



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)



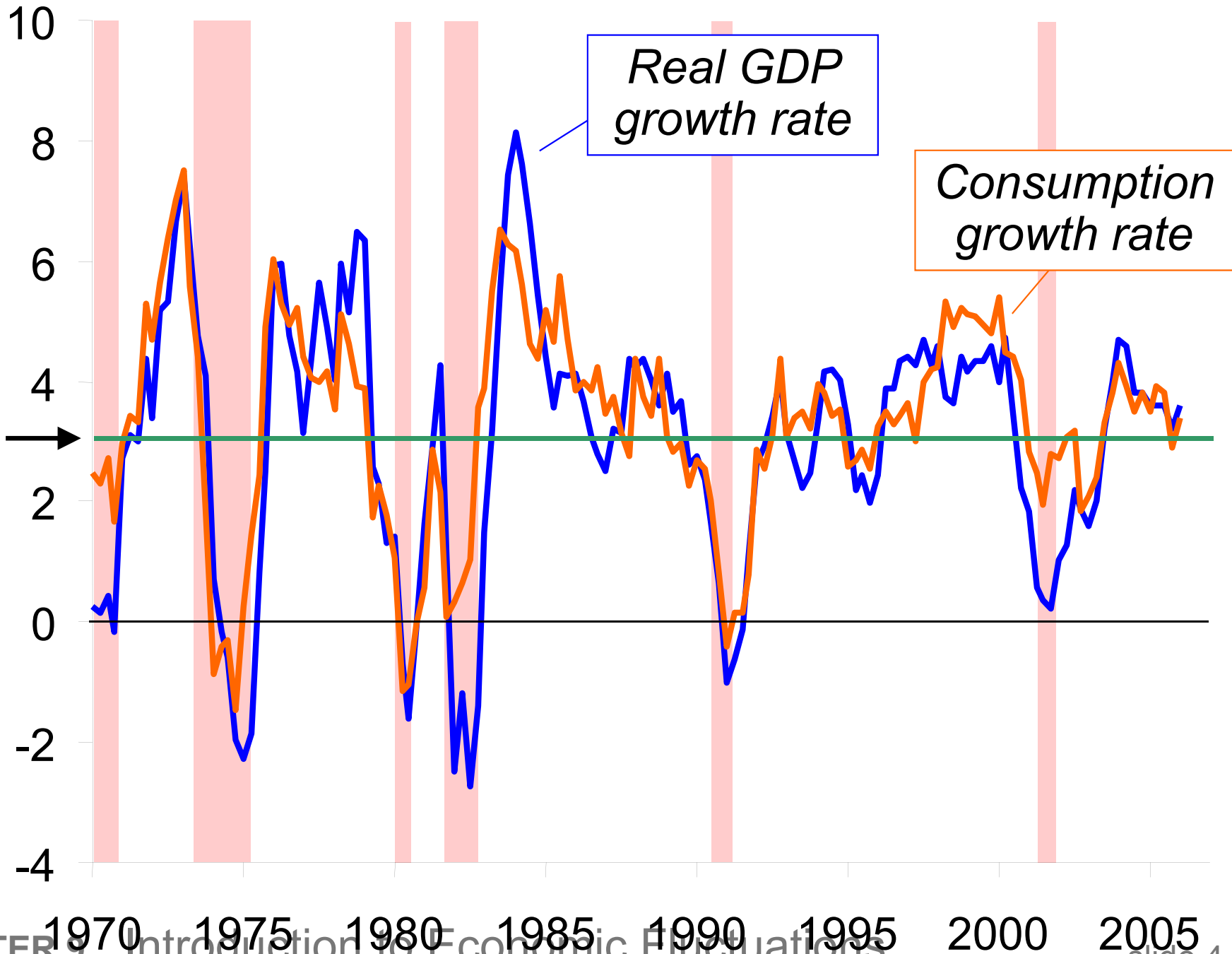
Facts about the business cycle

- 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

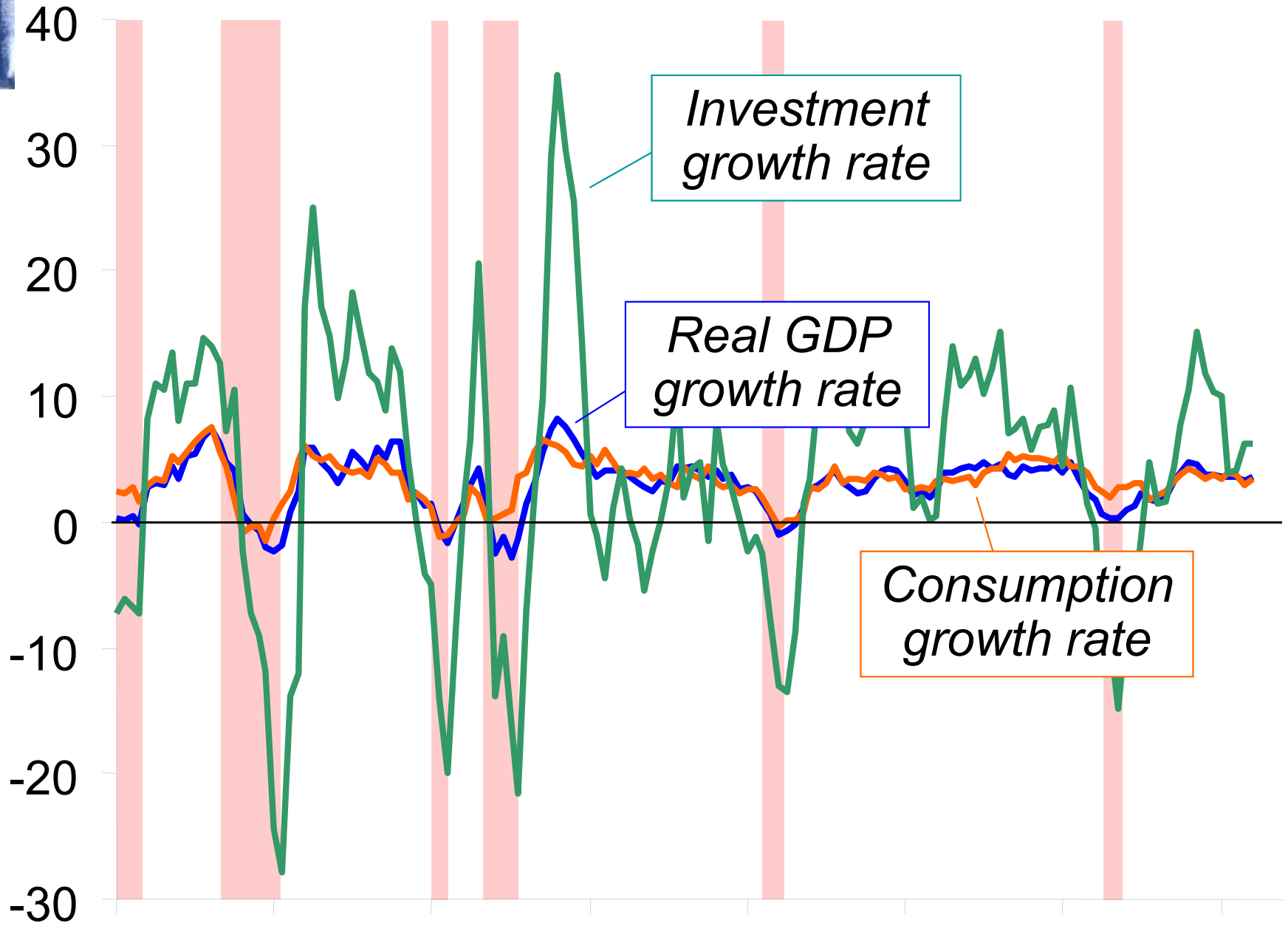
