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

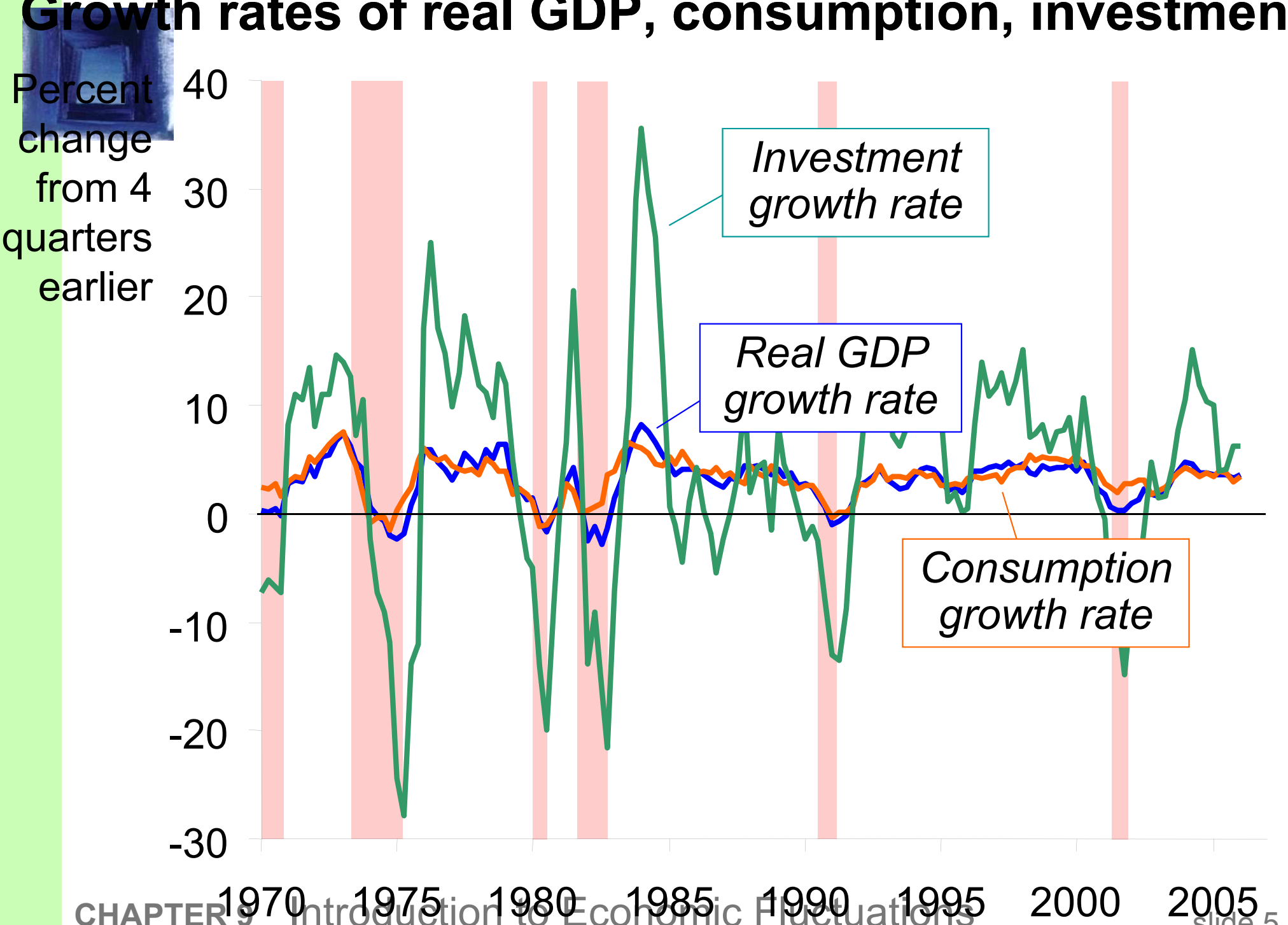
- In the following lectures, we will study the short-run fluctuations of the economy (business cycles)
- We focus on three models:
  - ISLM model (lecture 9)
  - Mudell-Fleming model (lecture 10)
  - Model AS-AD
    - AD (lectures 9 and 10)
    - AS (lecture 11)

Facts about the business cycle

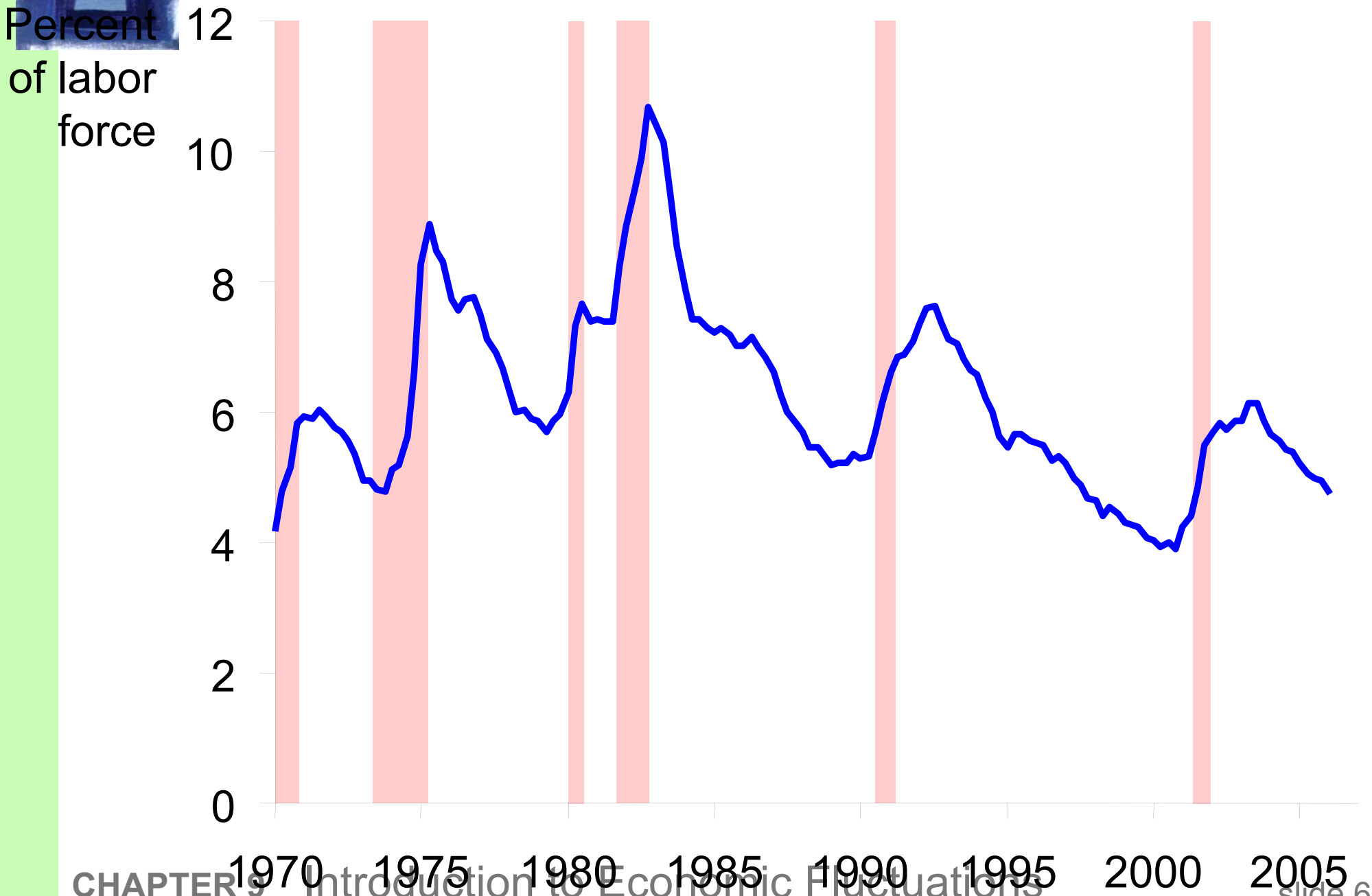
- GDP growth averages 3–3.5 percent per year over the long run with large fluctuations in the short run.
- Consumption and investment fluctuate with GDP, but consumption tends to be less volatile and investment more volatile than GDP.
- Unemployment rises during recessions and falls during expansions.
- **Okun's Law**: the negative relationship between GDP and unemployment.

Growth rates of real GDP, consumption

Growth rates of real GDP, consumption, investment



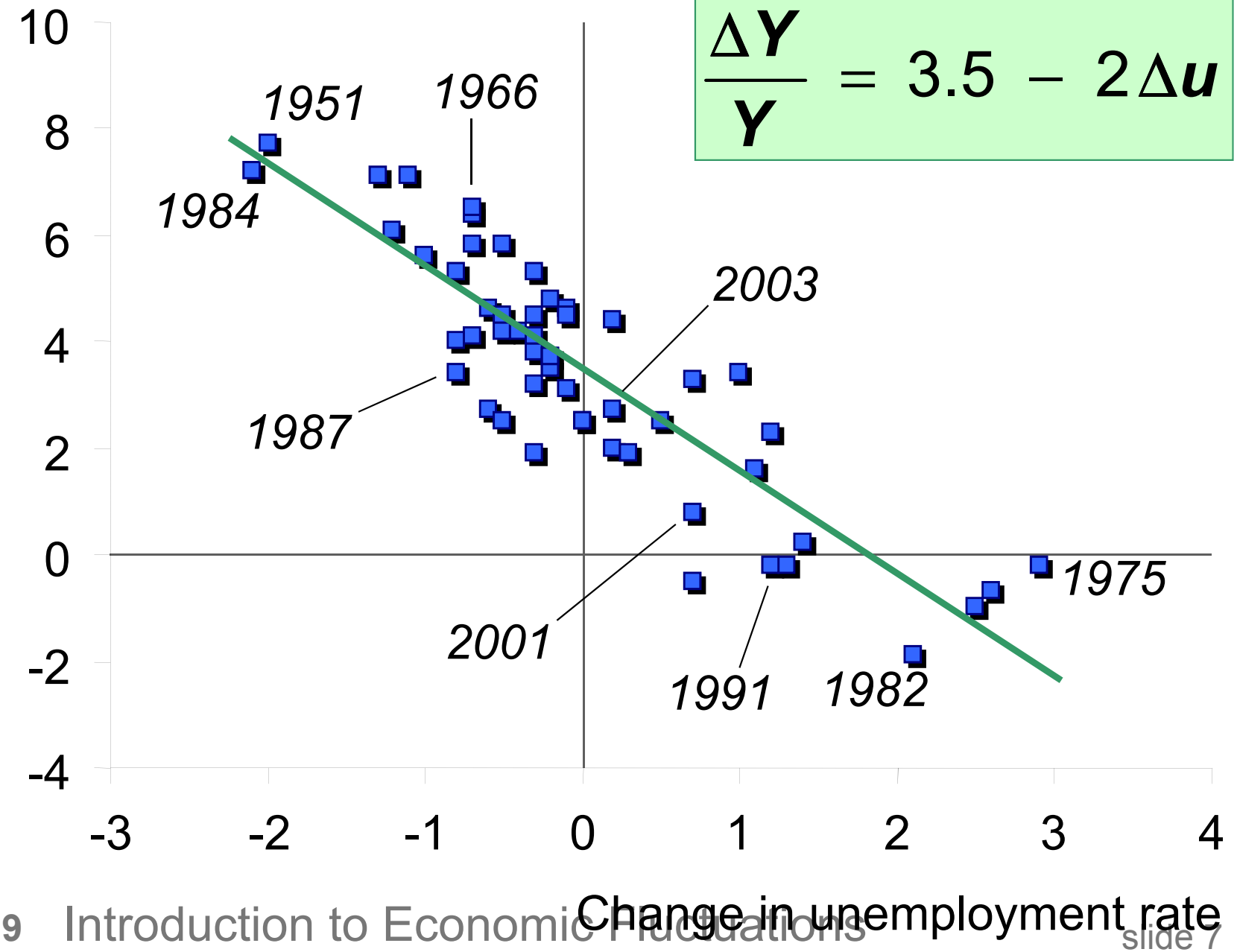
Unemployment



Okun's Law

Percentage change in real GDP

$$\frac{\Delta Y}{Y} = 3.5 - 2\Delta u$$



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.

Recap of classical macro theory (Chaps. 3-8)

- Output is determined by the supply side:
  - supplies of capital, labor
  - technology.
- Changes in demand for goods & services (***C***, ***I***, ***G***) only affect prices, not quantities.
- Assumes complete price flexibility.
- Applies to the long run.

