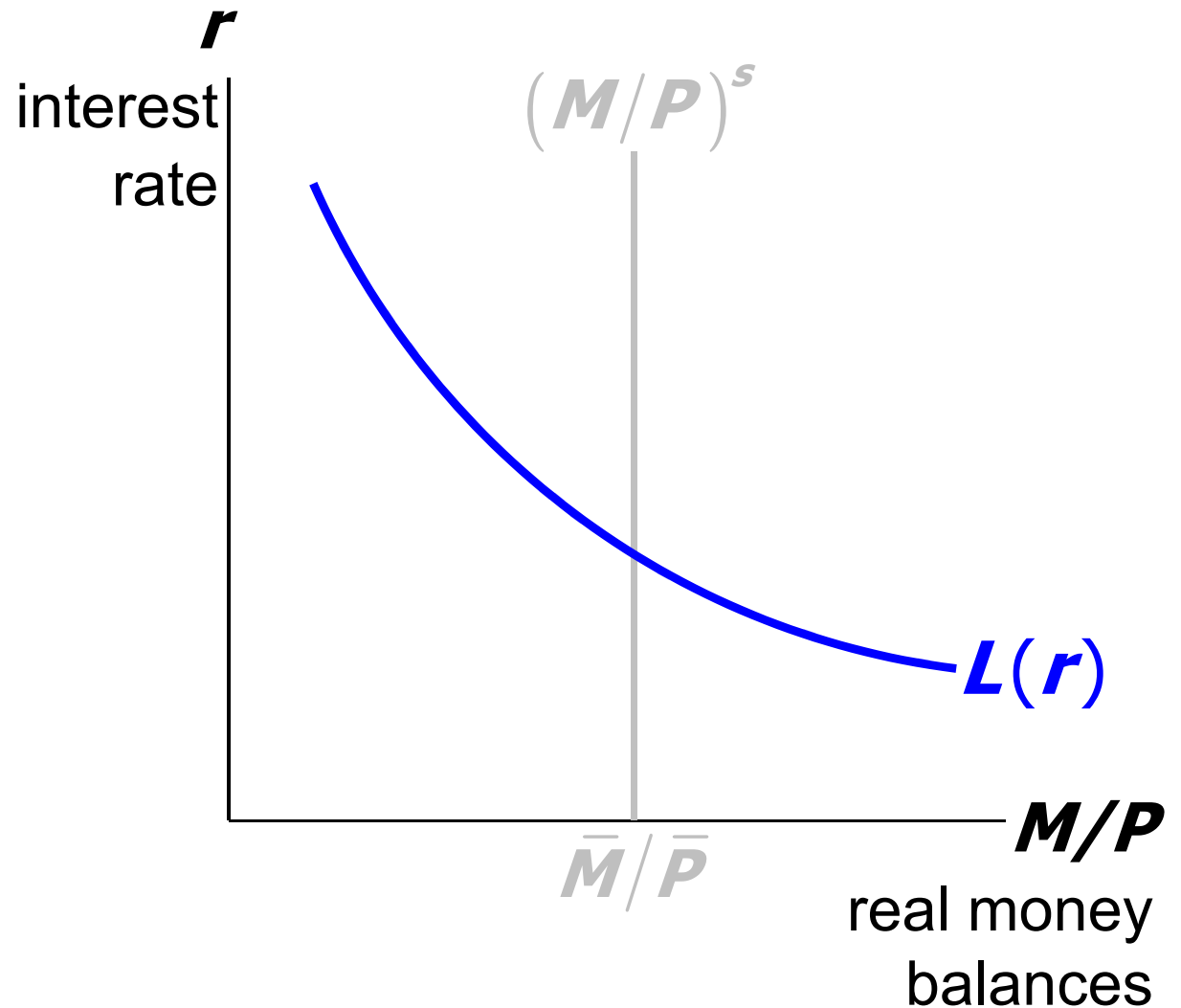
$$(M/P)^s = \bar{M}/\bar{P}$$
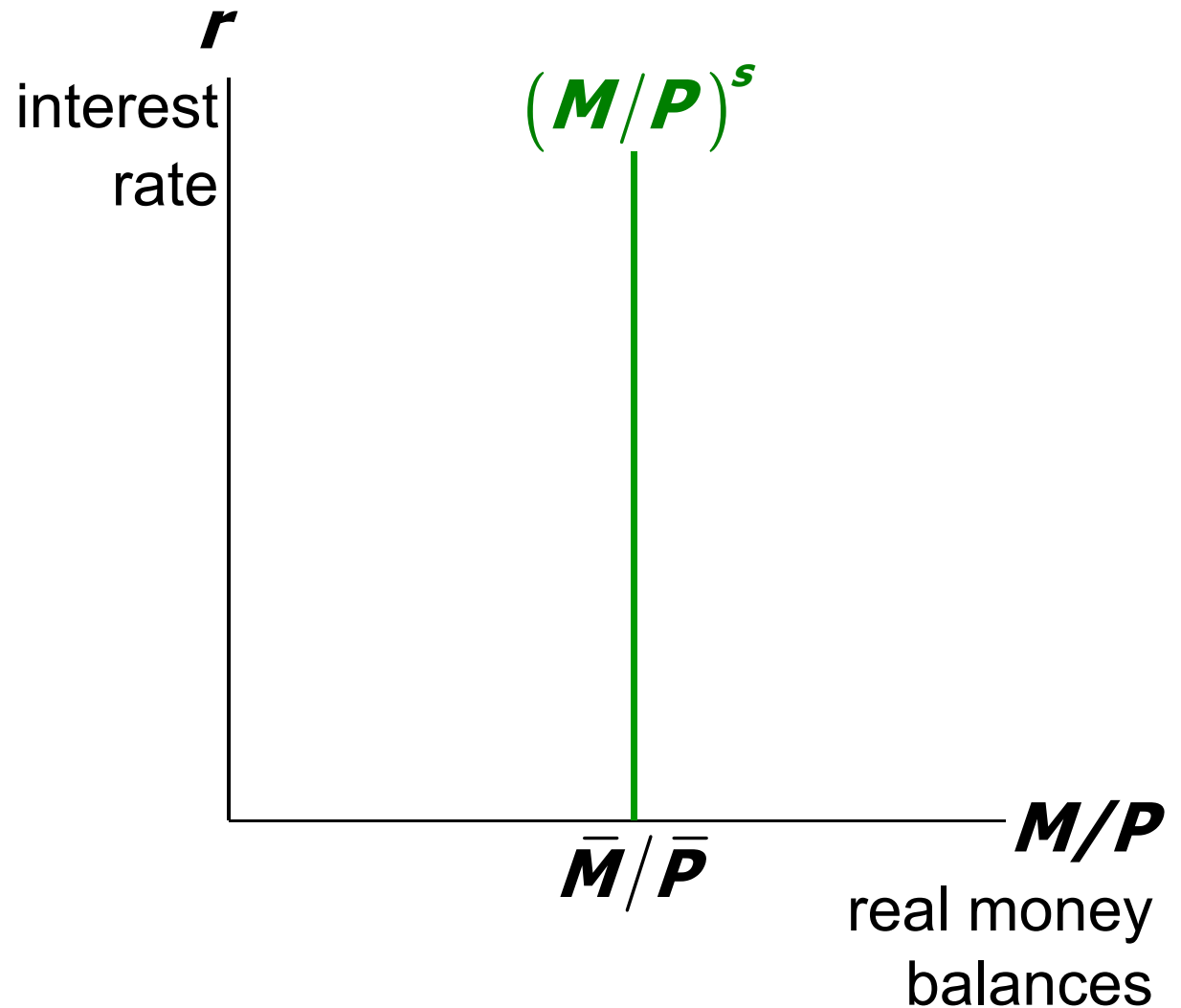
Money demand