Percent change from 4 quarters earlier

Average growth rate



Growth rates of real GDP, consumption, investment

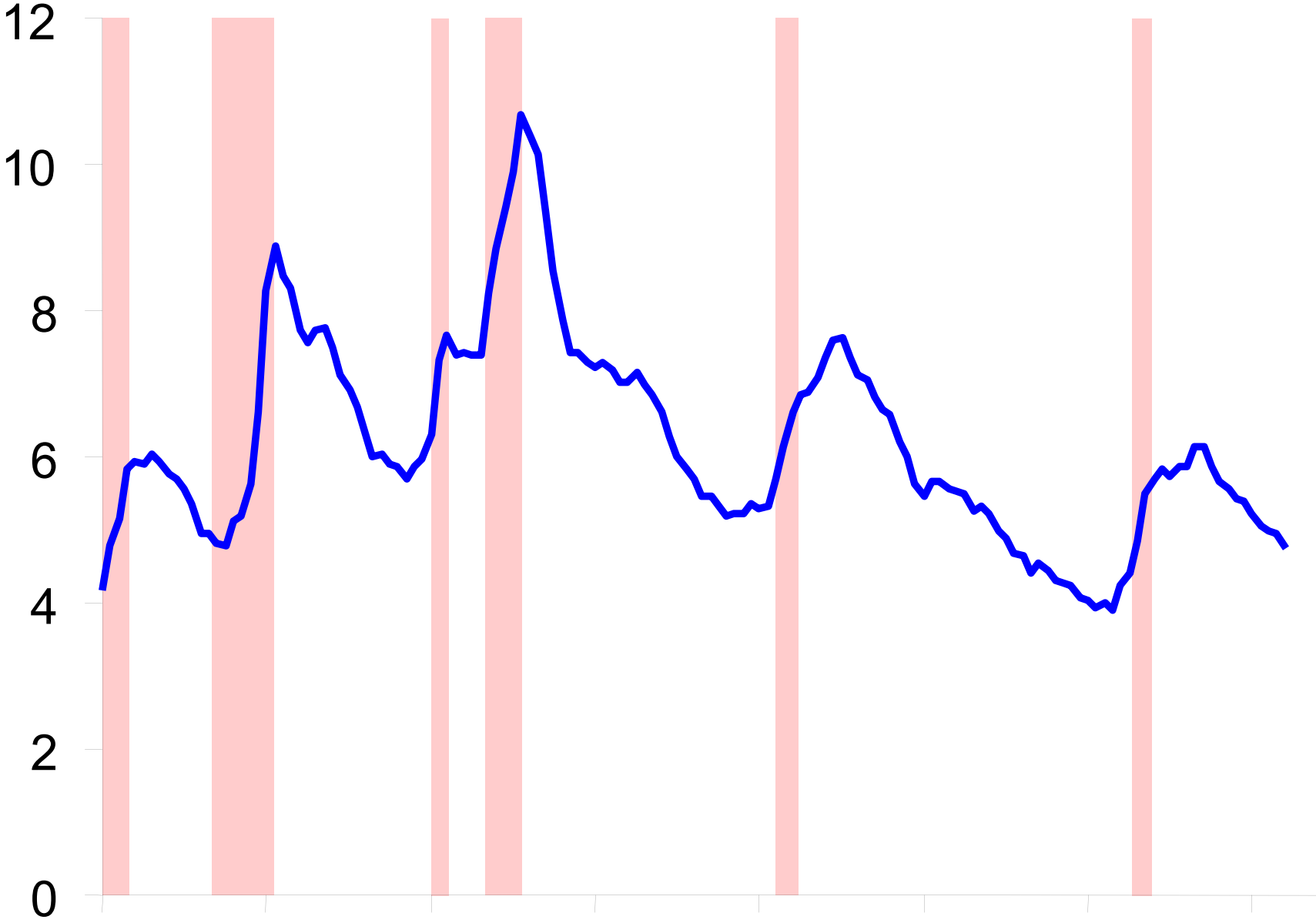
Percent change from 4 quarters earlier