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 model of aggregate demand and supply

- the paradigm most mainstream economists and policymakers use to think about economic fluctuations and policies to stabilize the economy
- shows how the price level and aggregate output are determined
- shows how the economy's behavior is different in the short run and long run

IS-LM

- 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.
- This lecture focuses on the closed-economy case.
- Next lecture 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: $G = \bar{G}, \quad T = \bar{T}$

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

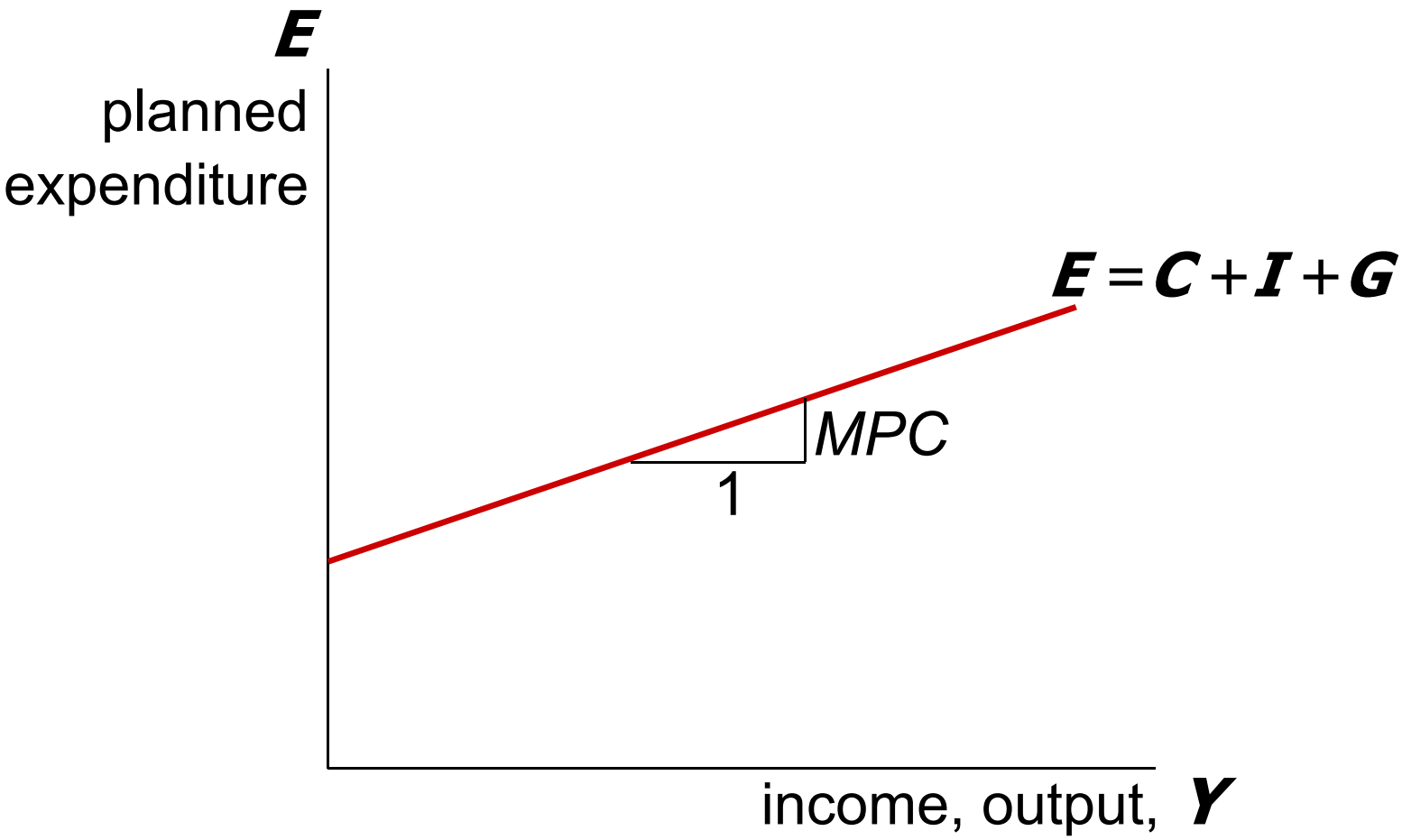
planned expenditure: $E = C(Y - \bar{T}) + \bar{I} + \bar{G}$

equilibrium condition:

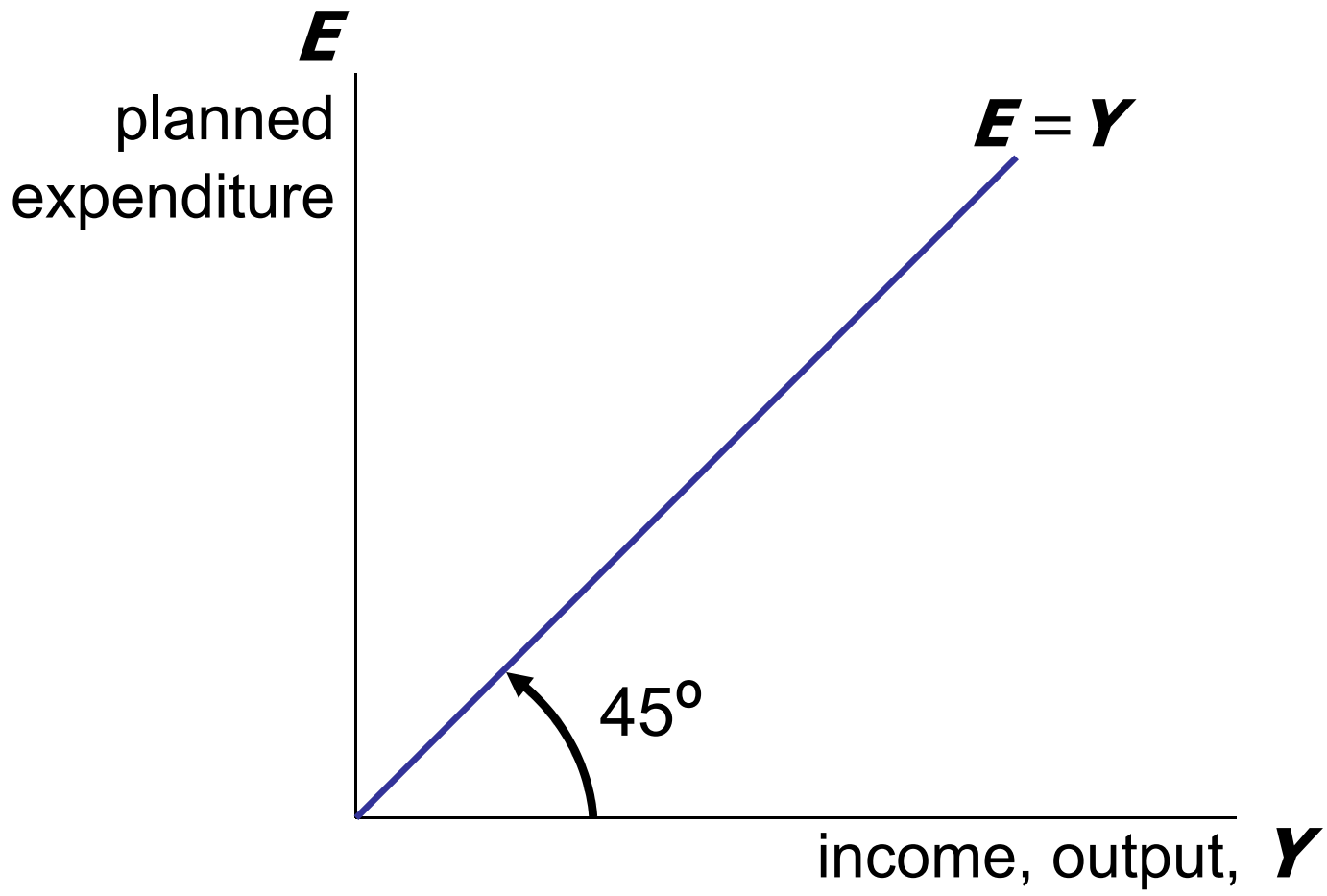
actual expenditure = planned expenditure

$$Y = E$$

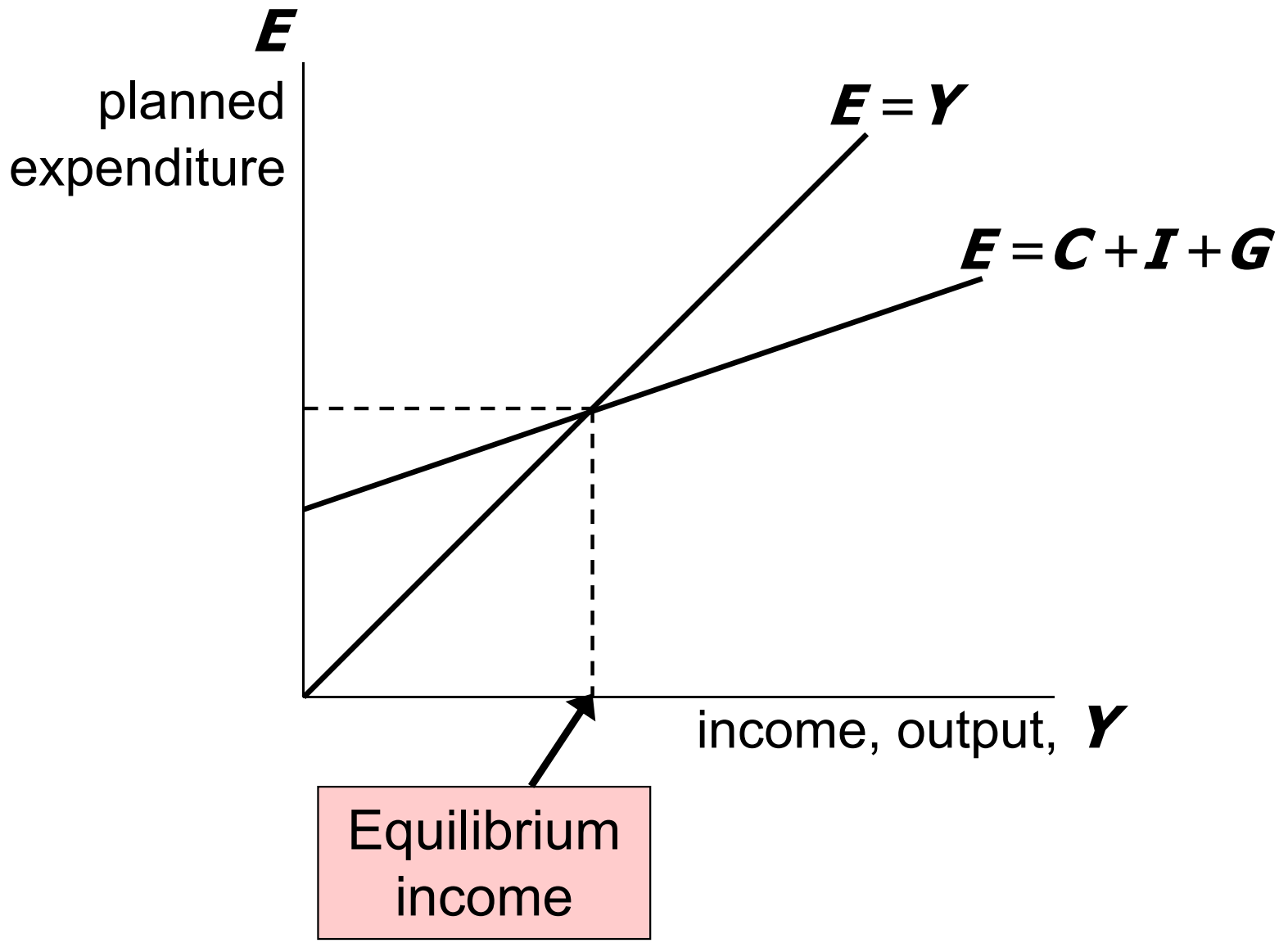
Graphing planned expenditure



Graphing the equilibrium condition

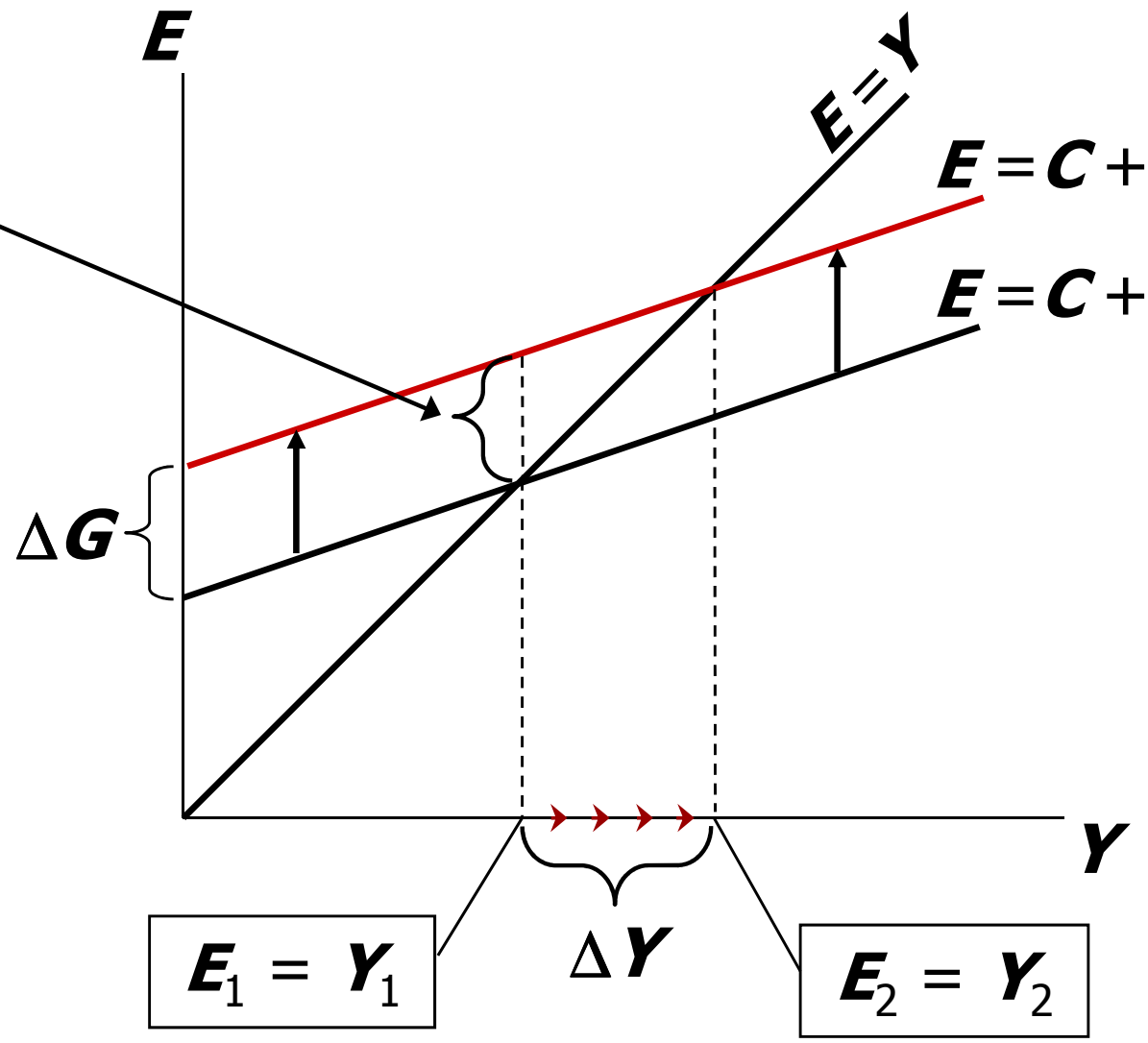


The equilibrium value of income



An increase in government purchases

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



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

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

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

Example: If *MPC* = 0.8, then

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

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 $\uparrow Y \Rightarrow \uparrow C$