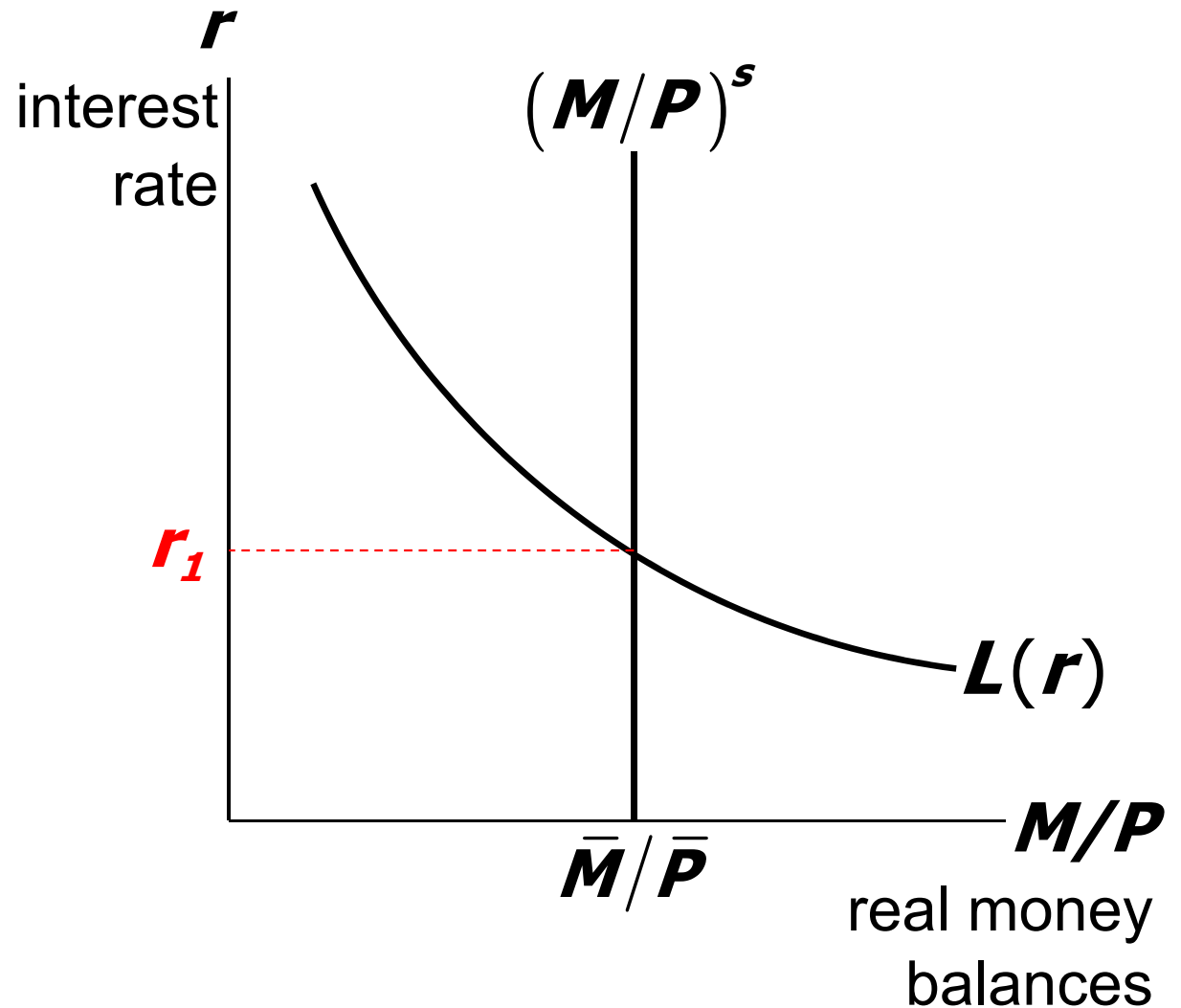Demand for real money balances:

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

Equilibrium

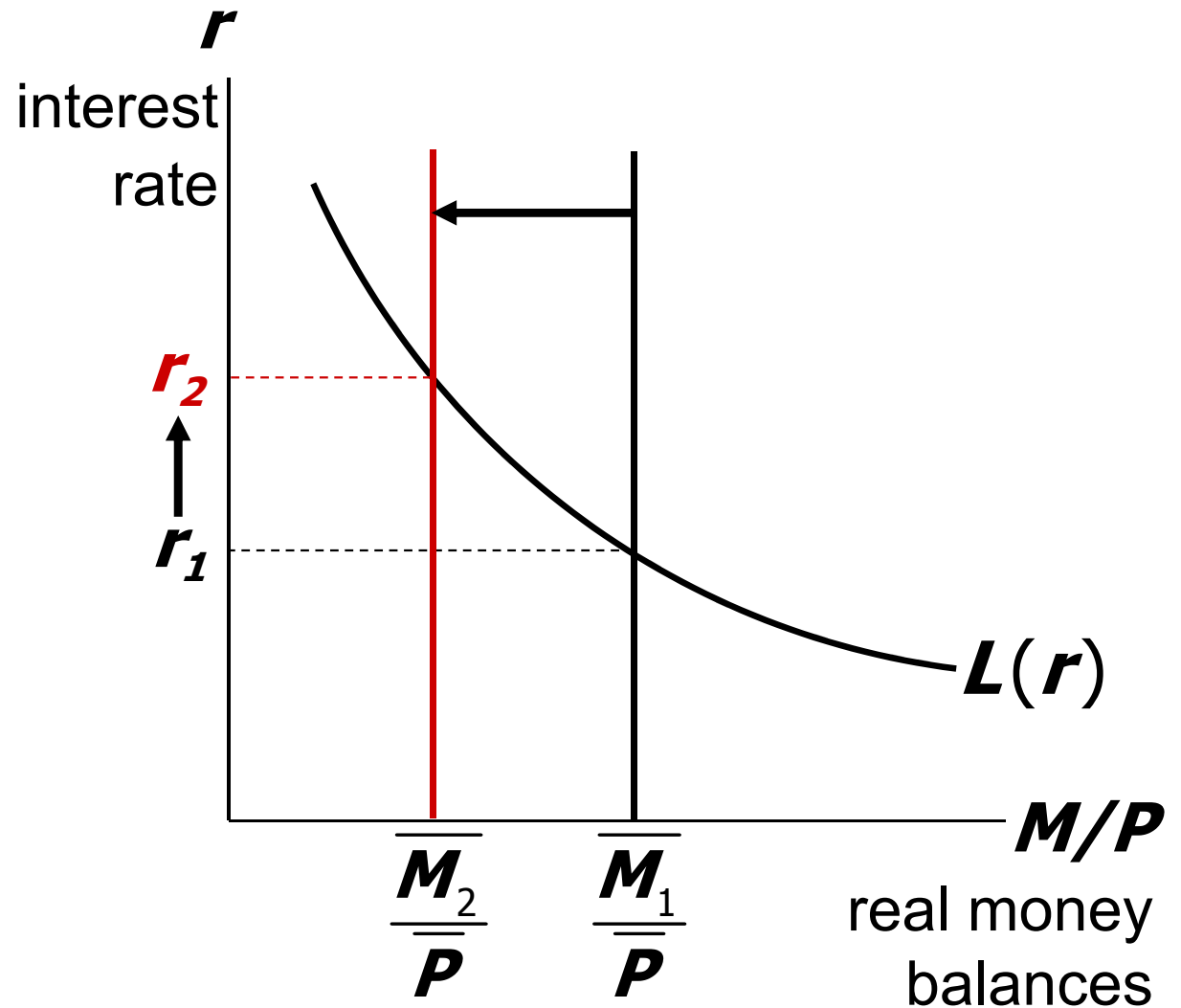The interest rate adjusts to equate the supply and demand for money:

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

r

interest rate

$(M/P)^s$

r_1

$L(r)$

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

M/P

real money balances

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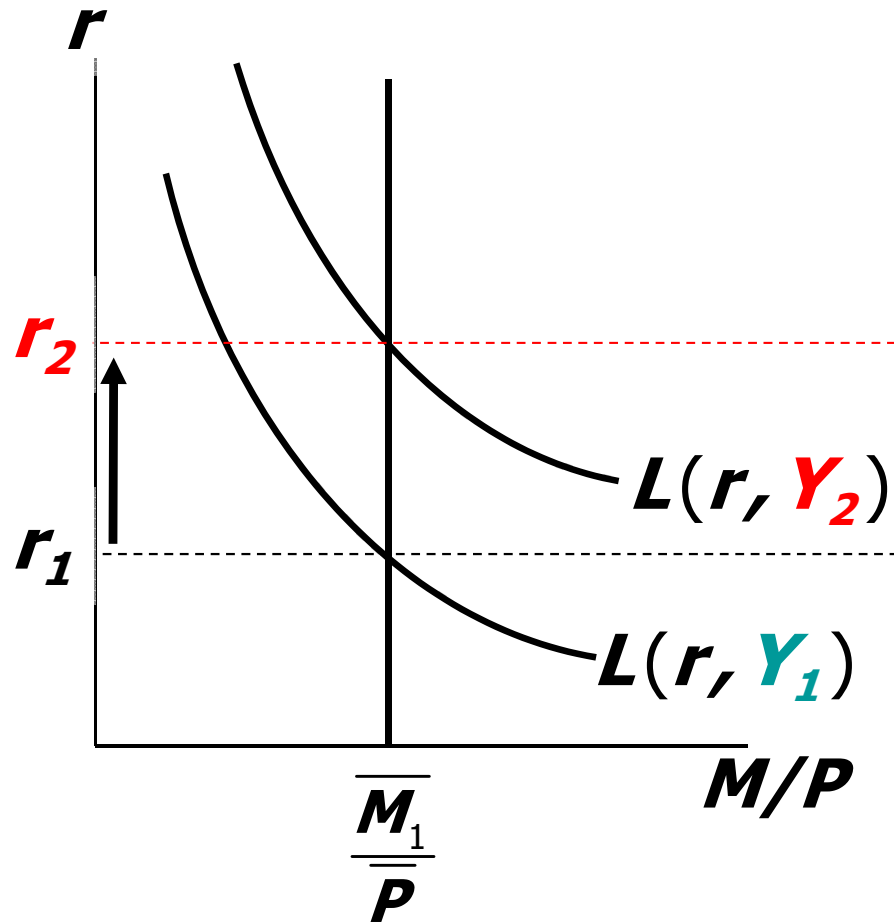
The equation for the *LM* curve is:
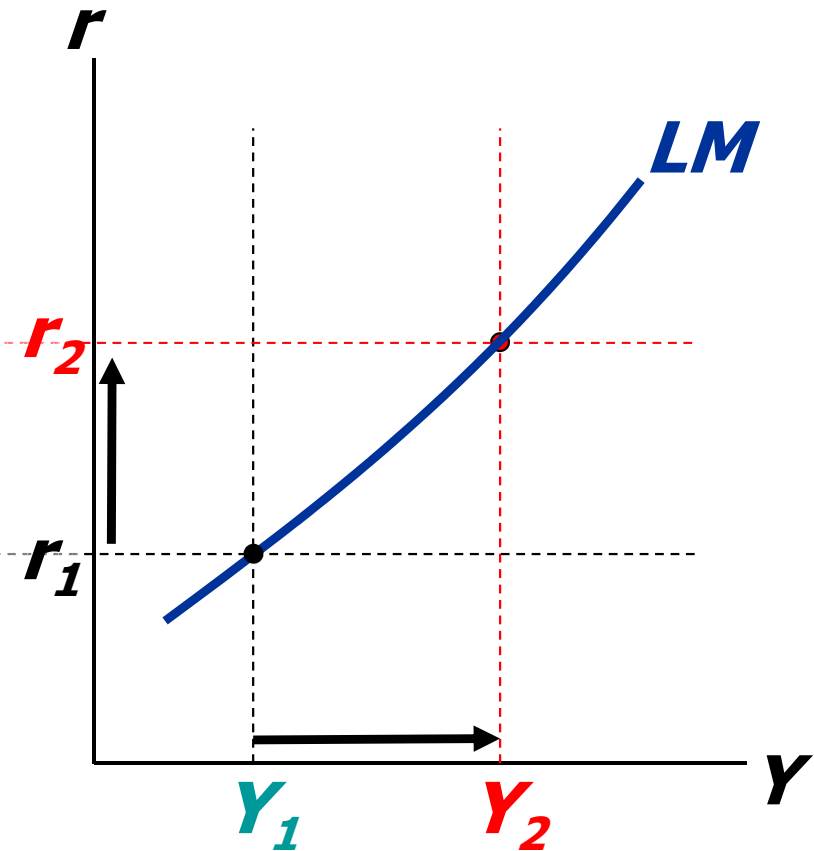
$$\overline{M}/\overline{P} = L(r,Y)$$