Unemployment



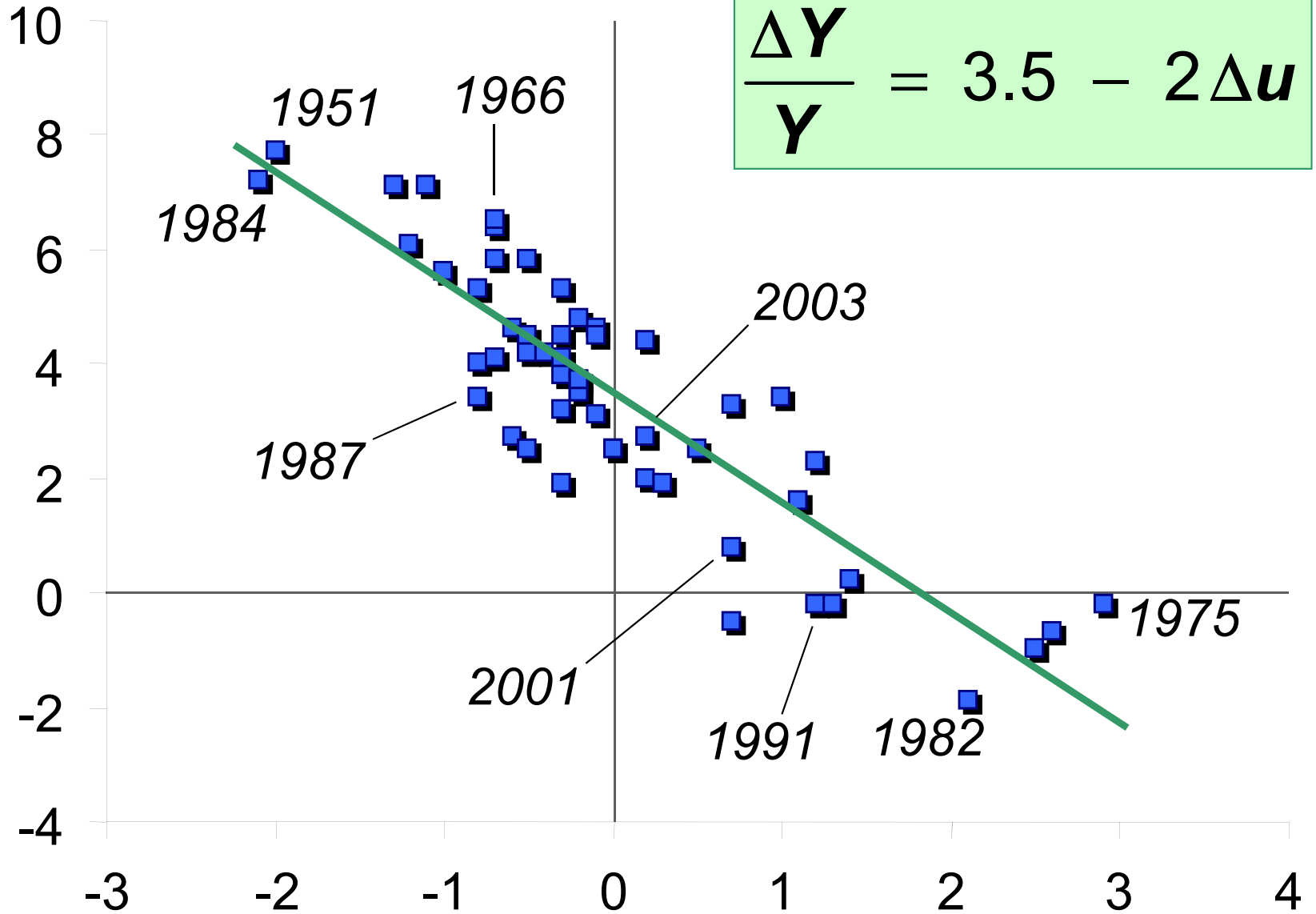
Percent
of labor
force





Okun's Law

Percentage change in real GDP





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: $G = \bar{G}, T = \bar{T}$