  $\Rightarrow$ further $\uparrow Y$

  $\Rightarrow$ further $\uparrow C$

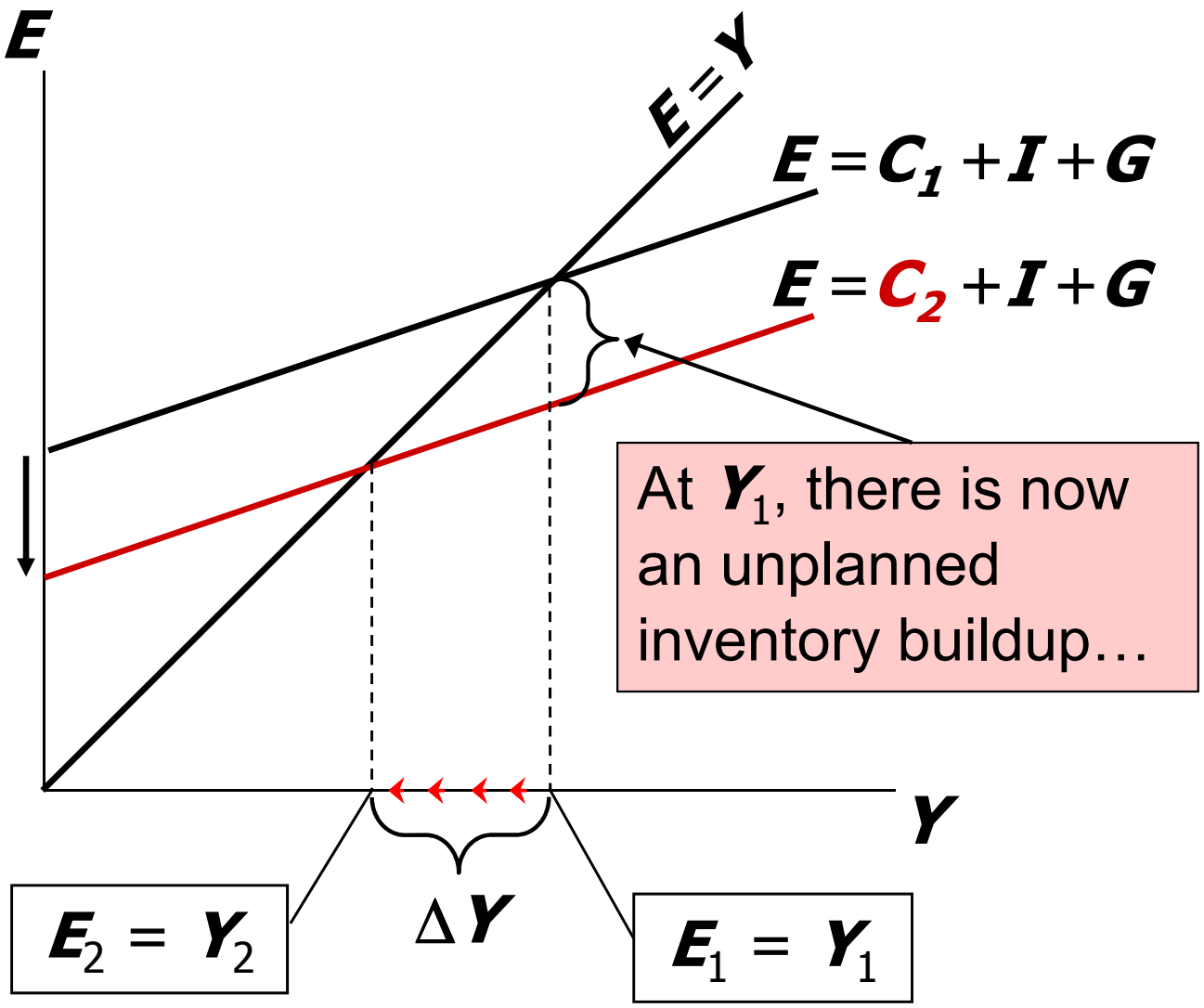
  $\Rightarrow$ further $\uparrow Y$
- So the final impact on income is much bigger than the initial ΔG.

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



At Y_1, there is now an unplanned inventory buildup…

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

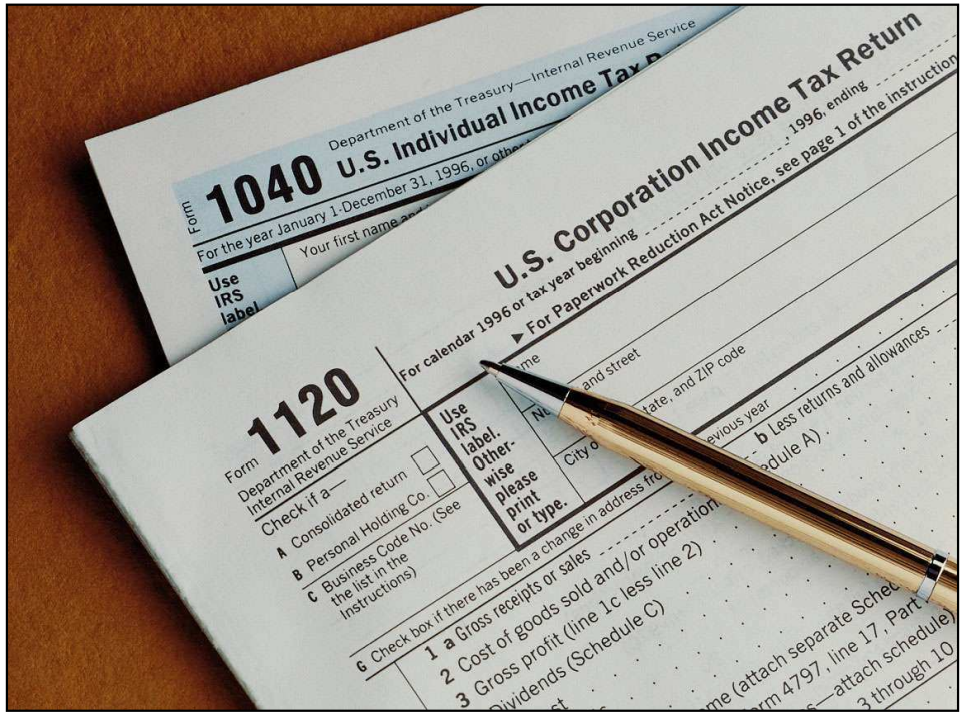
def: the change in income resulting from a \$1 increase in $\boldsymbol{T}$:

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

If *MPC* = 0.8, then the tax multiplier equals

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

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:

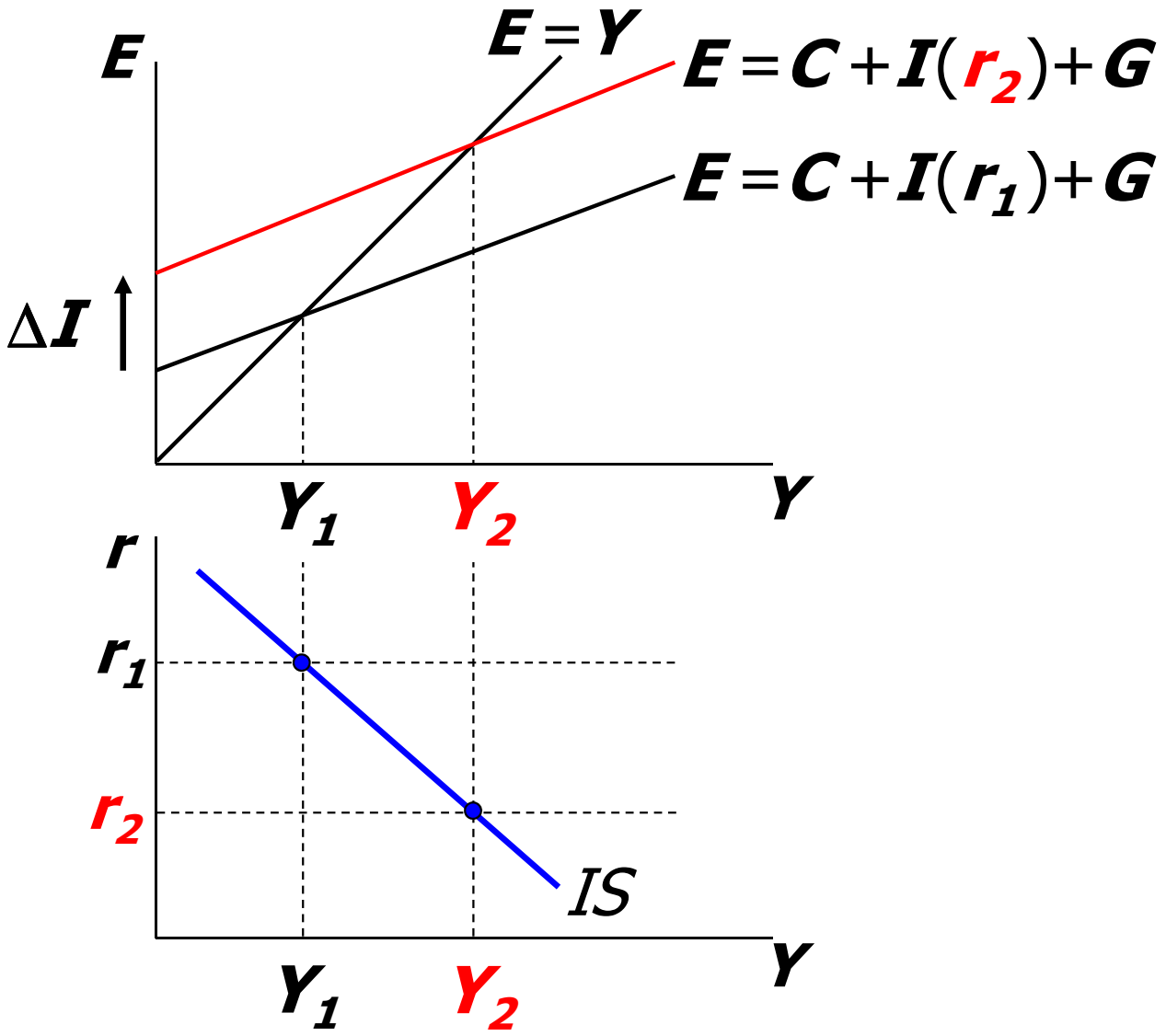
$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