Deriving the *LM* curve

(a) The market for
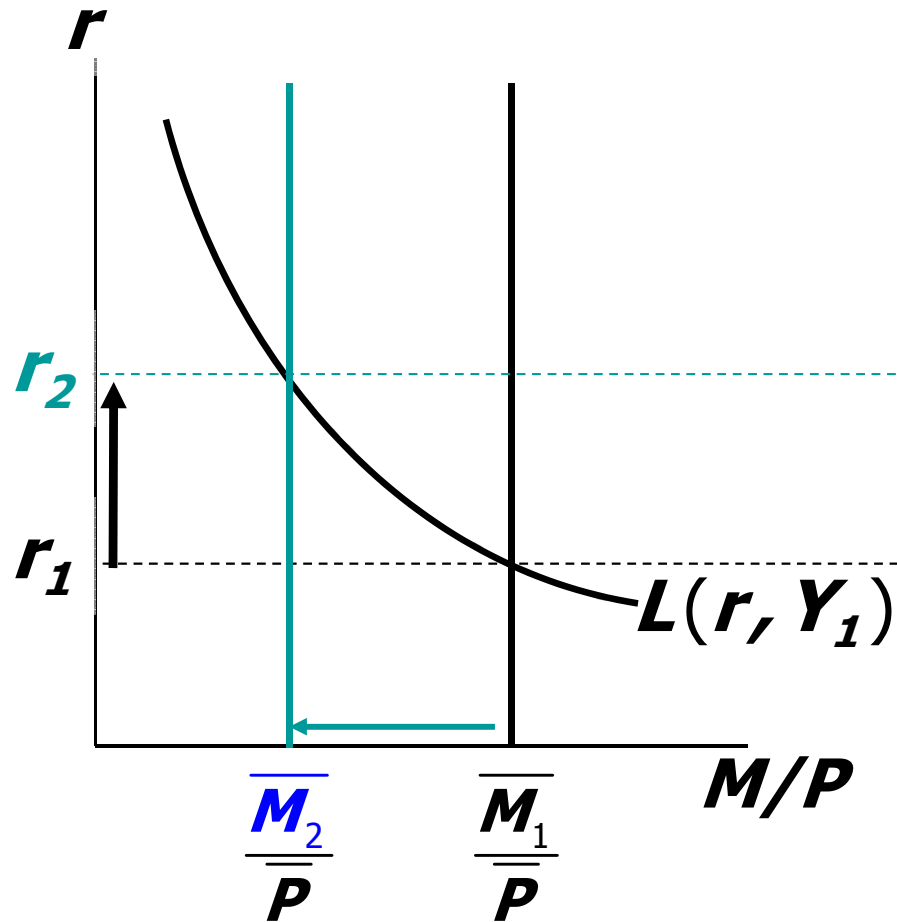real money balances

(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.

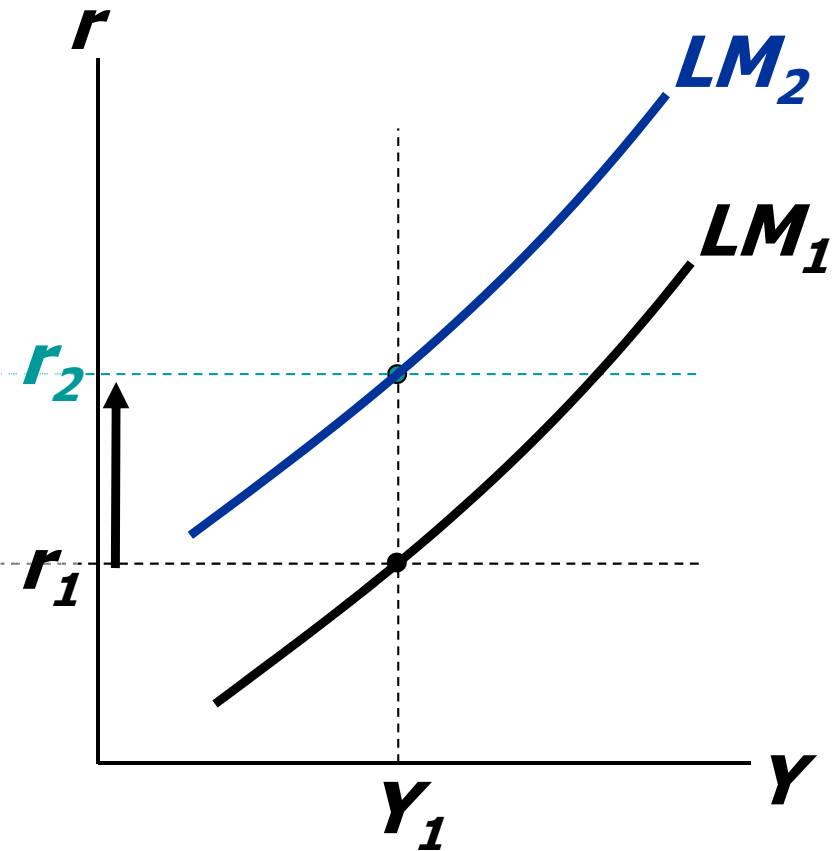- The interest rate must rise to restore equilibrium in the money market.

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.

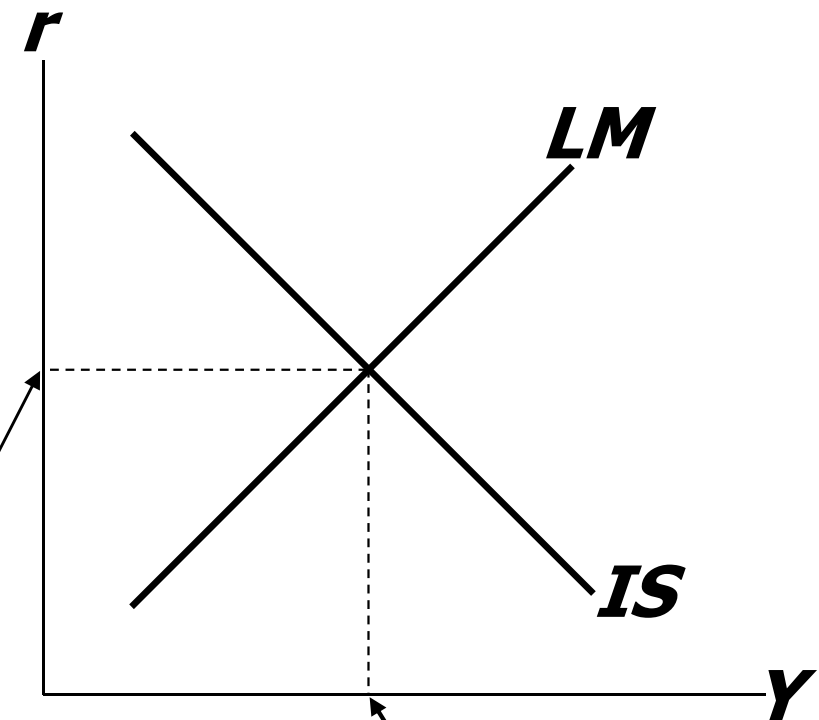- Use the liquidity preference model to show how these events shift the *LM* curve.