for now, planned
investment is exogenous:

$$I = \bar{I}$$

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

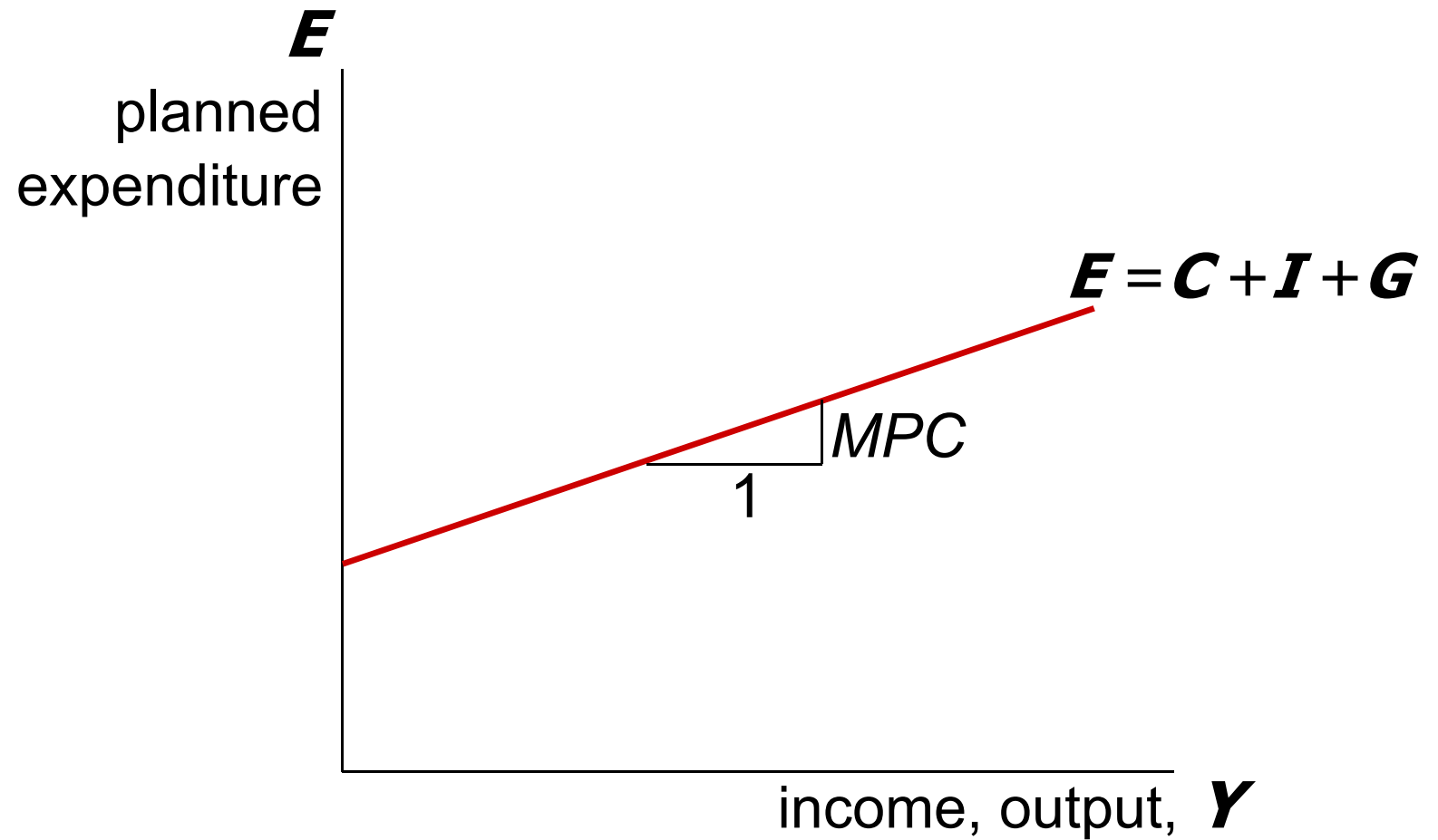
equilibrium condition:

actual expenditure = planned expenditure

$$Y = E$$

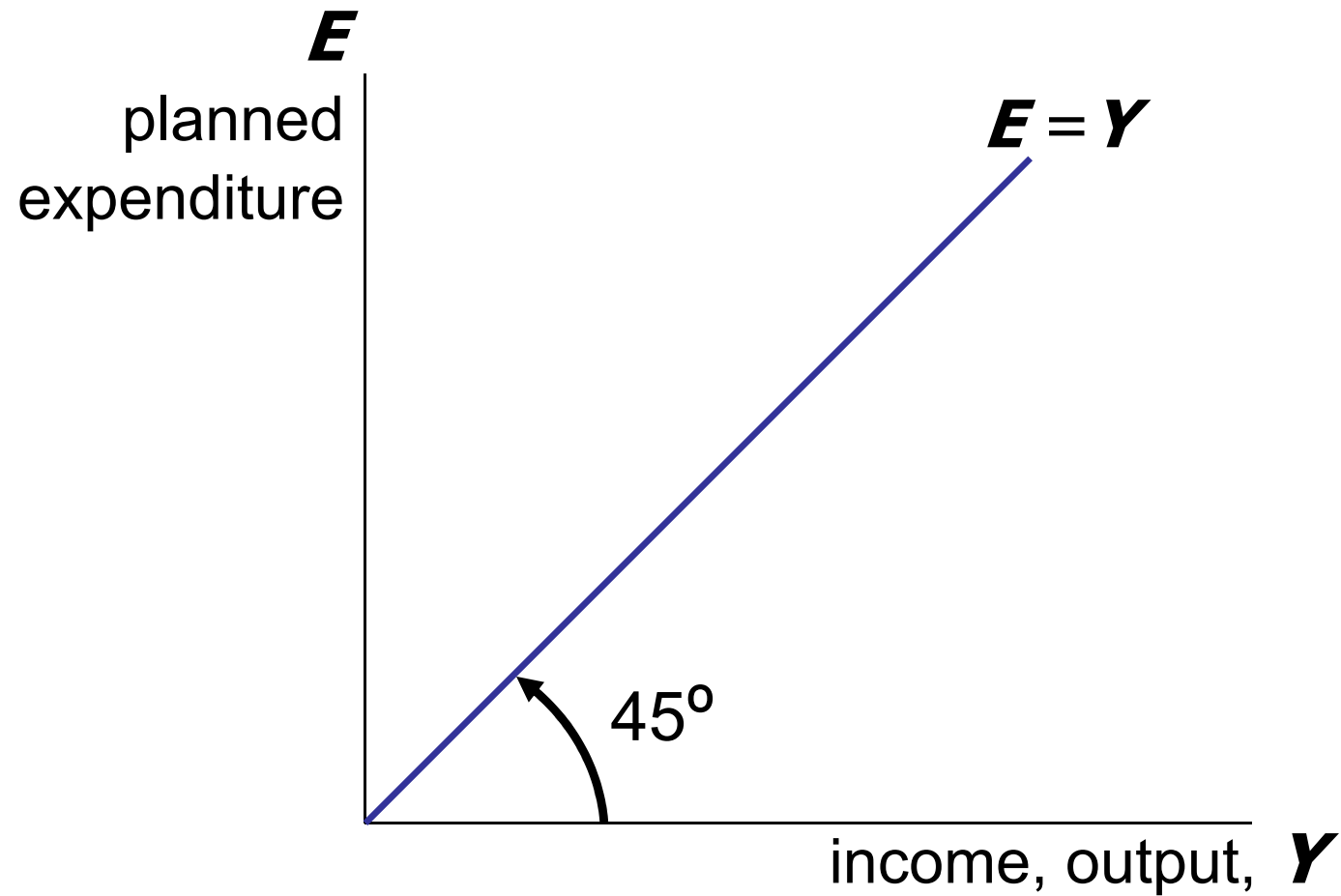


Graphing planned expenditure



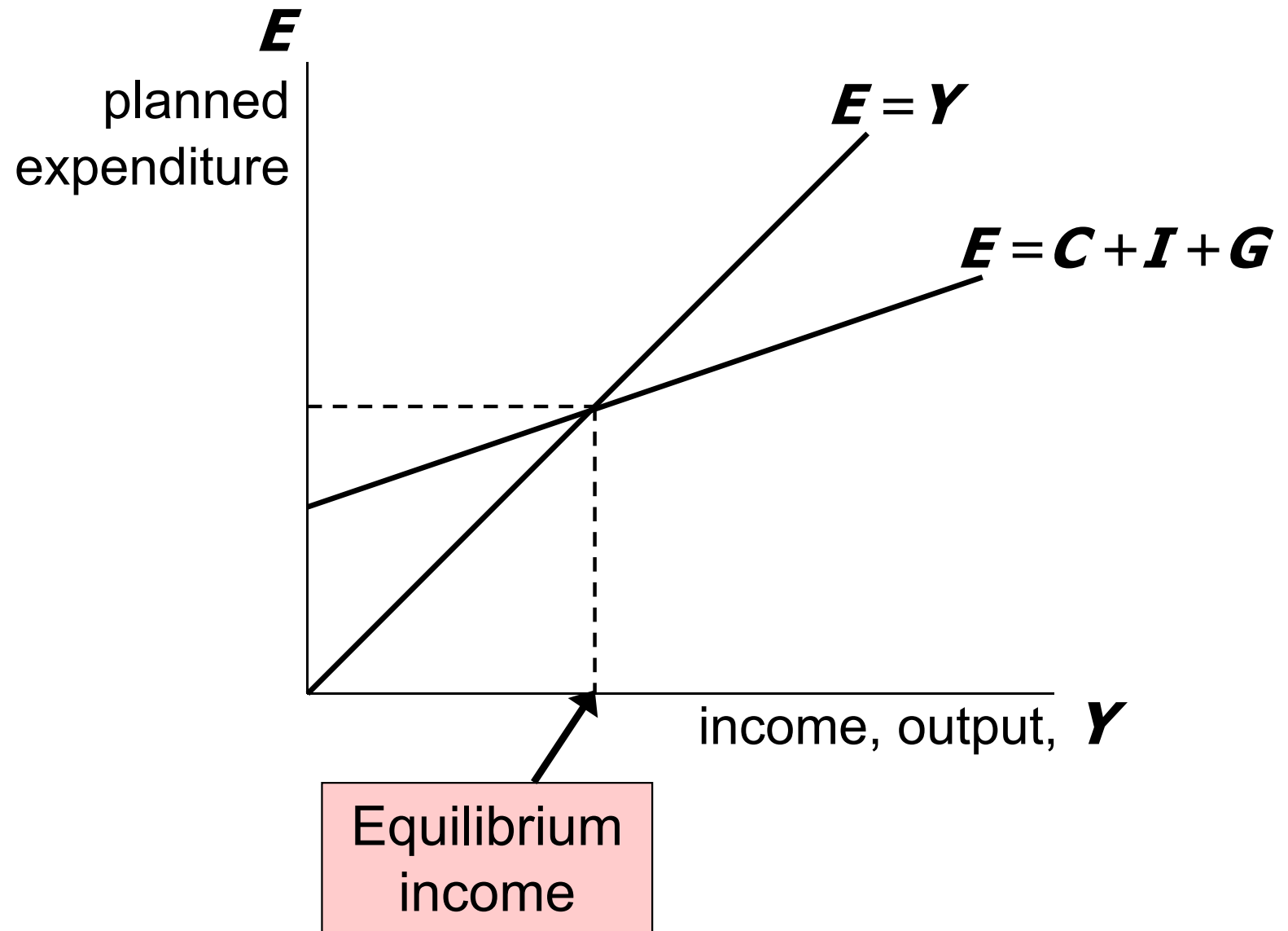


Graphing the equilibrium condition





The equilibrium value of income

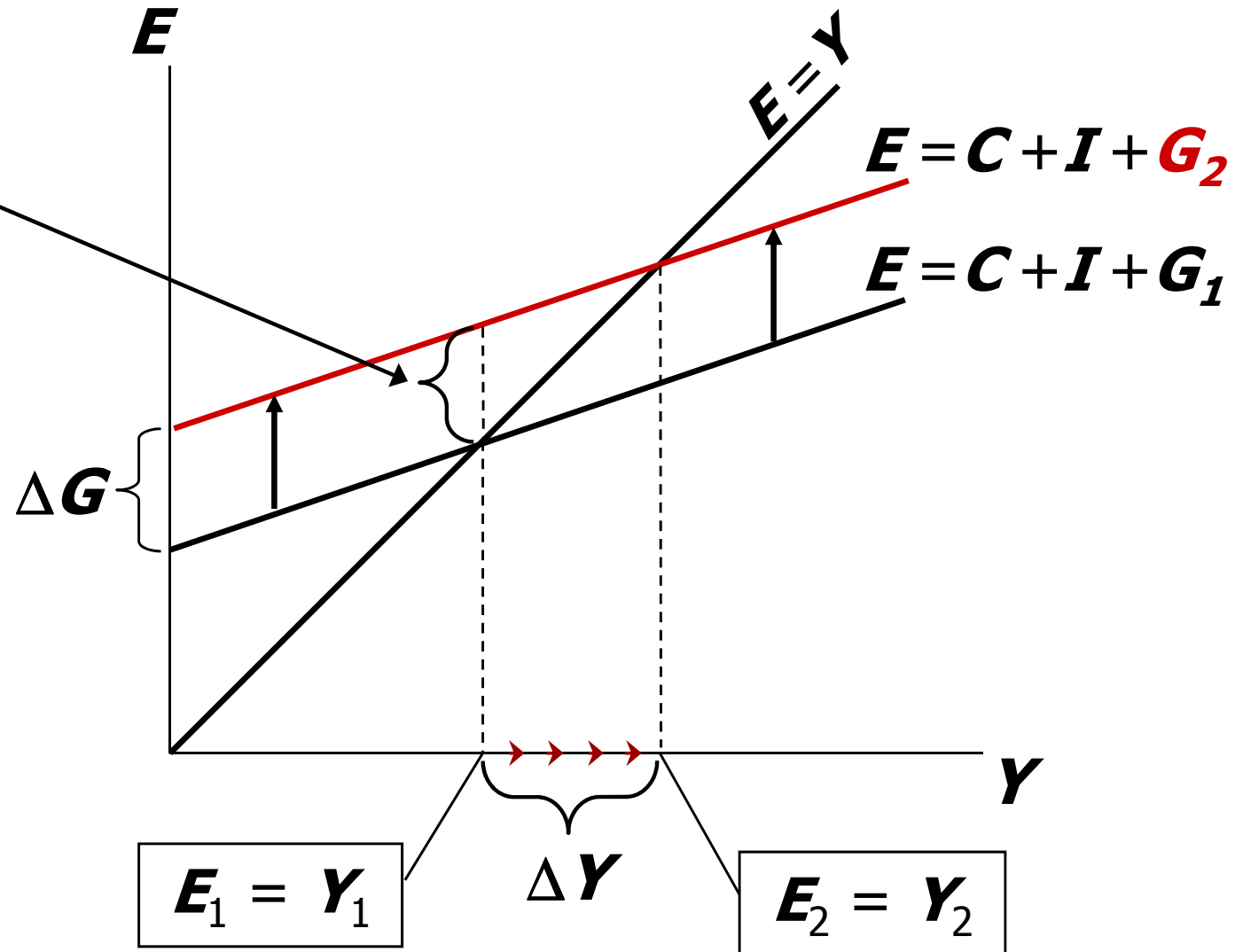