Deriving the *IS* curve

$\downarrow r \Rightarrow \uparrow I$

$\Rightarrow \uparrow E$

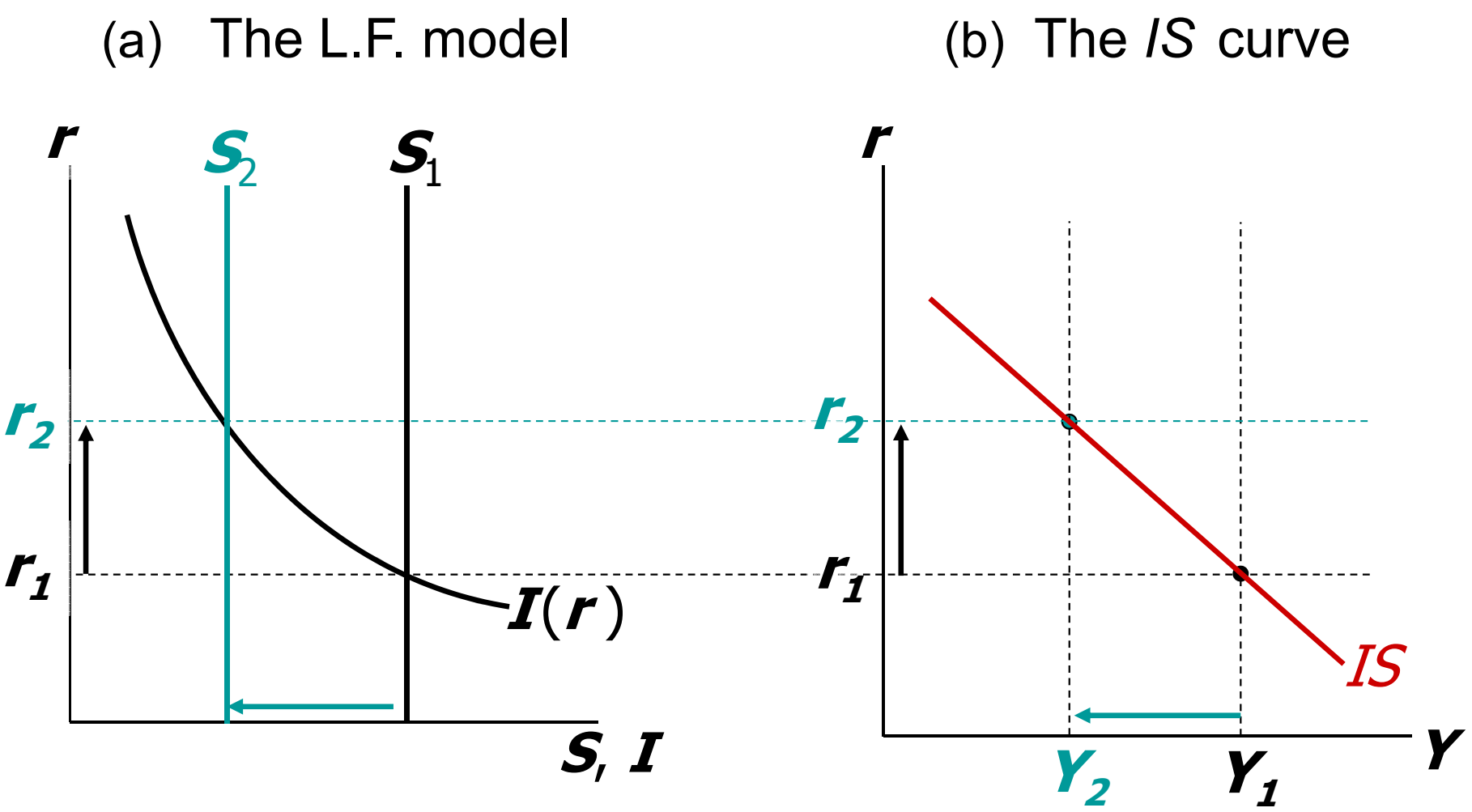
$\Rightarrow \uparrow Y$



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



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

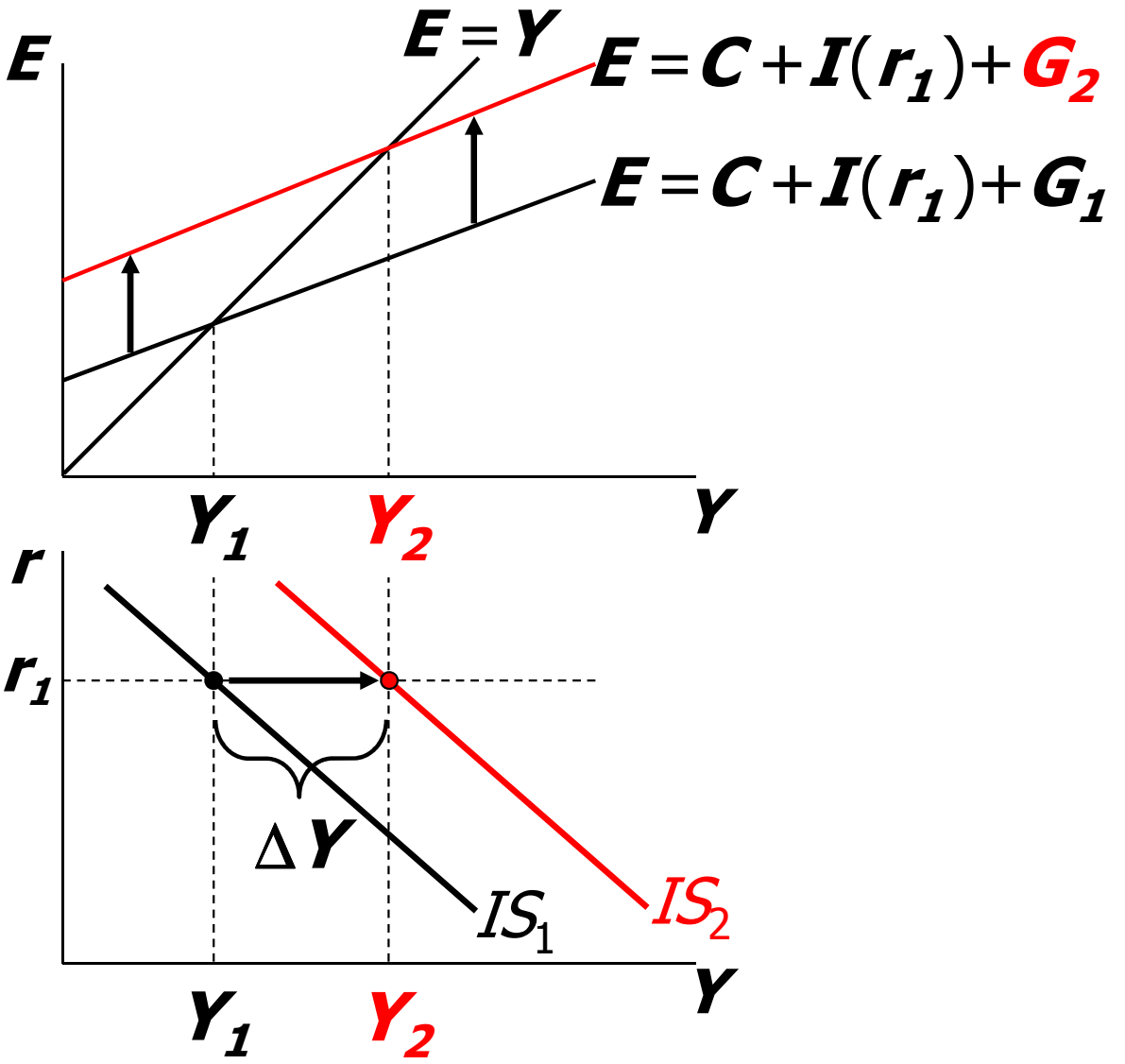
At any value of r,

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

…so the *IS* curve shifts to the right.

The horizontal distance of the *IS* shift equals

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



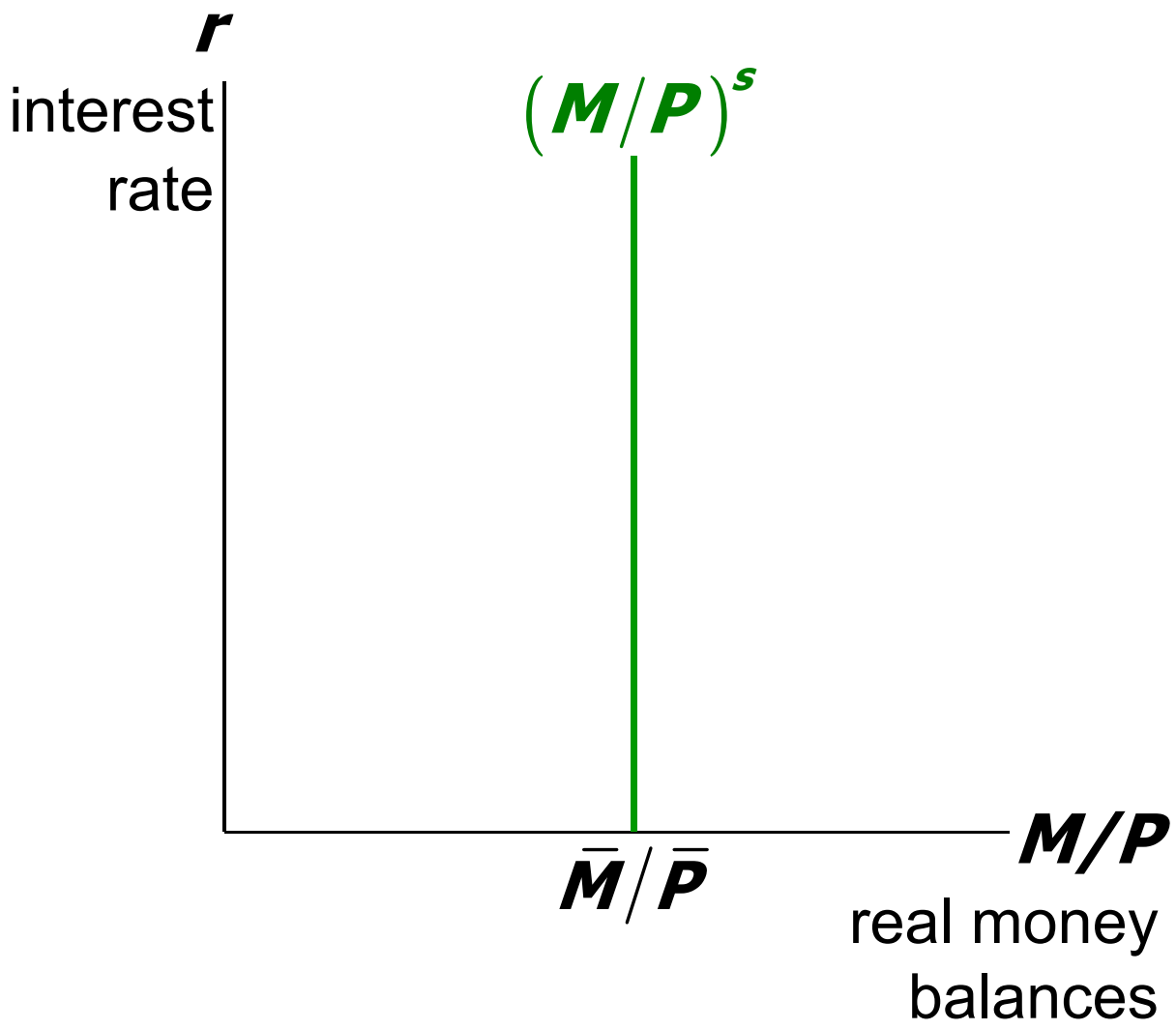
The Theory of Liquidity Preference

- 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:

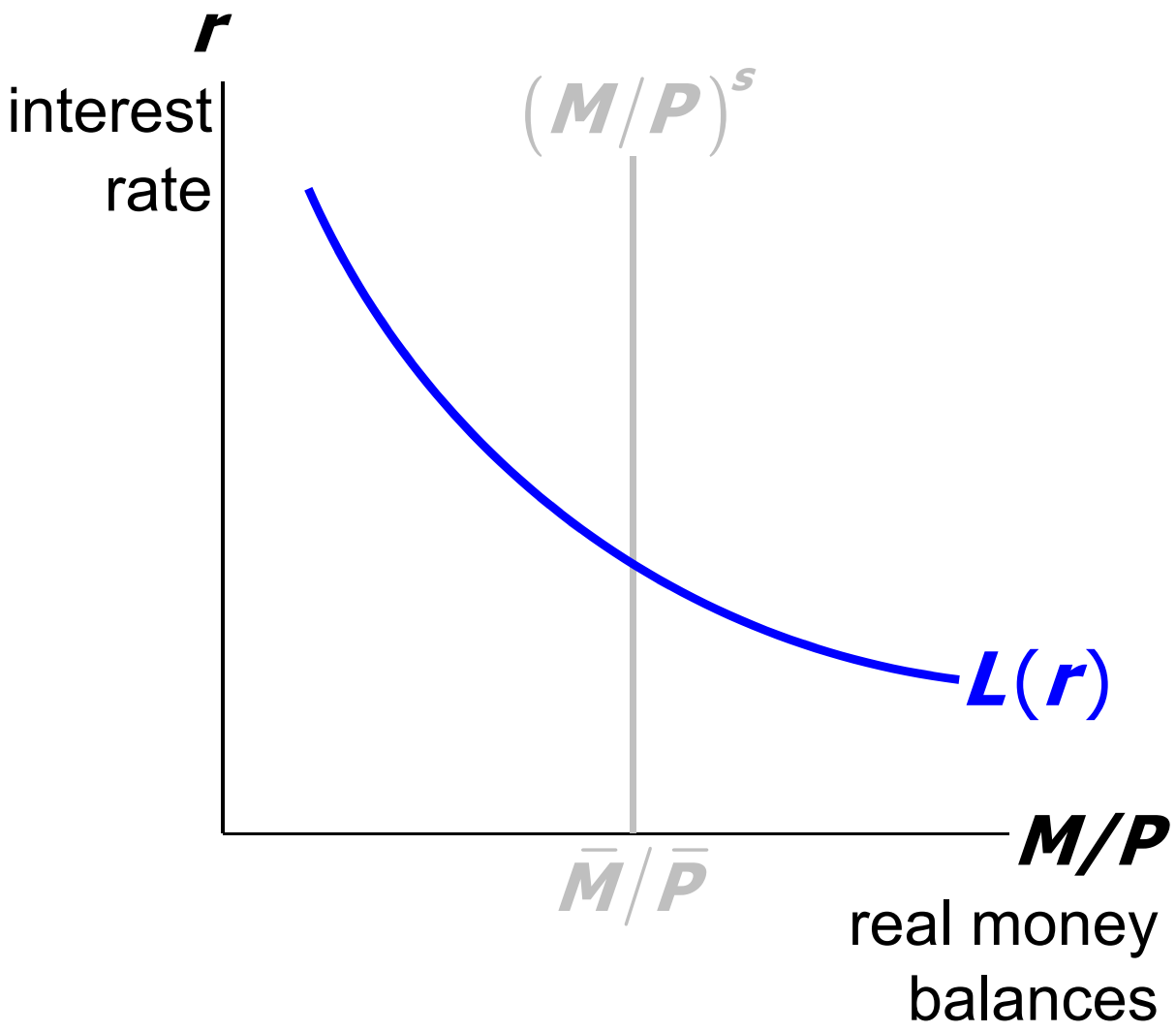
$$\left(M/P\right)^{s} = \bar{M}/\bar{P}$$



Money demand

Demand for real money balances:

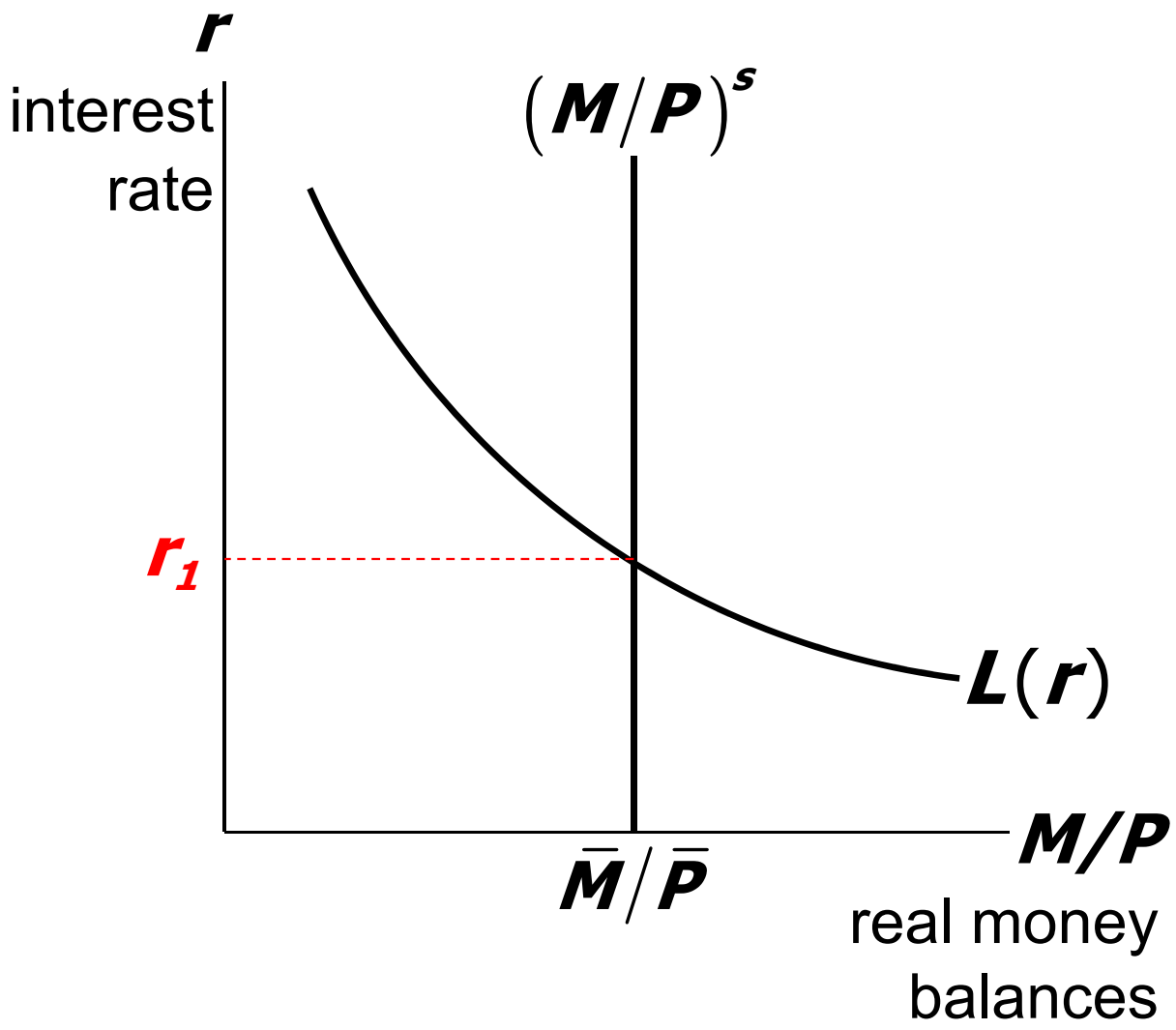
$$(M/P)^d = L(r)$$



Equilibrium

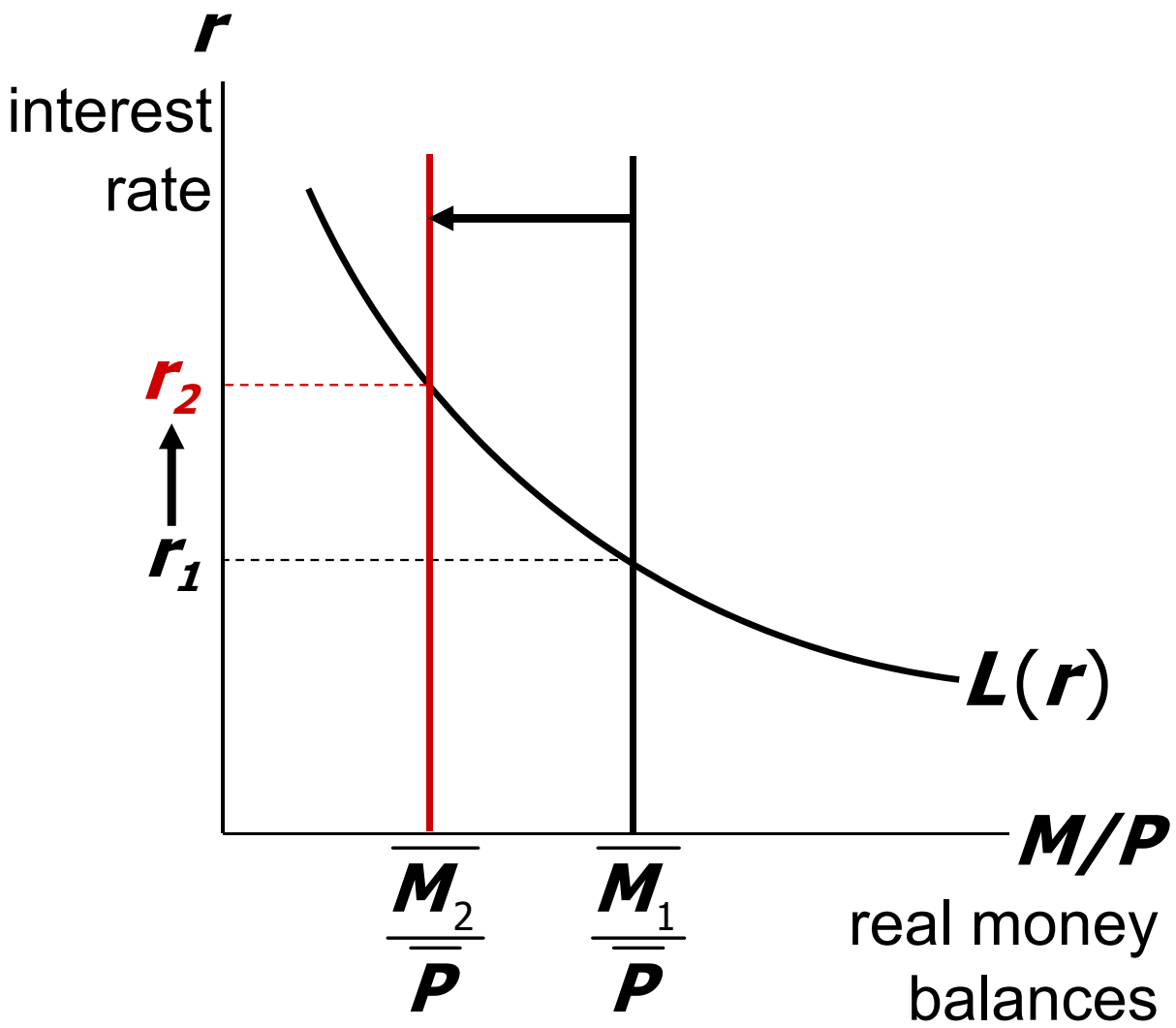
The interest rate adjusts to equate the supply and demand for money:

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



How the 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:

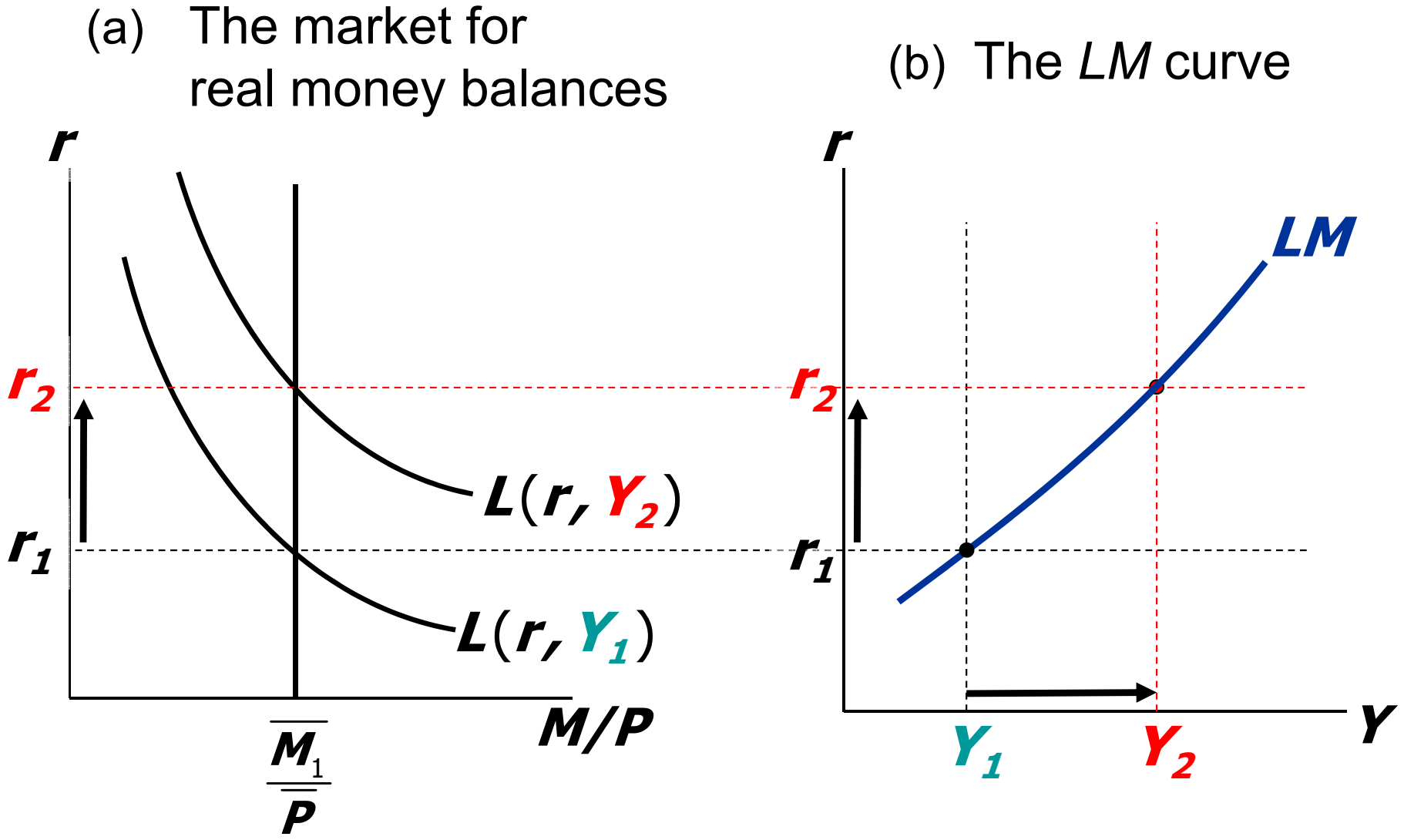
$$(M/P)^d = L(r, Y)$$

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:

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

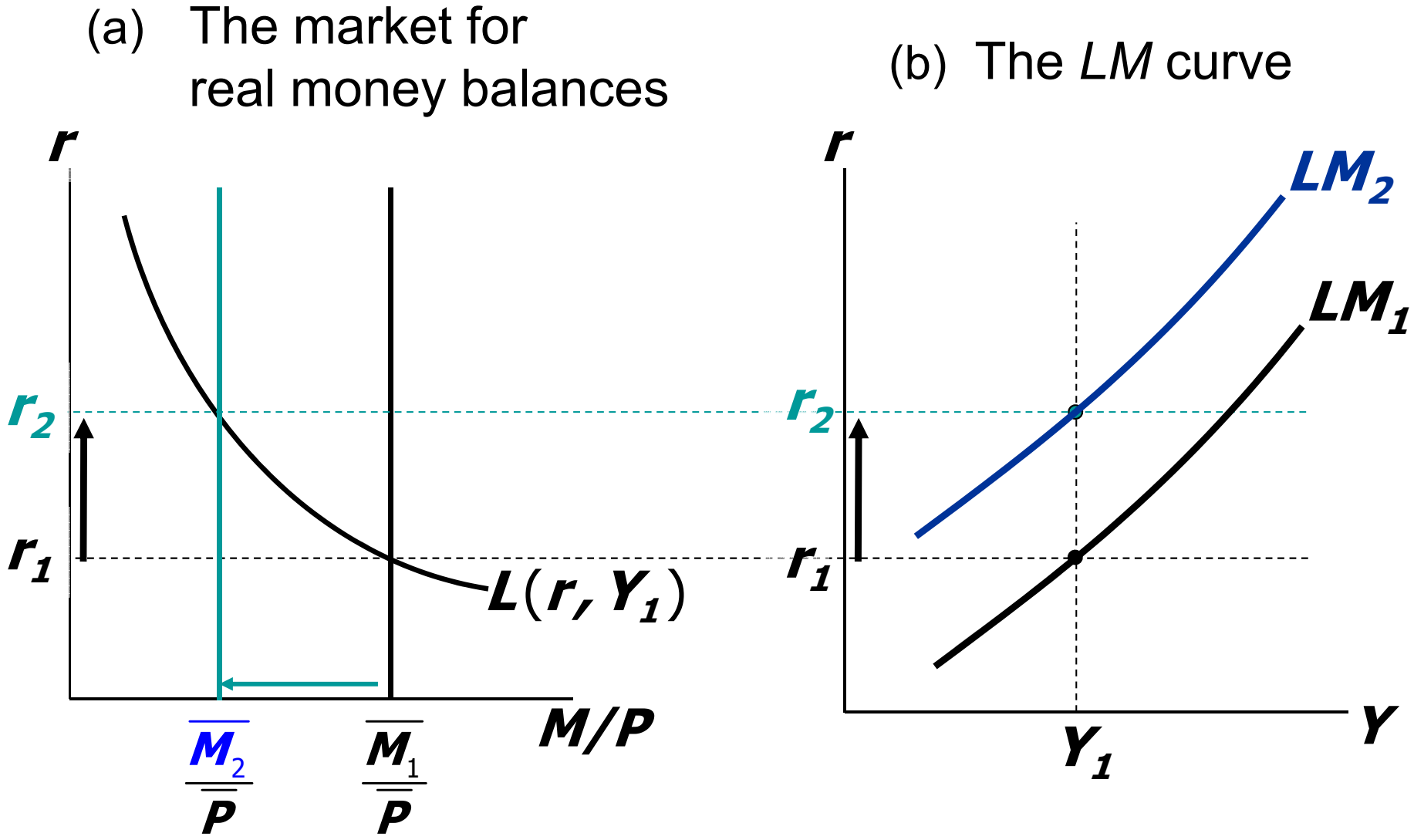
Deriving the *LM* curve



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



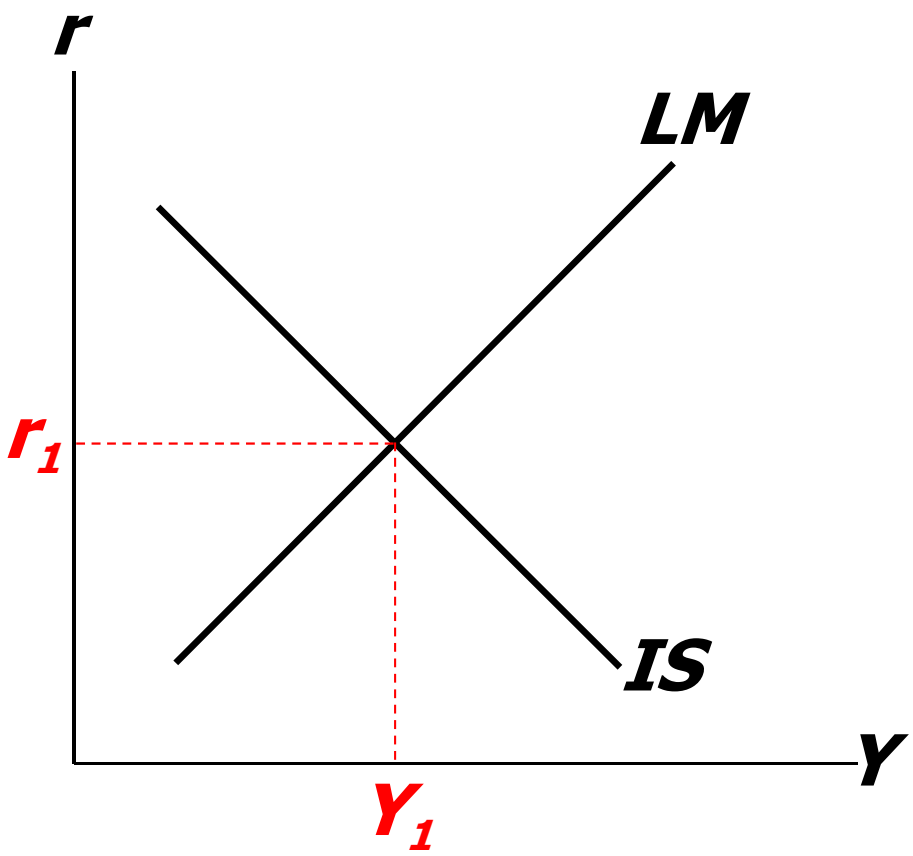
Equilibrium in the *IS-LM* model

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

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

The *LM* curve represents money market equilibrium.