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
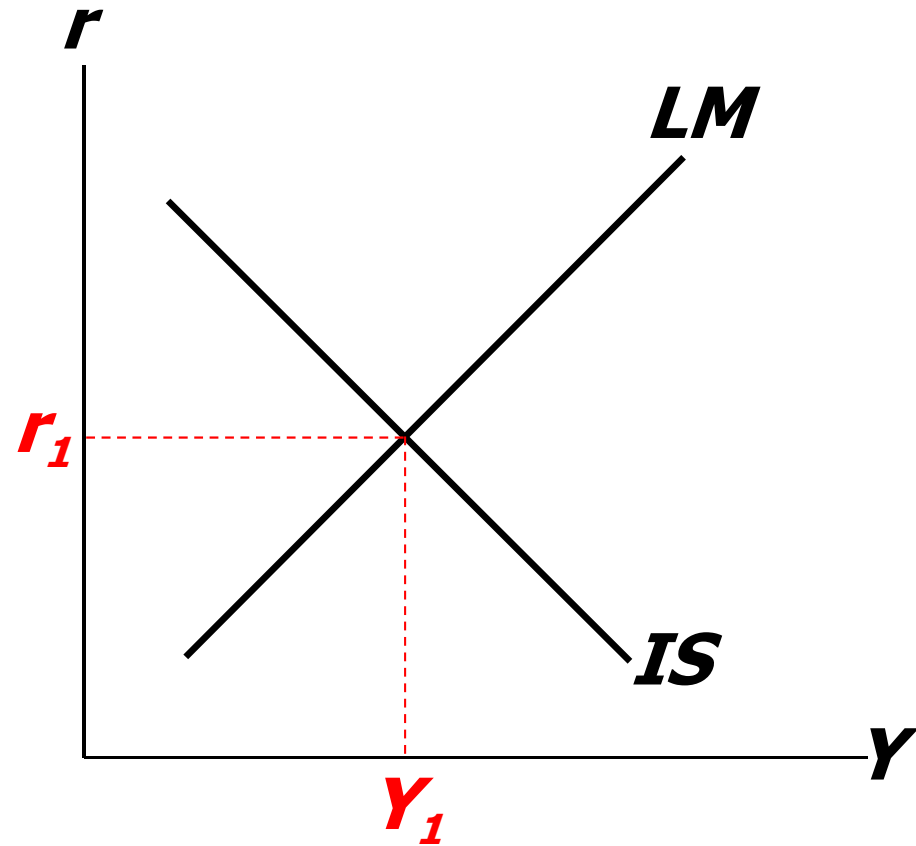
Equilibrium in the *IS-LM* model

The *IS* curve represents equilibrium in the goods market.

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

The *LM* curve represents money market equilibrium.

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

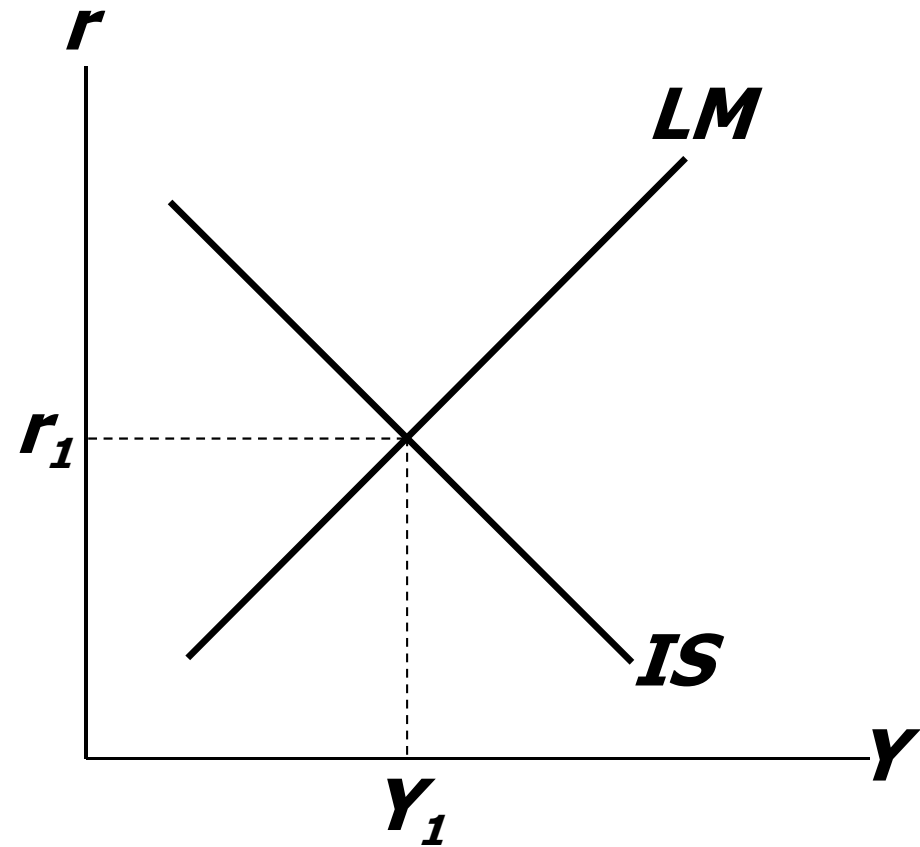The intersection determines the unique combination of **Y** and **r** that satisfies equilibrium in both markets.

Policy analysis with the *IS-LM* model

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

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

We can use the *IS-LM* model to analyze the effects of

- fiscal policy: **G** and/or **T**
- monetary policy: **M**

An increase in government purchases

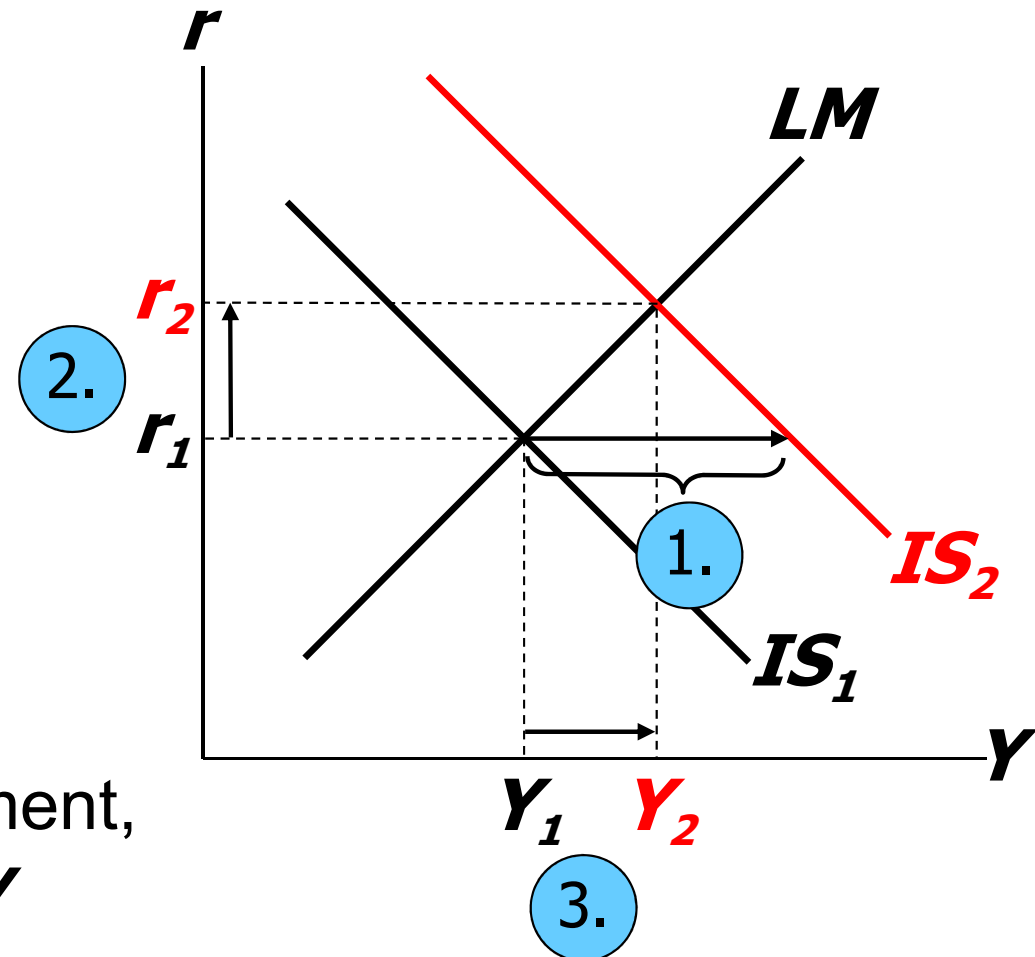1. *IS* curve shifts right by $\dfrac{1}{1-\text{MPC}}\Delta G$ causing output & income to rise.