An increase in government purchases

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

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

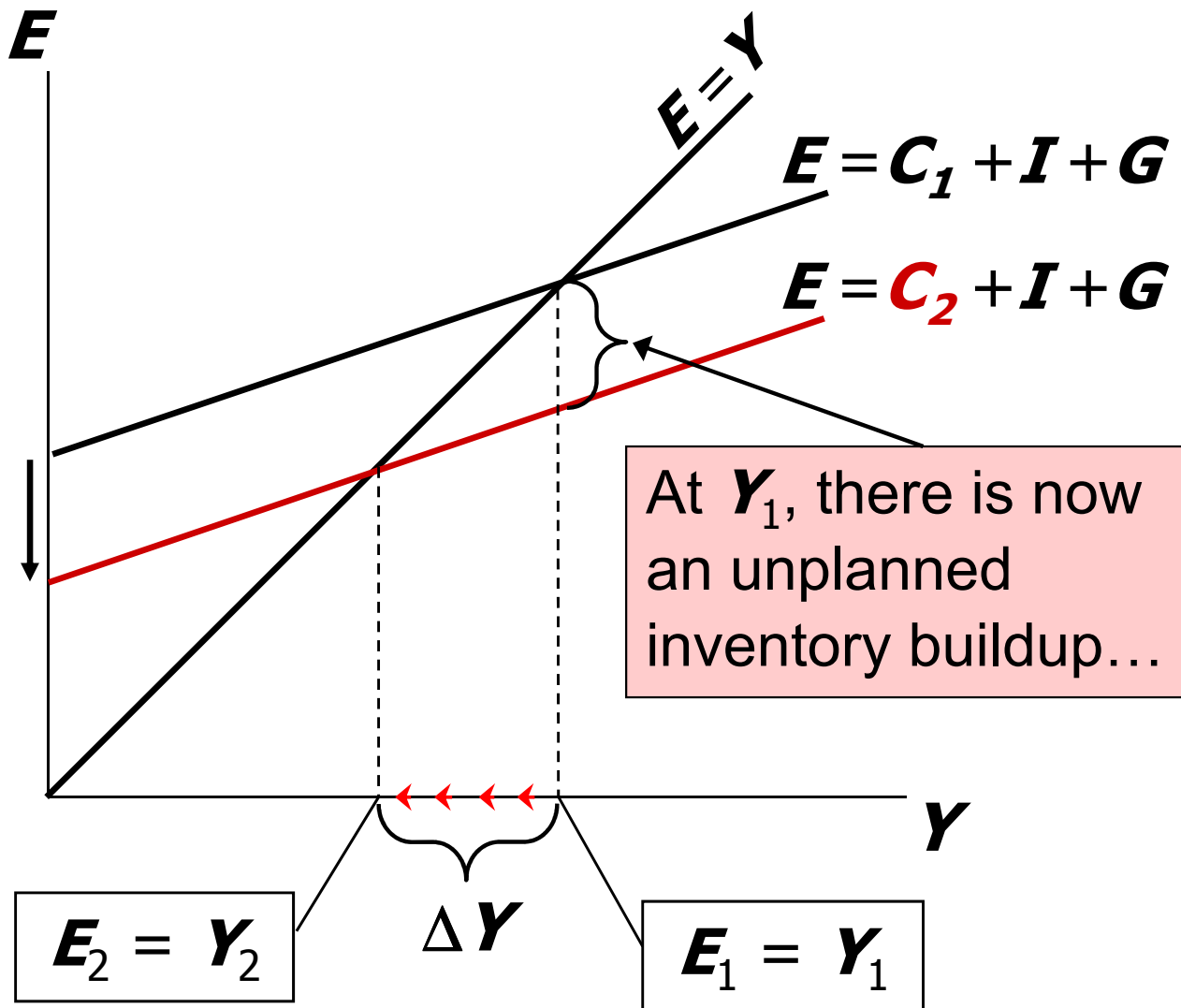


An increase in taxes

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

$$\Delta C = -MPC \Delta T$$

...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

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

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

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**.