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



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

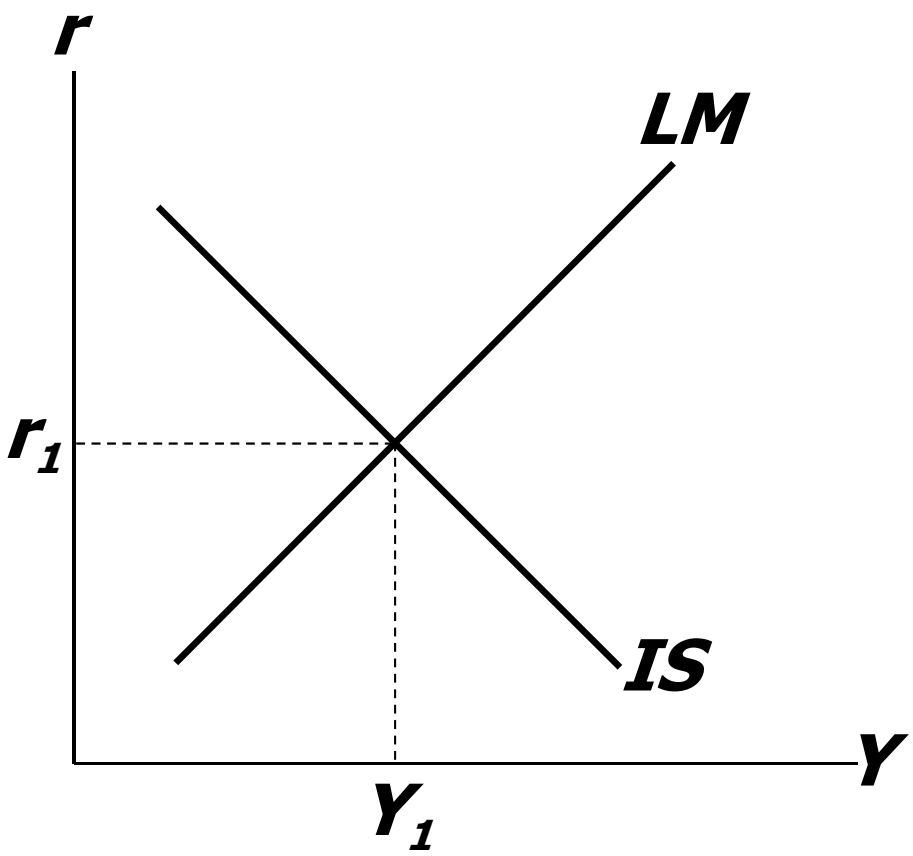
Policy analysis with the *IS-LM* model

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

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

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

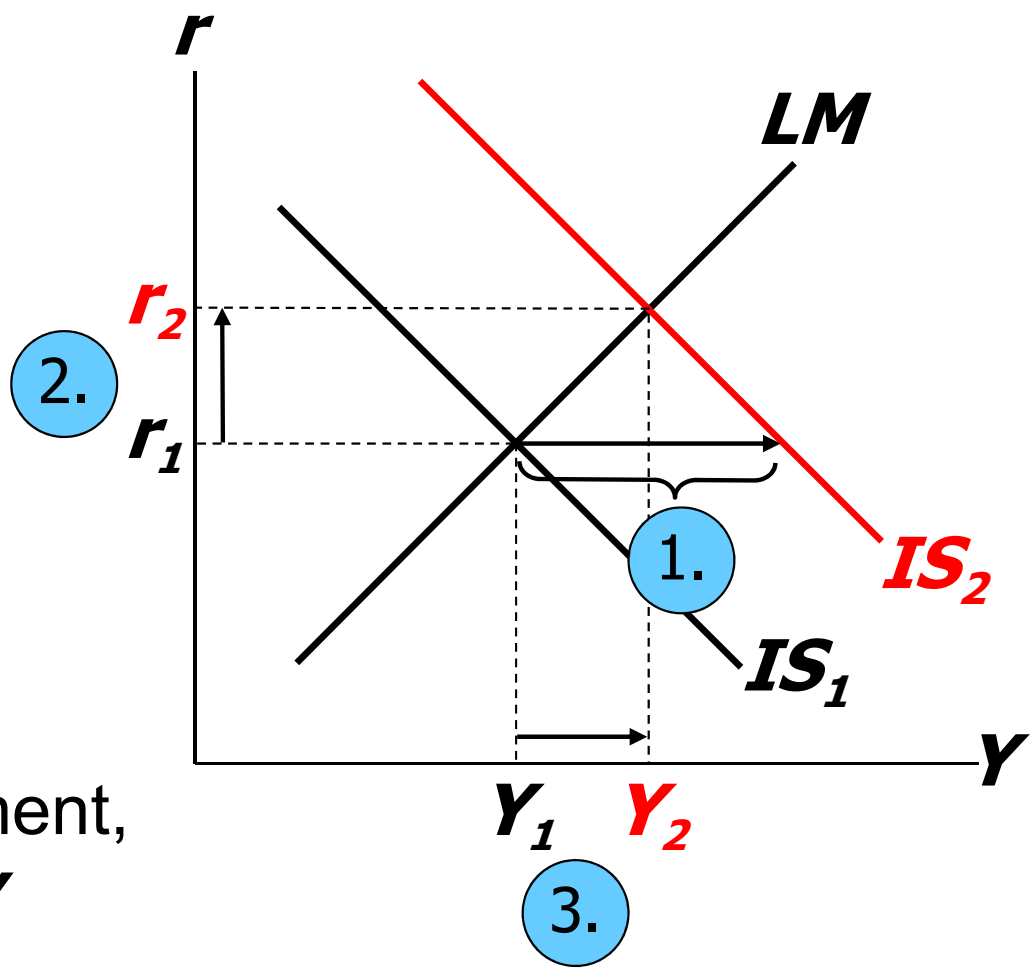
1. *IS* curve shifts right

   by $\frac{1}{1-\text{MPC}}\Delta G$

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



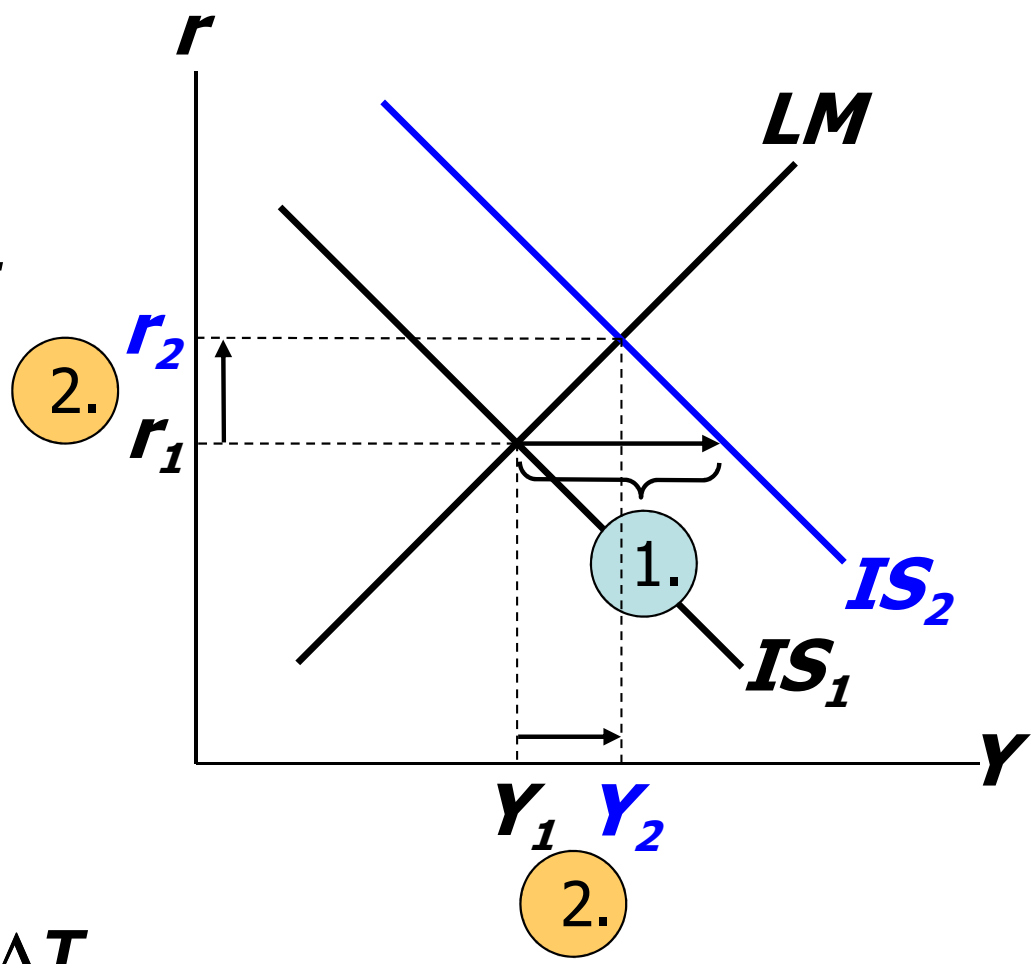
A tax cut

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

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

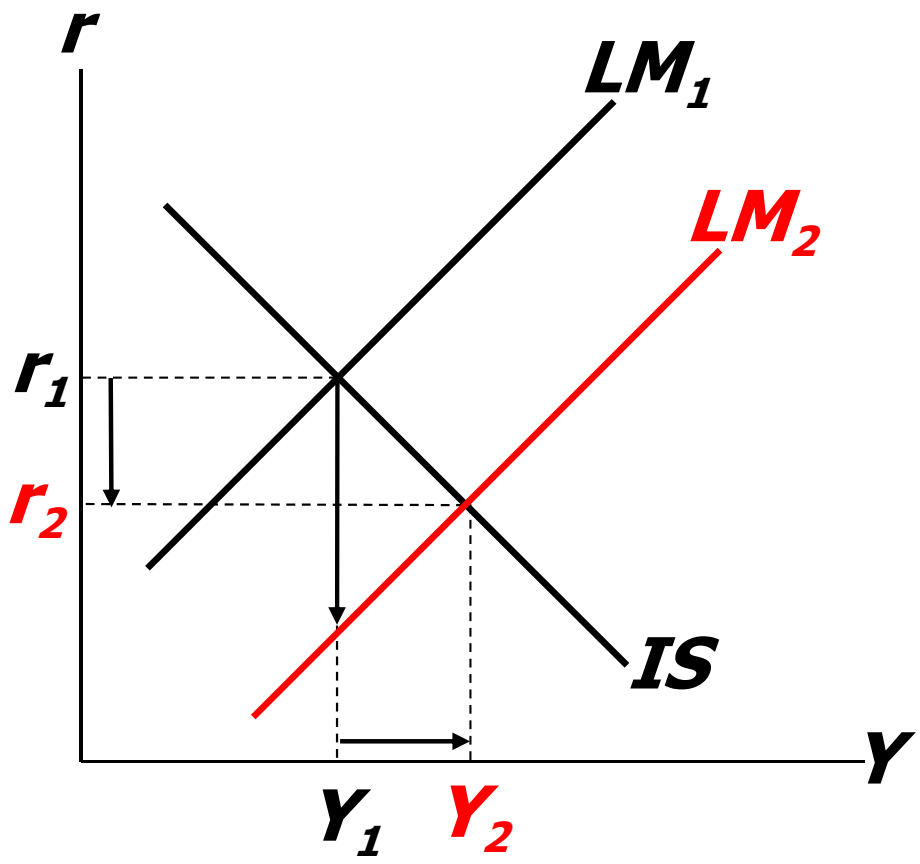


Monetary policy: An increase in *M*

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

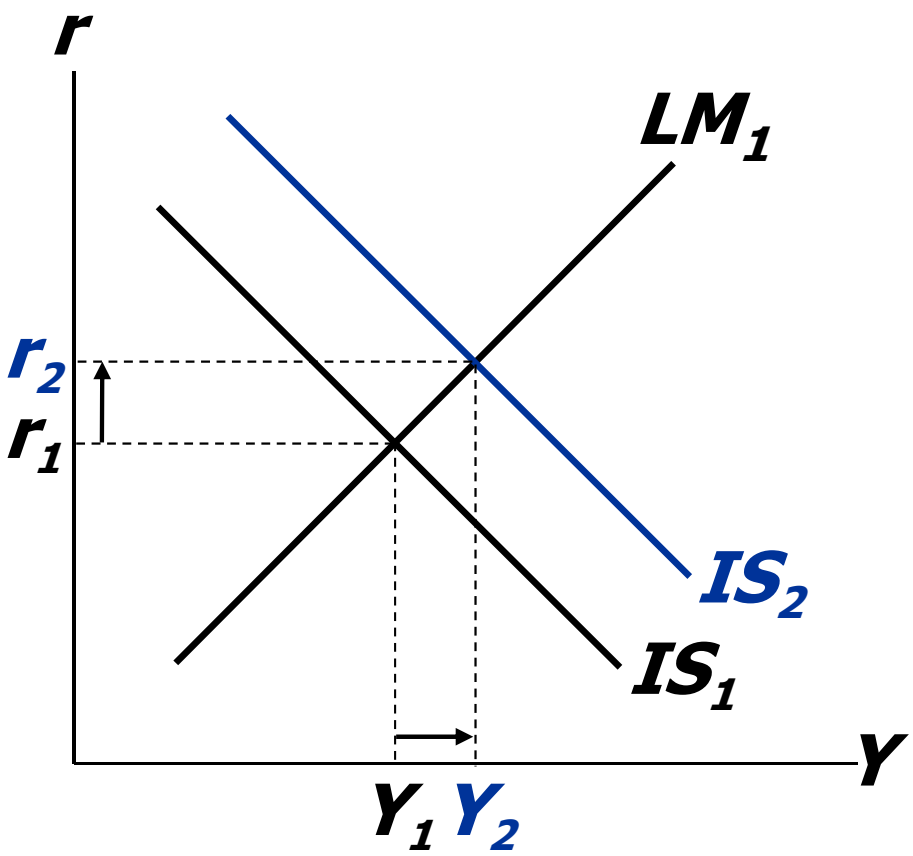
If Congress raises ***G***, the *IS* curve shifts right.