2. This raises money demand, causing the interest rate to rise…

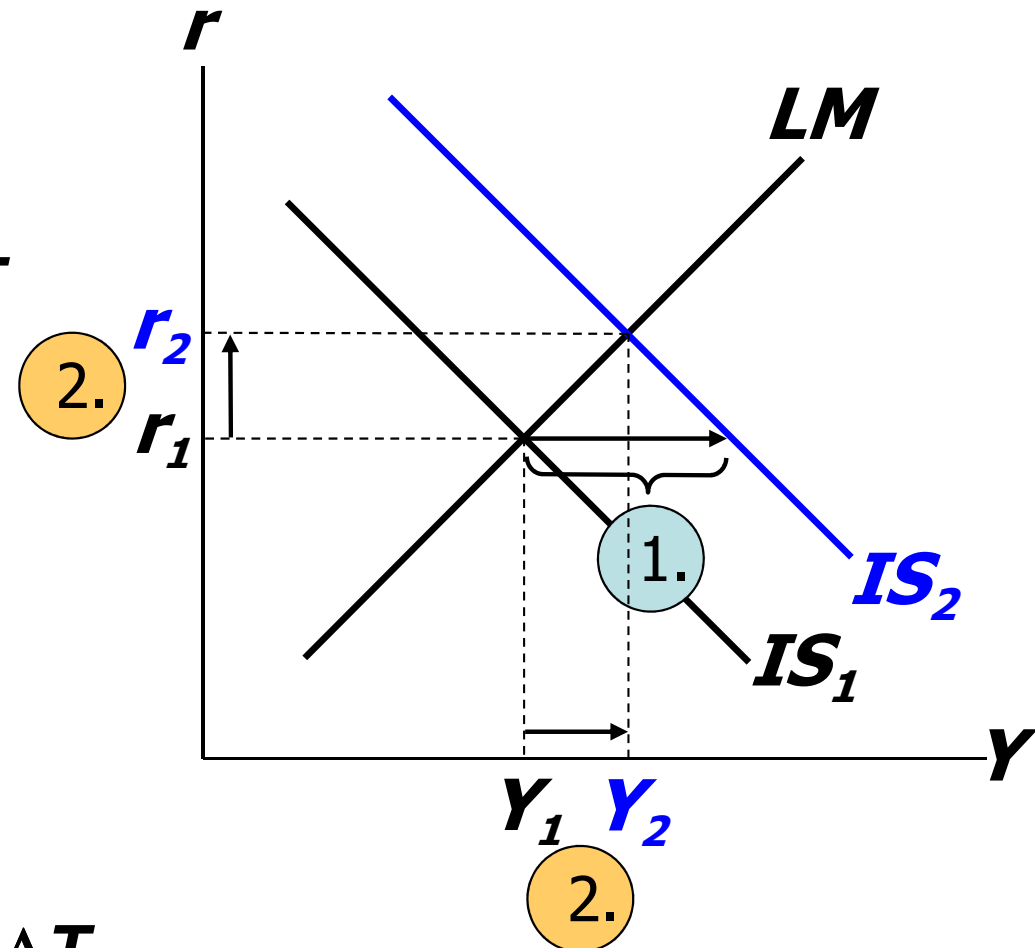3. …which reduces investment, so the final increase in **Y** is smaller than $\dfrac{1}{1-\text{MPC}}\Delta G$

A tax cut

Consumers save $(1-MPC)$ of the tax cut, so the initial boost in spending is smaller for ΔT than for an equal ΔG…

and the *IS* curve shifts by

1. $\dfrac{-MPC}{1-MPC}\Delta T$

2. …so the effects on *r* and *Y* are smaller for ΔT than for an equal ΔG.

Monetary policy: An increase in *M*

1. $\Delta M > 0$ shifts the *LM* curve down (or to the right)

2. …causing the interest rate to fall

3. …which increases investment, causing output & income to rise.
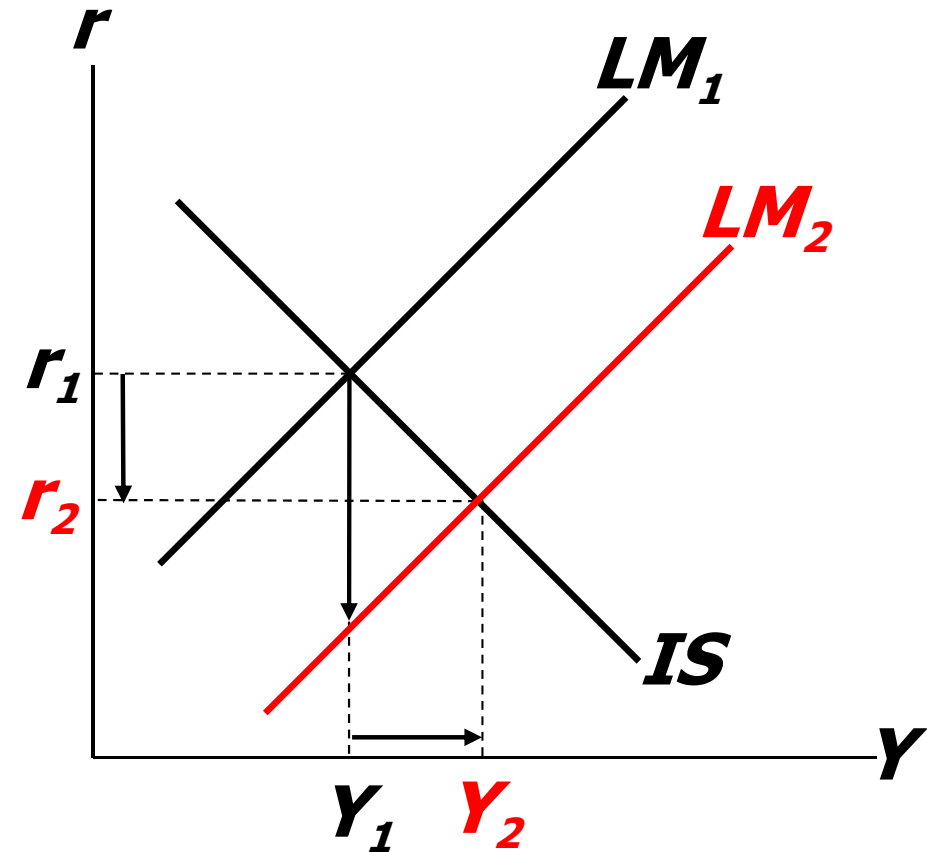
Interaction between monetary & fiscal policy

- Model:

  Monetary & fiscal policy variables
  (*M*, *G,* and *T*) are exogenous.

- Real world:

  Monetary policymakers may adjust *M*
  in response to changes in fiscal policy,
  or vice versa.

- Such interaction may alter the impact of the original policy change.

The Fed's response to $\Delta G > 0$

- Suppose Congress increases **G**.

- Possible Fed responses:
    1. hold **M** constant
    2. hold **r** constant
    3. hold **Y** constant

- In each case, the effects of the ΔG are different:
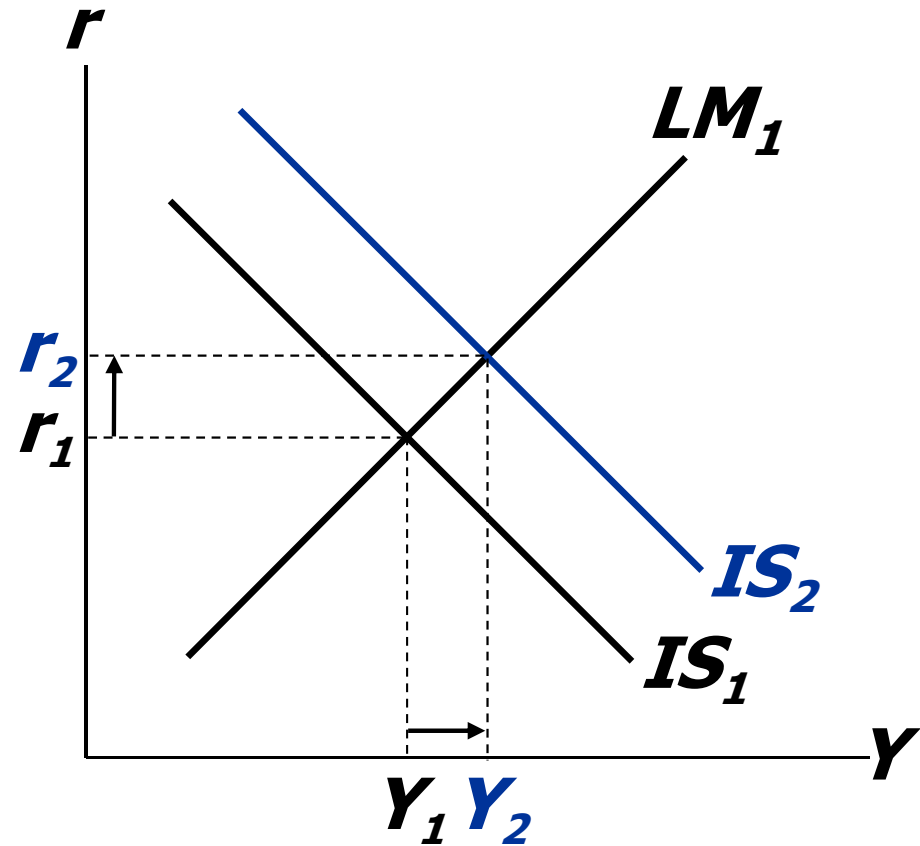
Response 1: Hold *M* constant

If Congress raises **G**, the *IS* curve shifts right.

If Fed holds **M** constant, then *LM* curve doesn't shift.

Results:

$$\Delta Y = Y_2 - Y_1$$

$$\Delta r = r_2 - r_1$$

Response 2:   Hold r constant
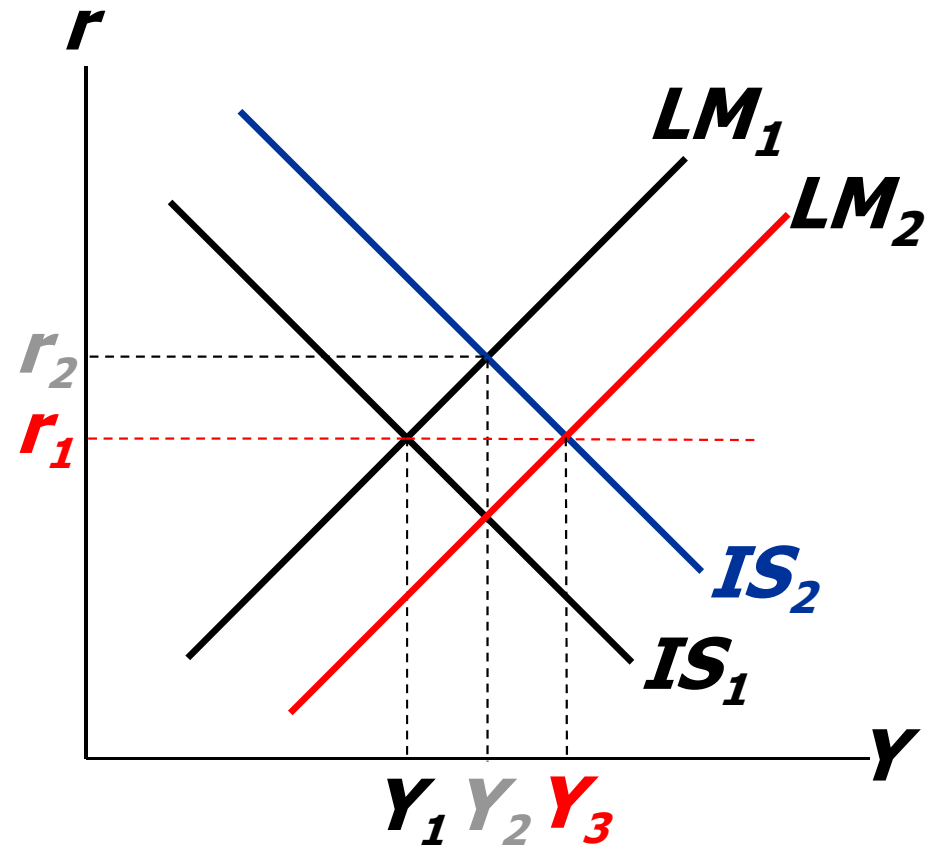
If Congress raises G,
the *IS* curve shifts right.

To keep r constant,
Fed increases M
to shift *LM* curve right.

Results:

$$\Delta Y = Y_3 - Y_1$$

$$\Delta r = 0$$

Response 3: Hold Y constant

If Congress raises G, the *IS* curve shifts right.

To keep **Y** constant, Fed reduces **M** to shift *LM* curve left.

Results:

$$\Delta Y = 0$$

$$\Delta r = r_3 - r_1$$
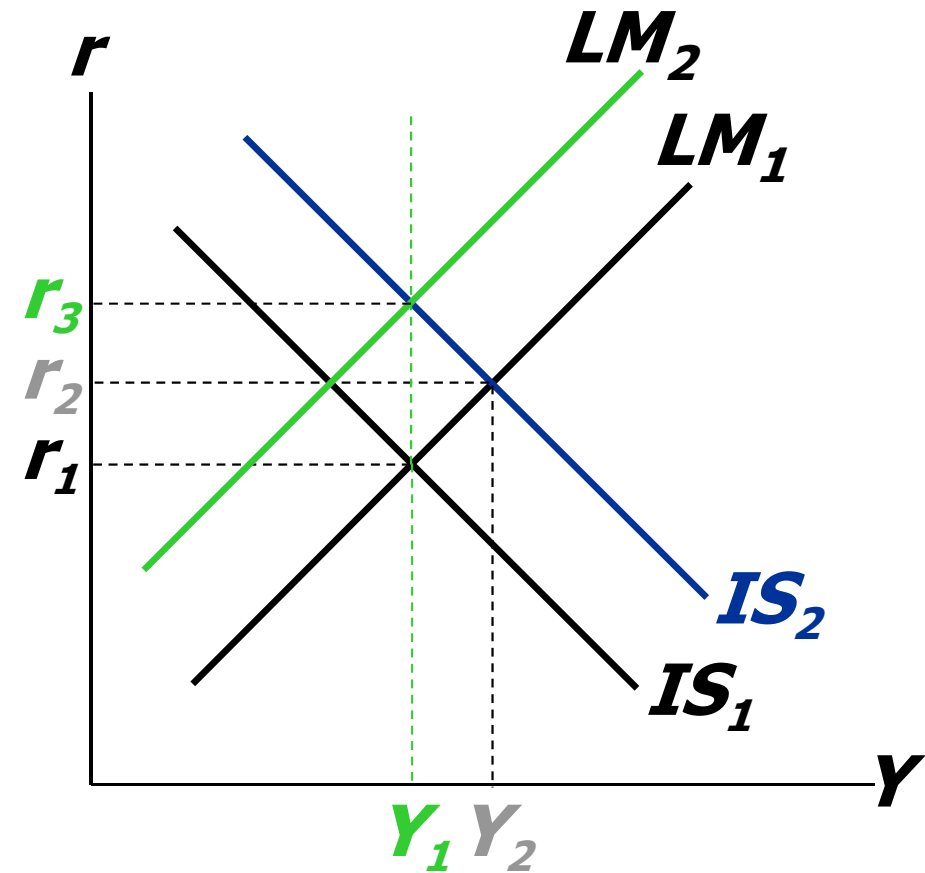
Estimates of fiscal policy multipliers
from the DRI macroeconometric model

Assumption about monetary policy	Estimated value of $\Delta Y/\Delta G$	Estimated value of $\Delta Y/\Delta T$
Fed holds money supply constant	0.60	–0.26
Fed holds nominal interest rate constant	1.93	–1.19

IS-LM and aggregate demand

- So far, we've been using the *IS-LM* model to analyze the short run, when the price level is assumed fixed.

- However, a change in **P** would shift *LM* and therefore affect **Y.**

- The **aggregate demand curve** (*introduced in Chap. 9*) captures this relationship between **P** and **Y.**

Deriving the *AD* curve

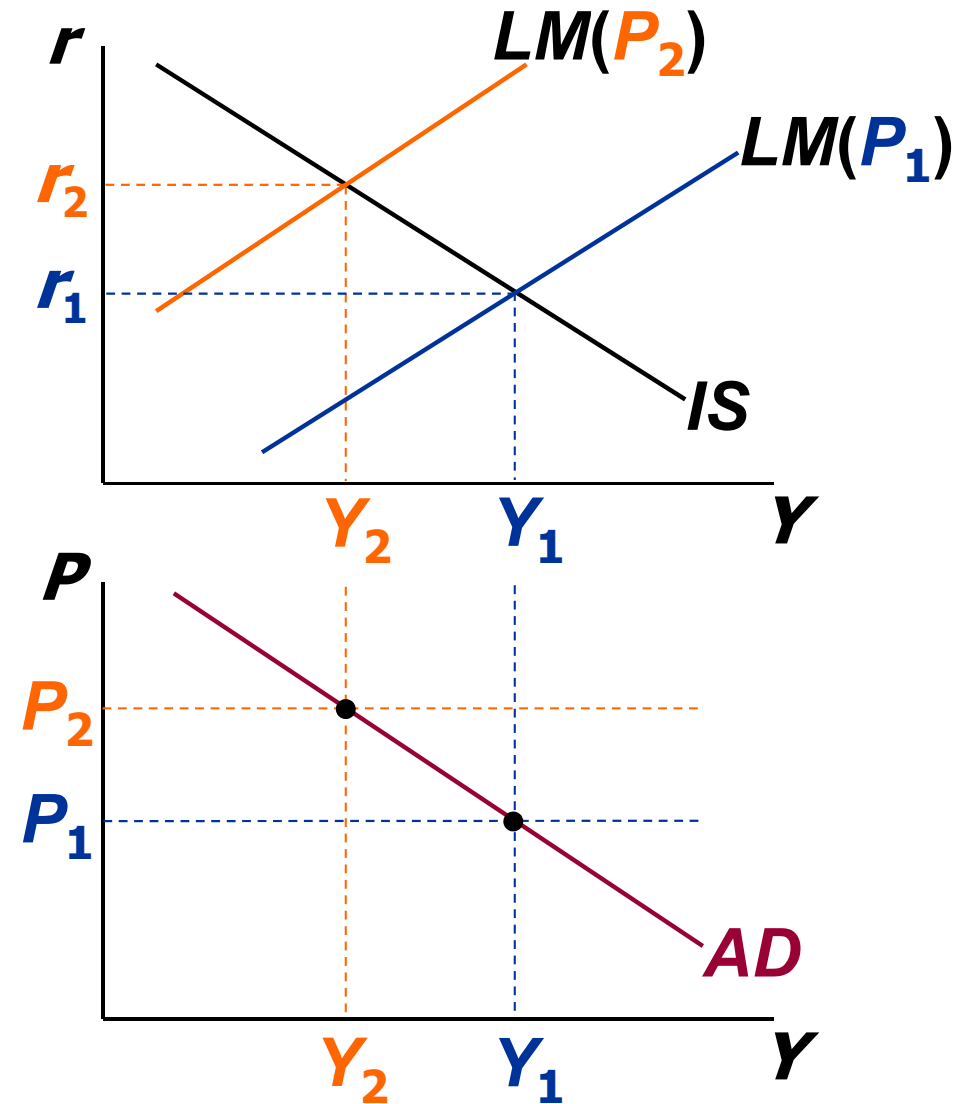Intuition for slope of *AD* curve:

$\uparrow P \Rightarrow \downarrow (M/P)$

$\Rightarrow LM$ shifts left

$\Rightarrow \uparrow r$

$\Rightarrow \downarrow I$

$\Rightarrow \downarrow Y$

Monetary policy and the *AD* curve

The Fed can increase aggregate demand:
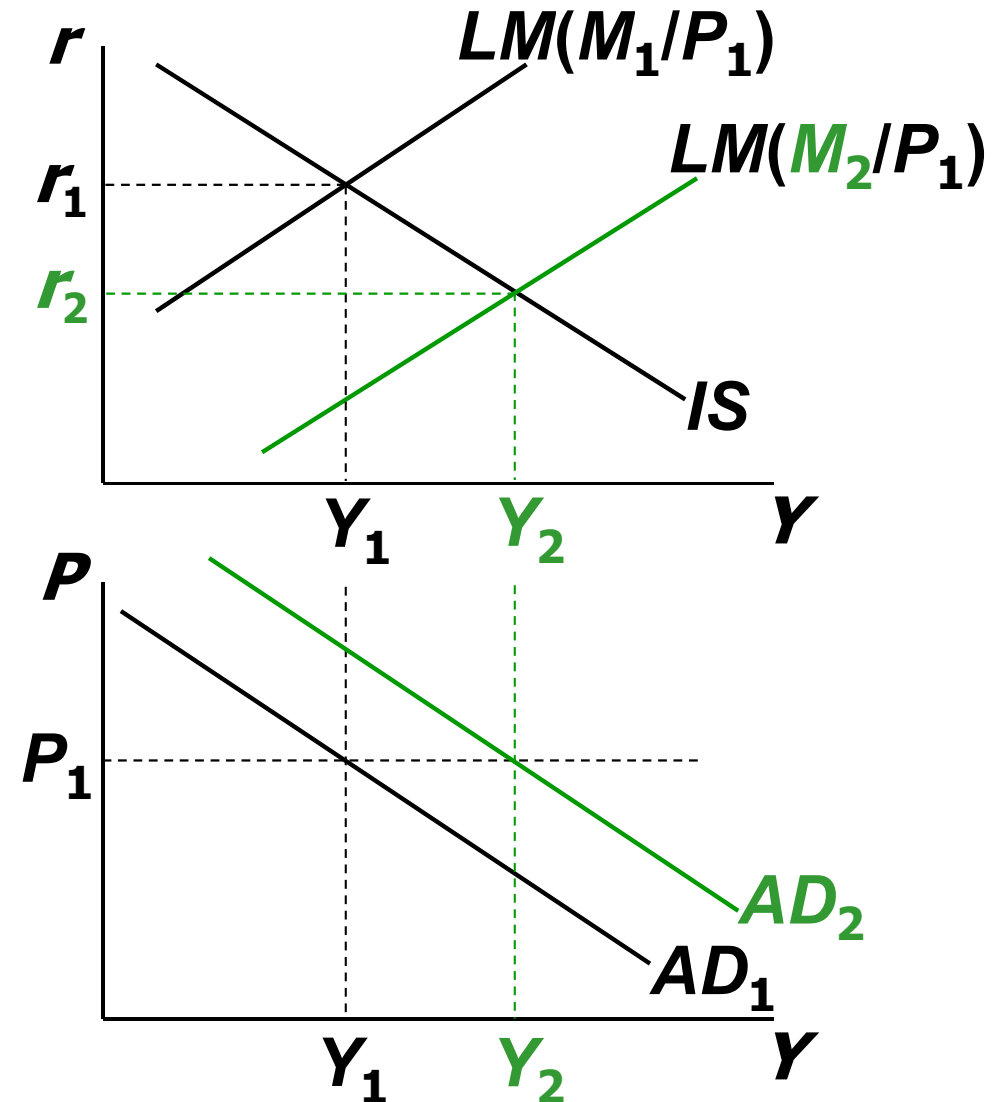
$\uparrow M \Rightarrow LM$ shifts right

$\Rightarrow \downarrow r$

$\Rightarrow \uparrow I$

$\Rightarrow \uparrow Y$ at each value of P

Fiscal policy and the *AD* curve

Expansionary fiscal policy ($\uparrow G$ and/or $\downarrow T$) increases agg. demand:

$\downarrow T \Rightarrow \uparrow C$

$\quad \Rightarrow IS$ shifts right

$\quad \Rightarrow \uparrow Y$ at each

value

of *P*
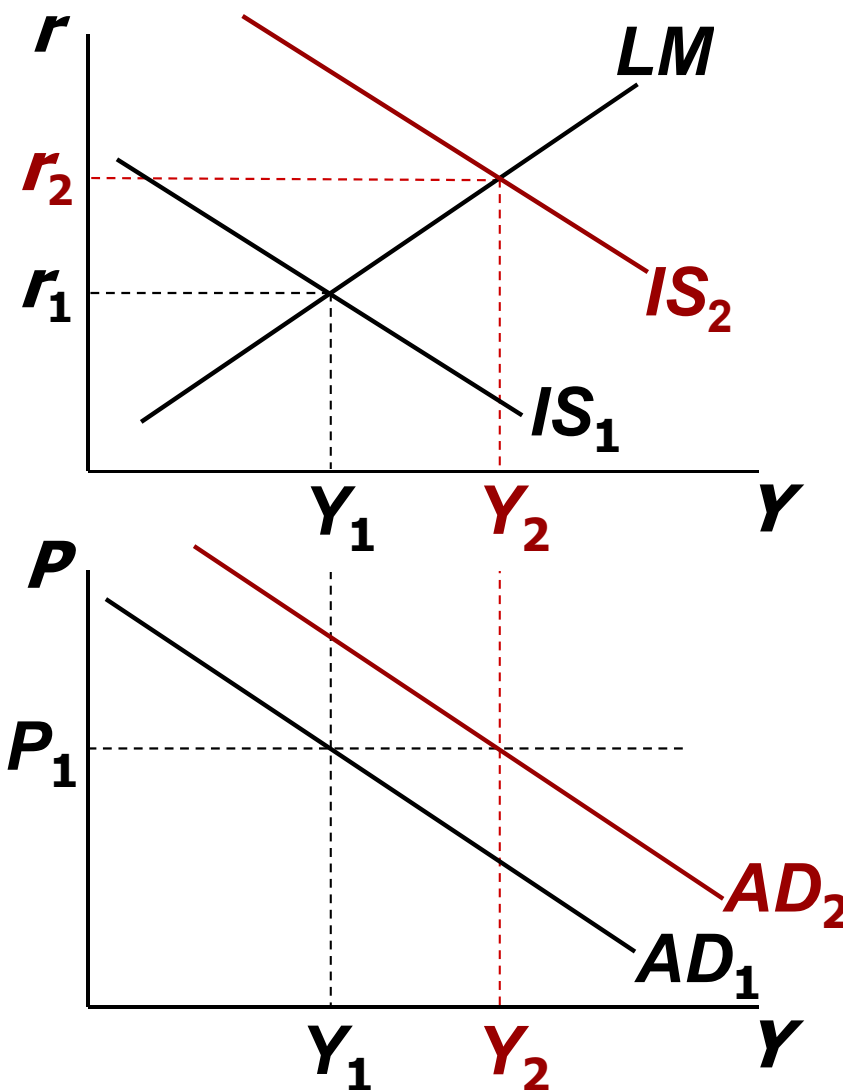
IS-LM and AD-AS in the short run & long run

Recall from Chapter 9:   The force that moves the economy from the short run to the long run is the gradual adjustment of prices.

In the short-run equilibrium, if	then over time, the price level will
$Y > \bar{Y}$	rise
$Y < \bar{Y}$	fall
$Y = \bar{Y}$	remain constant

The Big Picture

Keynesian Cross → *IS* curve

Theory of Liquidity Preference → *LM* curve

IS-LM model

IS curve, *LM* curve → *IS-LM* model

IS-LM model → Agg. demand curve

Agg. demand curve → Model of Agg. Demand and Agg. Supply

Agg. supply curve → Model of Agg. Demand and Agg. Supply

Model of Agg. Demand and Agg. Supply → Explanation of short-run fluctuations
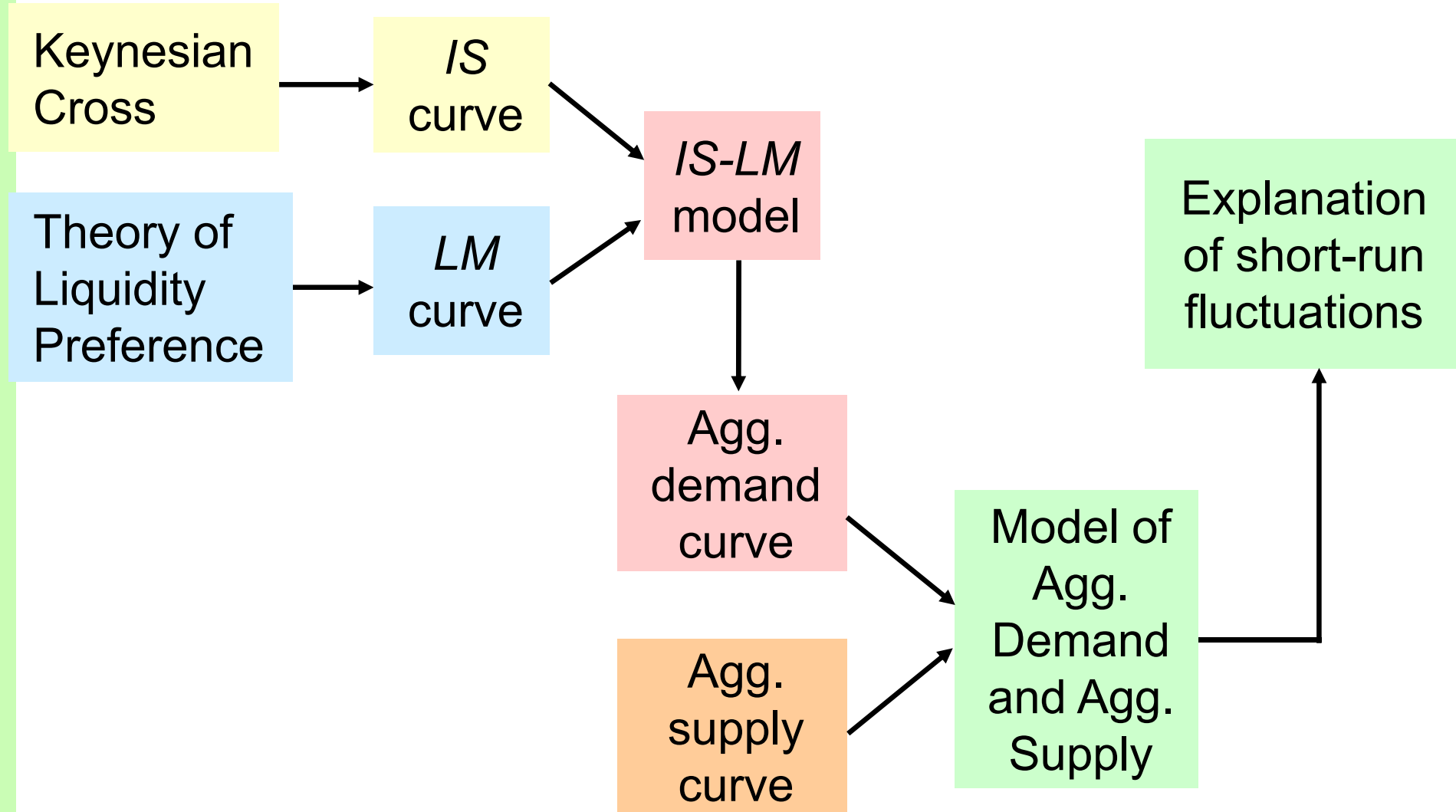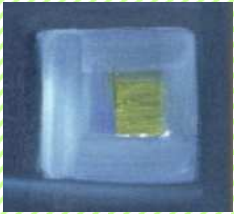
Chapter Summary