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

Results:

$$\Delta \boldsymbol{Y} = \boldsymbol{Y}_2 - \boldsymbol{Y}_1$$

$$\Delta \boldsymbol{r} = \boldsymbol{r}_2 - \boldsymbol{r}_1$$



Response 2: Hold *r* constant

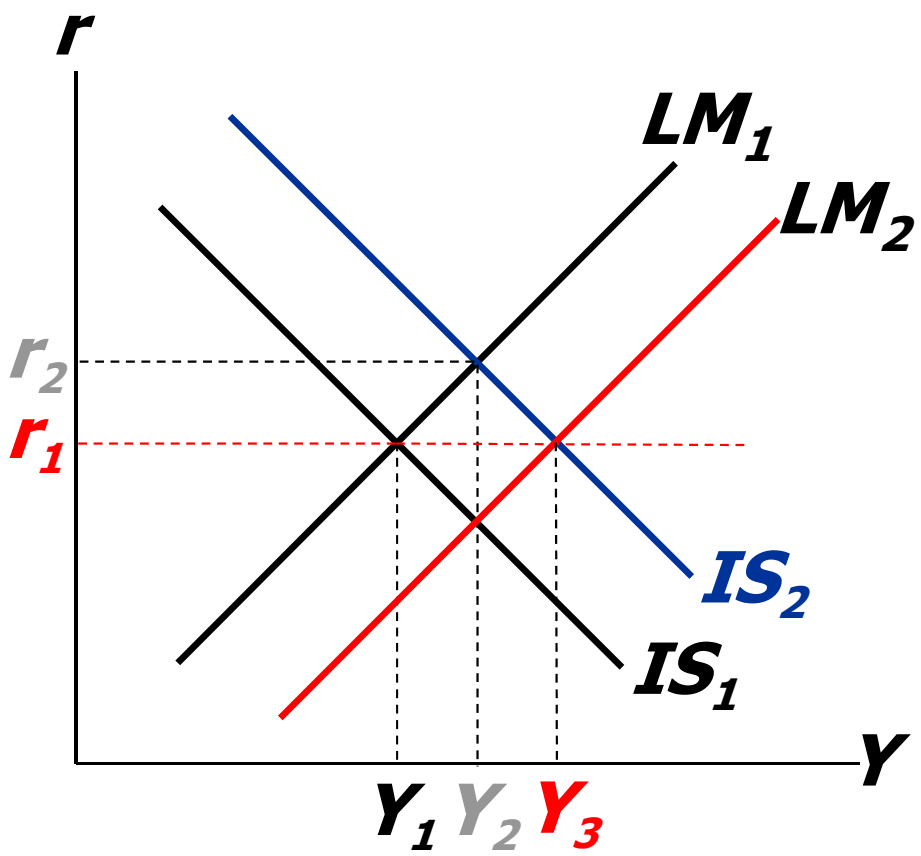
If Congress raises ***G***,
the *IS* curve shifts right.

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

Results:

$$\Delta \boldsymbol{Y} = \boldsymbol{Y}_3 - \boldsymbol{Y}_1$$

$$\Delta \boldsymbol{r} = 0$$



Response 3: Hold *Y* constant

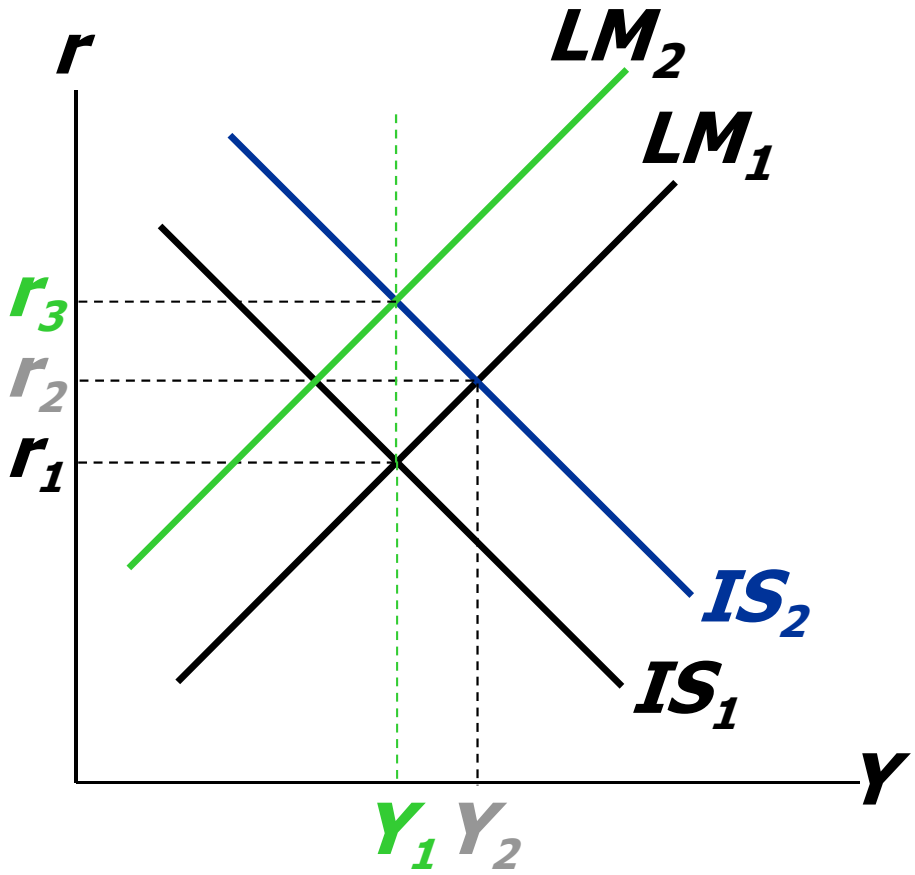
If Congress raises ***G***, the *IS* curve shifts right.

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

Results:

$$\Delta \boldsymbol{Y} = 0$$

$$\Delta \boldsymbol{r} = \boldsymbol{r}_3 - \boldsymbol{r}_1$$



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:

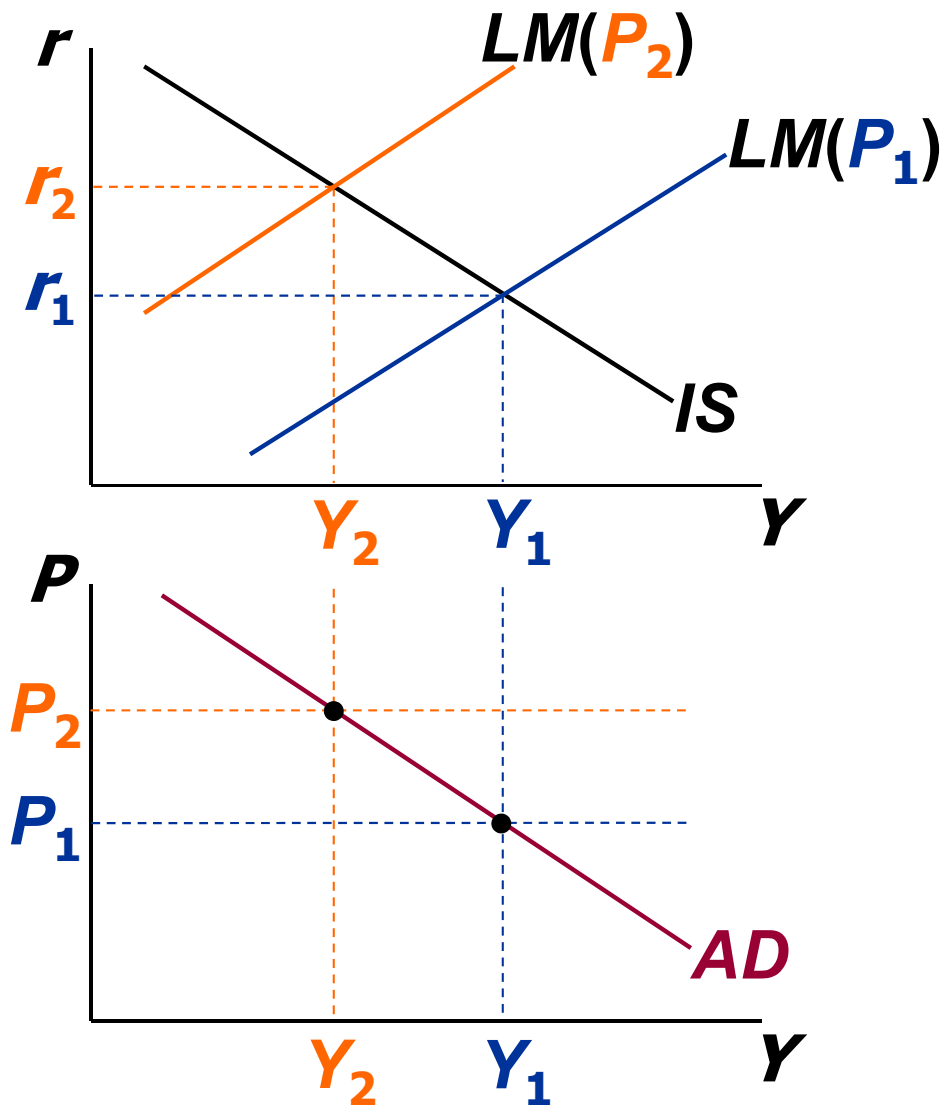
$\uparrow P \Rightarrow \downarrow (M/P)$

$\Rightarrow$ *LM* shifts left

$\Rightarrow \uparrow r$

$\Rightarrow \downarrow I$

$\Rightarrow \downarrow Y$



Monetary policy and the *AD* curve

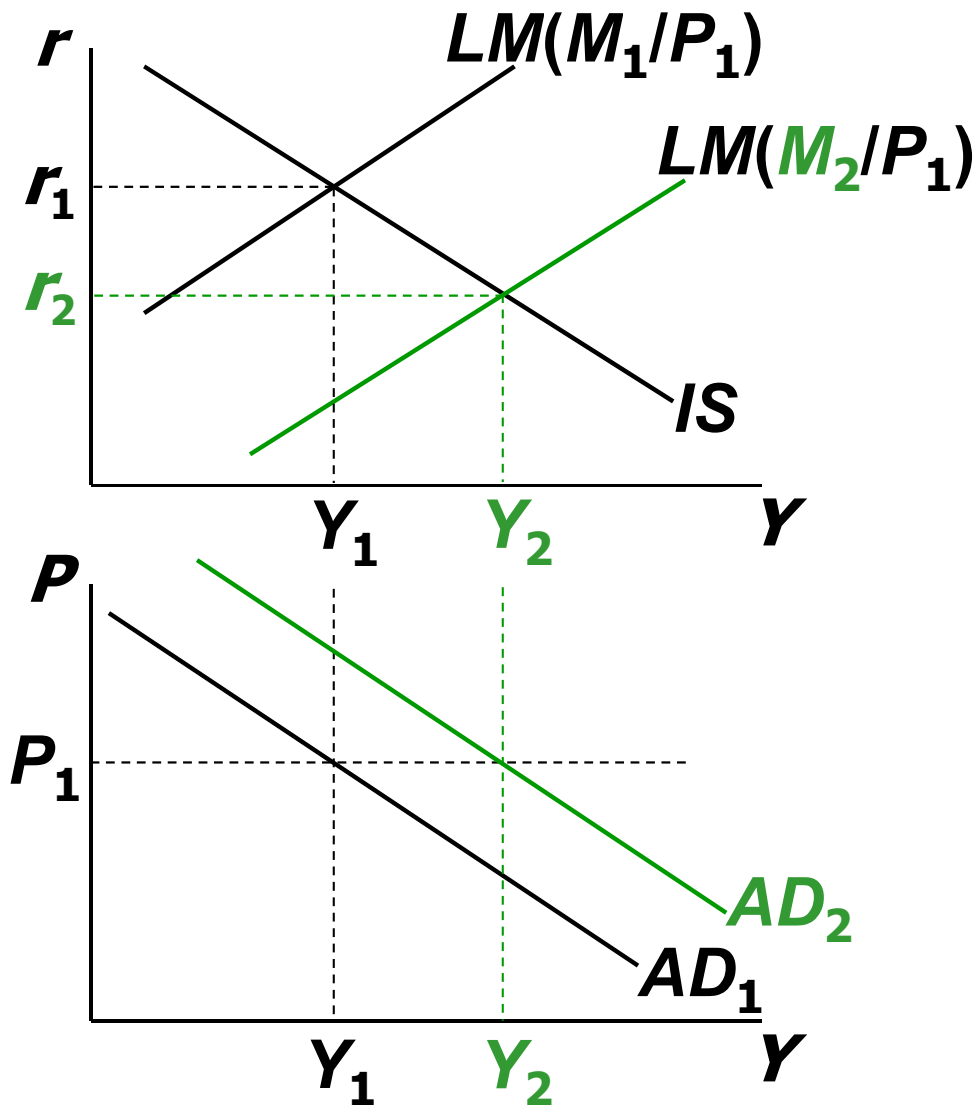
The Fed can increase aggregate demand:

$\uparrow M \Rightarrow LM$ shifts right

$\Rightarrow \downarrow r$

$\Rightarrow \uparrow I$

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



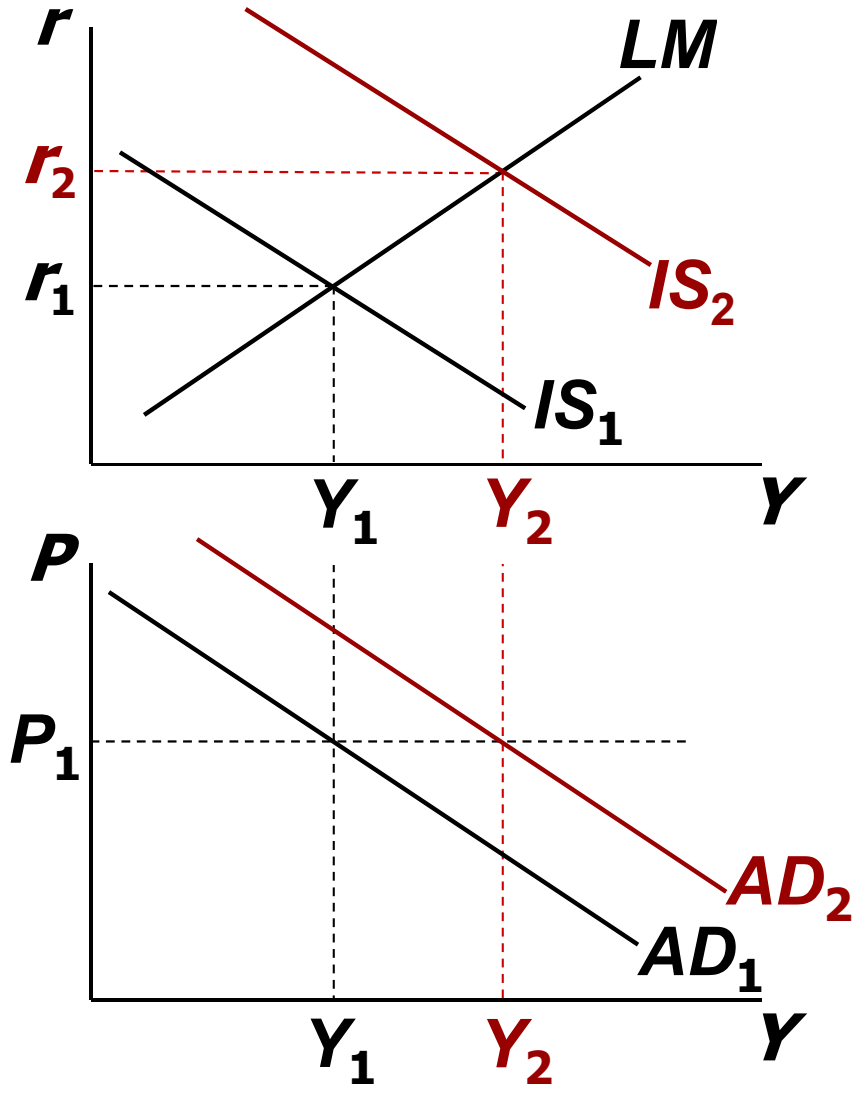
Fiscal policy and the *AD* curve

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

$\downarrow T \Rightarrow \uparrow C$

$\Rightarrow IS$ shifts right

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

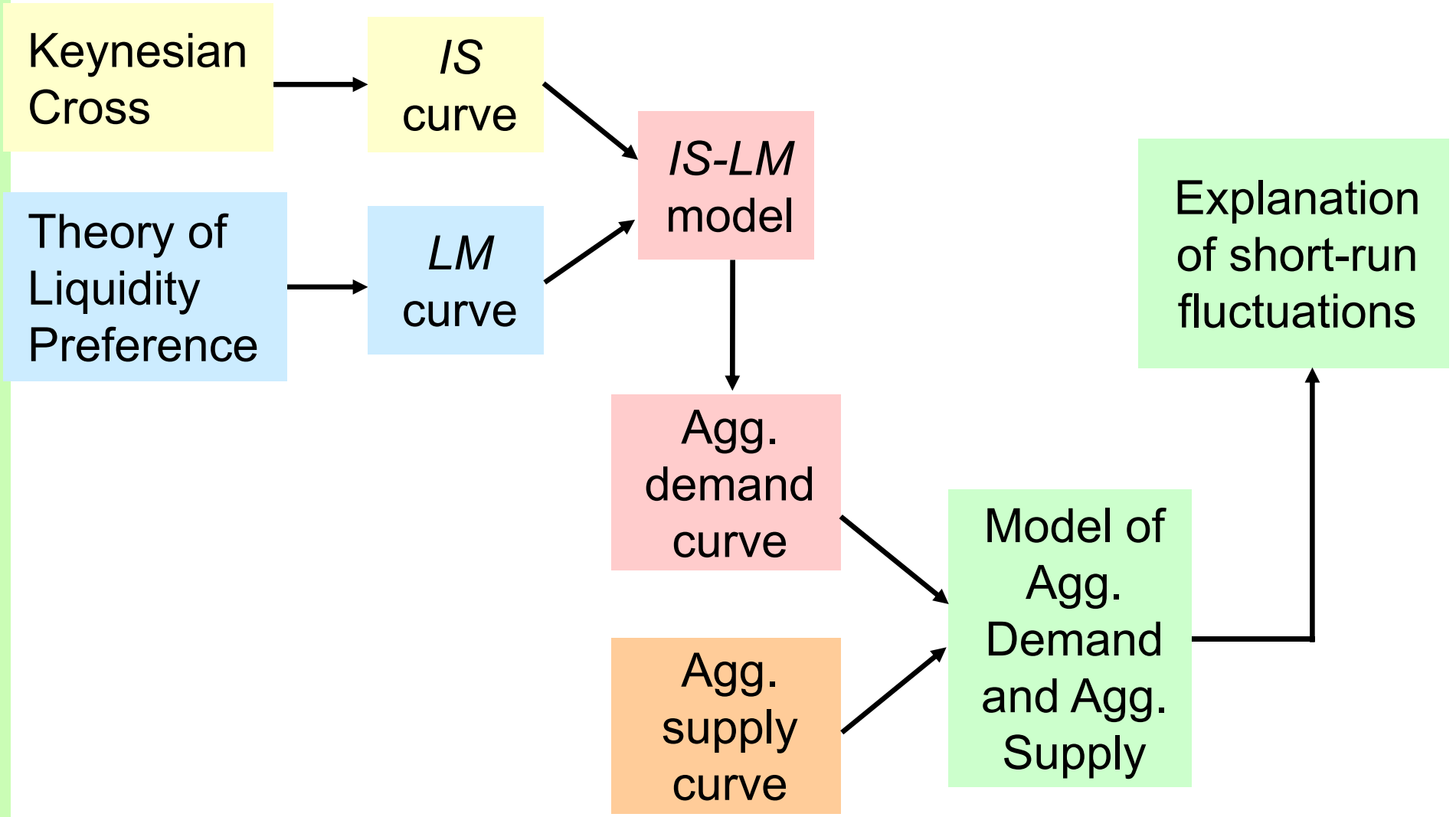


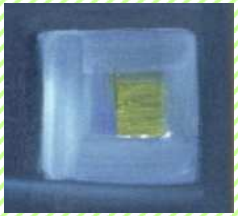
IS-LM and *AD-AS* in the short run & long run

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
$Y > \overline{Y}$	rise
$Y < \overline{Y}$	fall
$Y = \overline{Y}$	remain constant

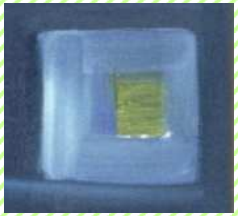
The Big Picture





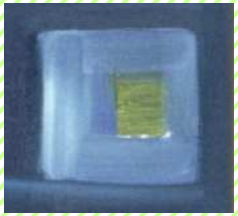
Chapter Summary

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



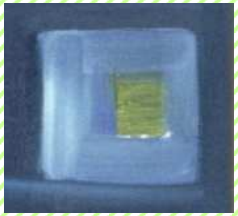
Chapter Summary

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.



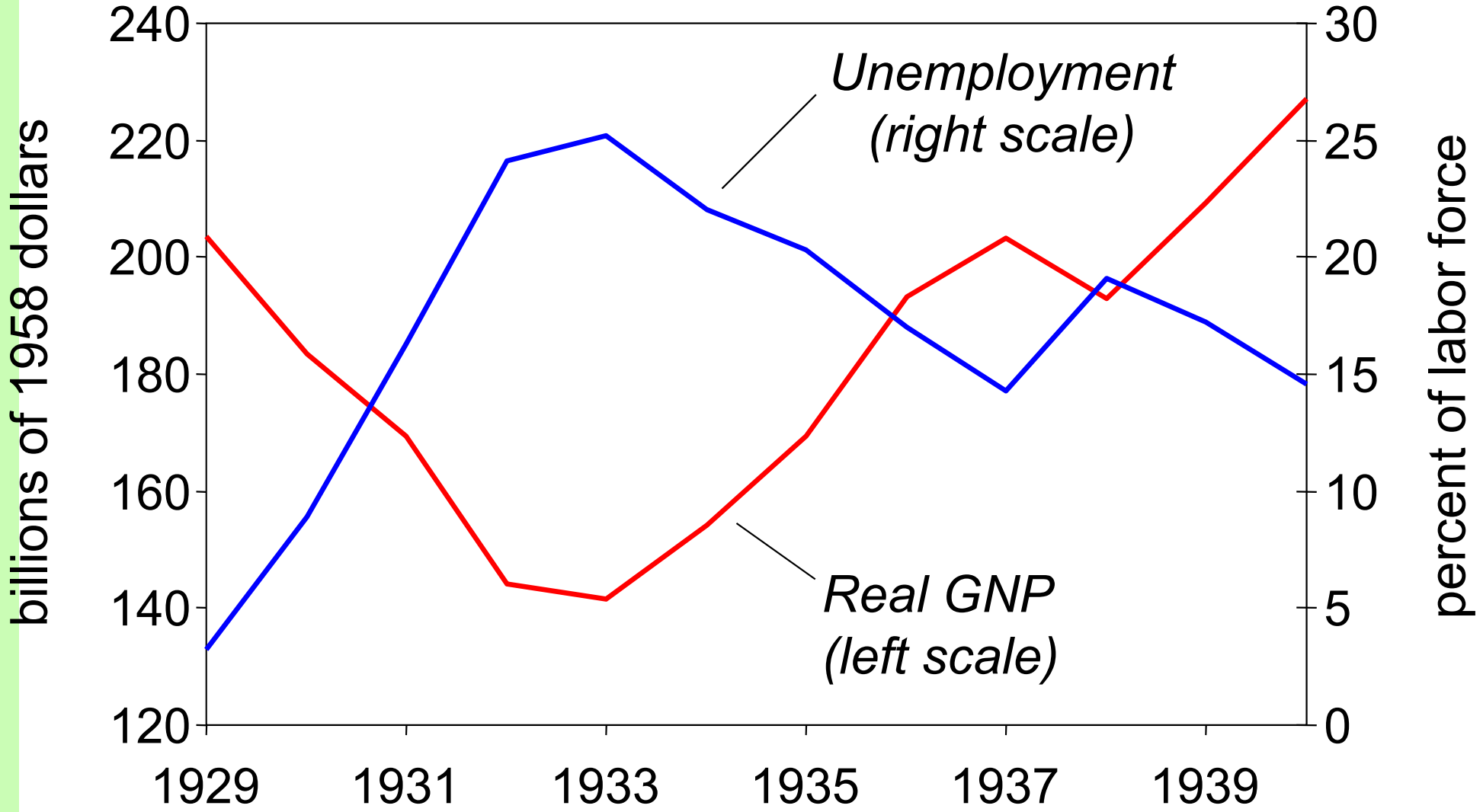
Chapter Summary

2. *AD* curve

- shows relation between ***P*** and the *IS-LM* model's equilibrium ***Y***.
- negative slope because
  $\uparrow \boldsymbol{P} \Rightarrow \downarrow(\boldsymbol{M/P}) \Rightarrow \uparrow \boldsymbol{r} \Rightarrow \downarrow \boldsymbol{I} \Rightarrow \downarrow \boldsymbol{Y}$
- 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:
  *M*1 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:
- $\downarrow \boldsymbol{P} \Rightarrow \uparrow(\boldsymbol{M/P}) \Rightarrow LM$ shifts right $\Rightarrow \uparrow \boldsymbol{Y}$
- **Pigou effect**:

$\downarrow \boldsymbol{P} \Rightarrow \uparrow(\boldsymbol{M/P})$

$\Rightarrow$ consumers' wealth $\uparrow$

$\Rightarrow \uparrow \boldsymbol{C}$

$\Rightarrow IS$ shifts right

$\Rightarrow \uparrow \boldsymbol{Y}$

THE MONEY HYPOTHESIS AGAIN: The effects of falling prices

- The destabilizing effects of expected deflation:

  $\downarrow \pi^e$

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

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

  $\Rightarrow$ planned expenditure & agg. demand $\downarrow$

  $\Rightarrow$ income & output $\downarrow$

THE MONEY HYPOTHESIS AGAIN: The effects of falling prices

- The destabilizing effects of unexpected deflation: **debt-deflation theory**

↓***P*** (if unexpected)

⇒ transfers purchasing power from borrowers to lenders

⇒ borrowers spend less, lenders spend more

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