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
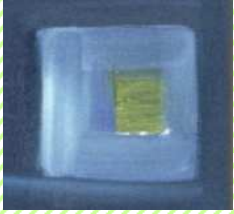
4. *LM* curve

   - 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.

Chapter Summary

2. *AD* curve

- shows relation between **P** and the *IS-LM* model's equilibrium **Y**.

- negative slope because
$$\uparrow P \Rightarrow \downarrow (M/P) \Rightarrow \uparrow r \Rightarrow \downarrow I \Rightarrow \downarrow Y$$

- expansionary fiscal policy shifts *IS* curve right, raises income, and shifts *AD* curve right.

- expansionary monetary policy shifts *LM* curve right, raises income, and shifts *AD* curve right.

- *IS* or *LM* shocks shift the *AD* curve.

APPENDIX: The Great Depression

The Great Depression
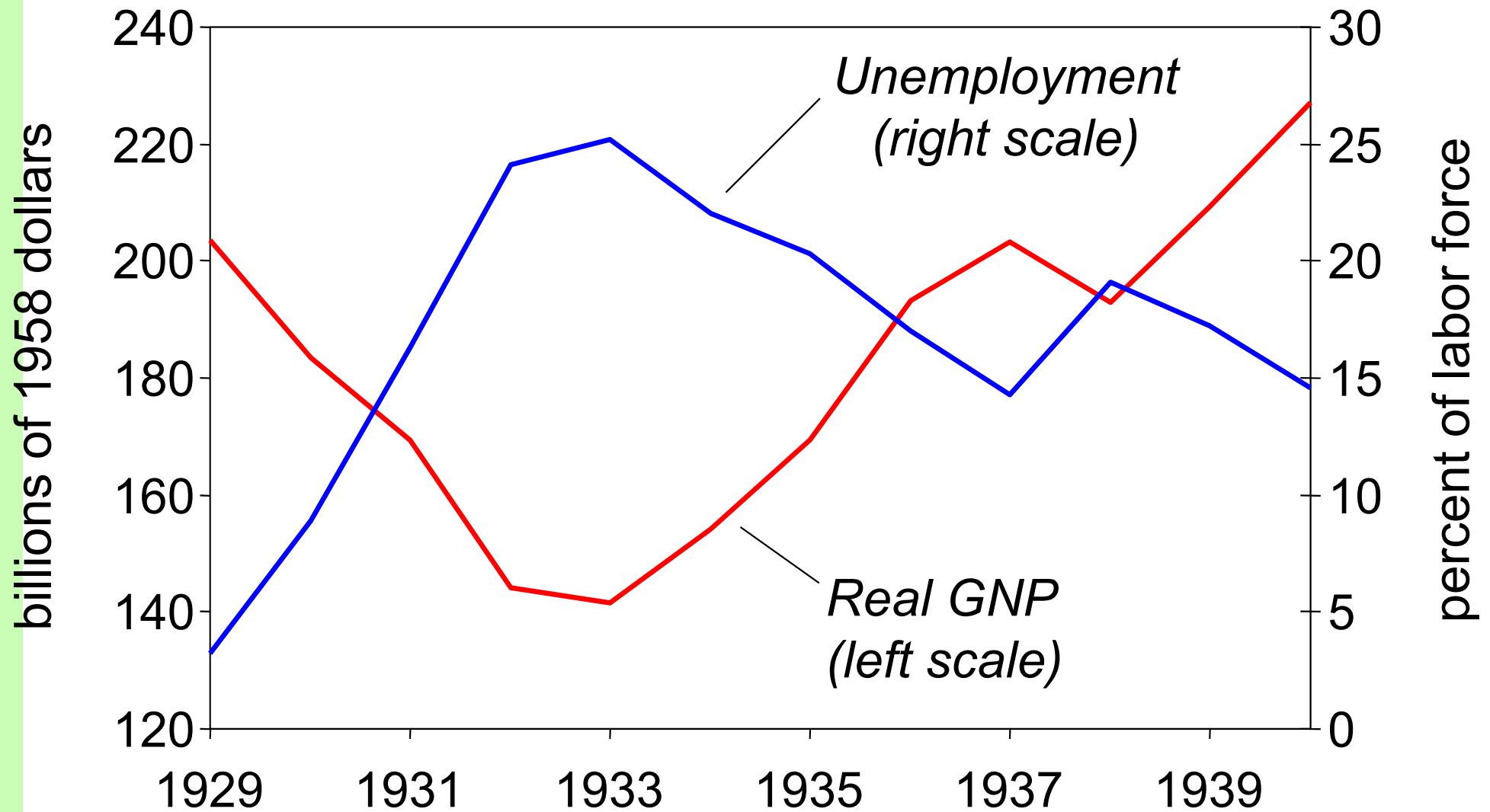
THE SPENDING HYPOTHESIS: Shocks to the *IS* curve

- asserts that the Depression was largely due to an exogenous fall in the demand for goods & services – a leftward shift of the *IS* curve.

- evidence:
  output and interest rates both fell, which is what a leftward *IS* shift would cause.

THE SPENDING HYPOTHESIS: Reasons for the *IS* shift

- Stock market crash $\Rightarrow$ exogenous $\downarrow C$
  - Oct-Dec 1929: S&P 500 fell 17%
  - Oct 1929-Dec 1933: S&P 500 fell 71%

- Drop in investment
  - "correction" after overbuilding in the 1920s
  - widespread bank failures made it harder to obtain financing for investment

- Contractionary fiscal policy
  - Politicians raised tax rates and cut spending to combat increasing deficits.

THE MONEY HYPOTHESIS:
A shock to the *LM* curve

- asserts that the Depression was largely due to huge fall in the money supply.

- evidence:
  M1 fell 25% during 1929-33.

- But, two problems with this hypothesis:
  - **P** fell even more, so **M/P** actually rose slightly during 1929-31.
  - nominal interest rates fell, which is the opposite of what a leftward *LM* shift would cause.

THE MONEY HYPOTHESIS AGAIN: The effects of falling prices

- asserts that the severity of the Depression was due to a huge deflation:
  P fell 25% during 1929-33.

- This deflation was probably caused by the fall in M, so perhaps money played an important role after all.

- In what ways does a deflation affect the economy?

THE MONEY HYPOTHESIS AGAIN:
The effects of falling prices

- The stabilizing effects of deflation:

- $\downarrow P \Rightarrow \uparrow(M/P) \Rightarrow LM$ shifts right $\Rightarrow \uparrow Y$

- **Pigou effect**:

$$\downarrow P \quad \Rightarrow \uparrow(M/P)$$

$$\Rightarrow \text{consumers' wealth } \uparrow$$

$$\Rightarrow \uparrow C$$

$$\Rightarrow IS \text{ shifts right}$$

$$\Rightarrow \uparrow Y$$

THE MONEY HYPOTHESIS AGAIN:
The effects of falling prices

- The destabilizing effects of <u>expected</u> deflation:

$$\downarrow \pi^e$$

$$\Rightarrow r \uparrow \quad \text{for each value of } i$$

$$\Rightarrow I \downarrow \quad \text{because } I = I(r)$$

$$\Rightarrow \text{planned expenditure \& agg. demand} \downarrow$$

$$\Rightarrow \text{income \& output} \downarrow$$

THE MONEY HYPOTHESIS AGAIN: The effects of falling prices

■ The destabilizing effects of <u>unexpected</u> deflation: **debt-deflation theory**

$\downarrow P$ (if unexpected)

$\Rightarrow$ transfers purchasing power from borrowers to lenders

$\Rightarrow$ borrowers spend less, lenders spend more

$\Rightarrow$ if borrowers' propensity to spend is larger than lenders', then aggregate spending falls, the *IS* curve shifts left, and *Y* falls