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

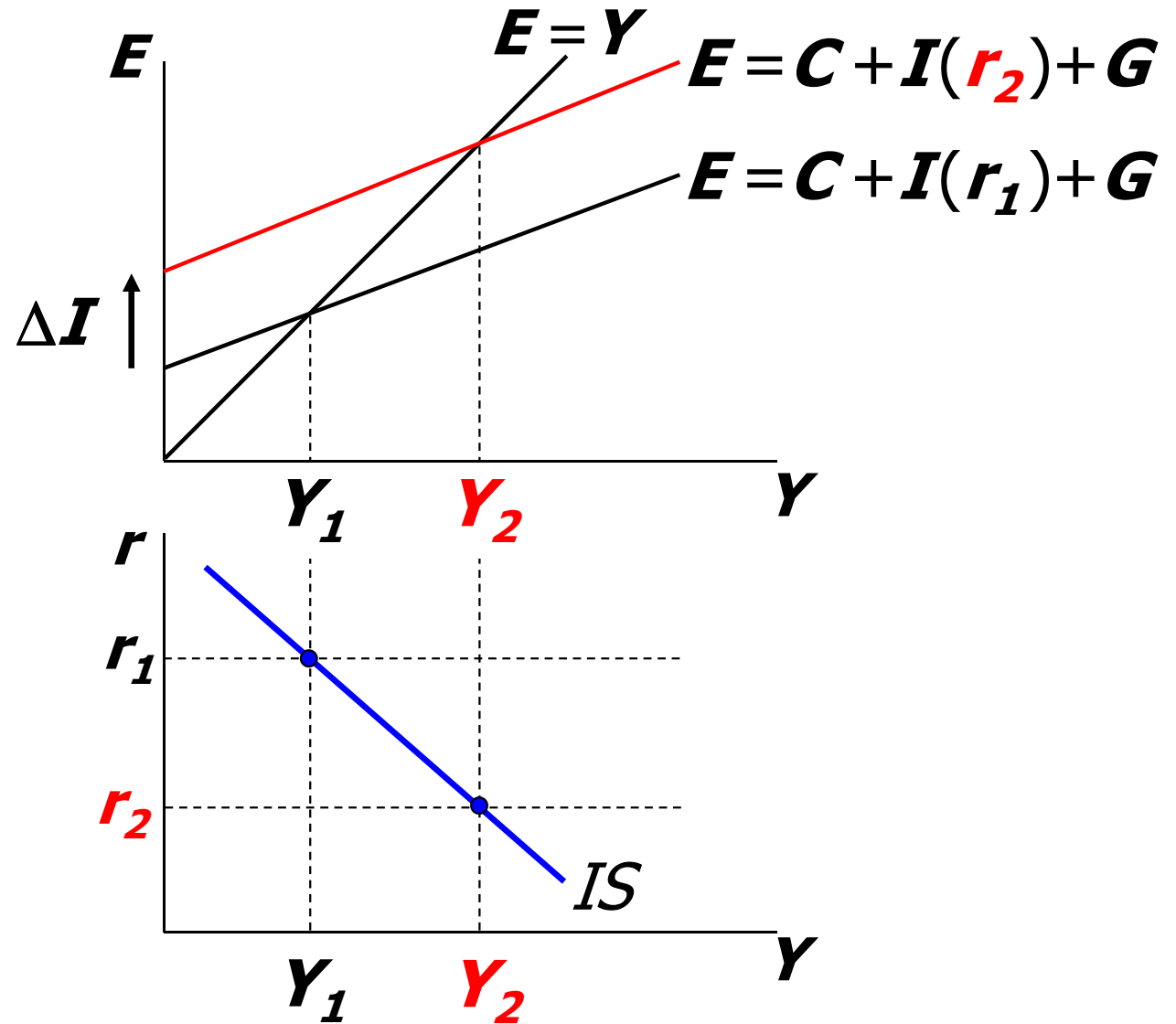
The equation for the *IS* curve is:

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



Deriving the *IS* curve

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





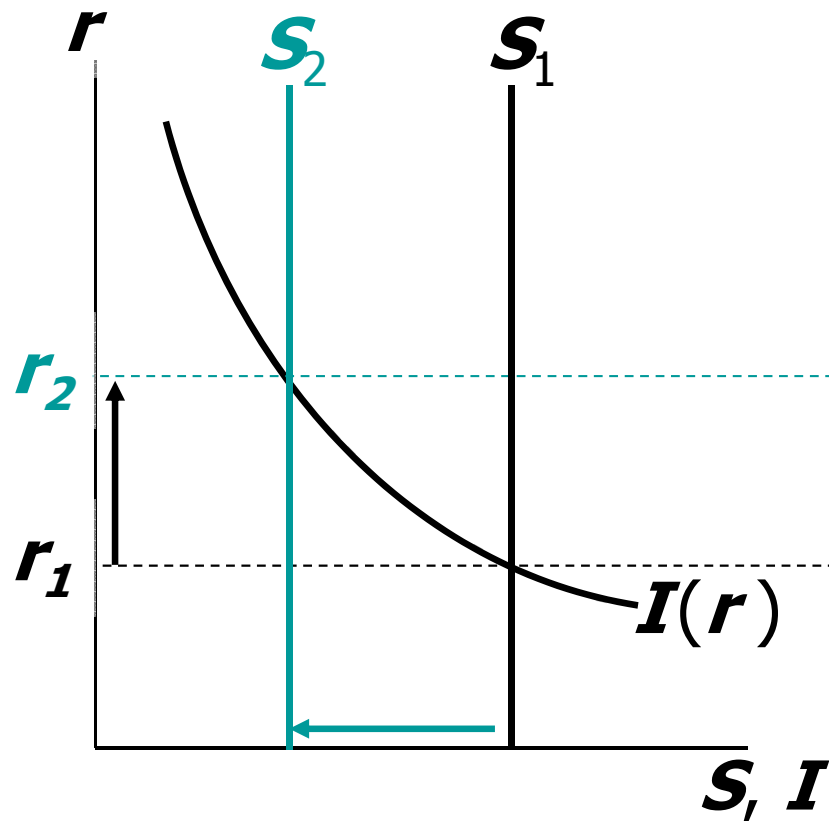
Why the *IS* curve is negatively sloped

- 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.

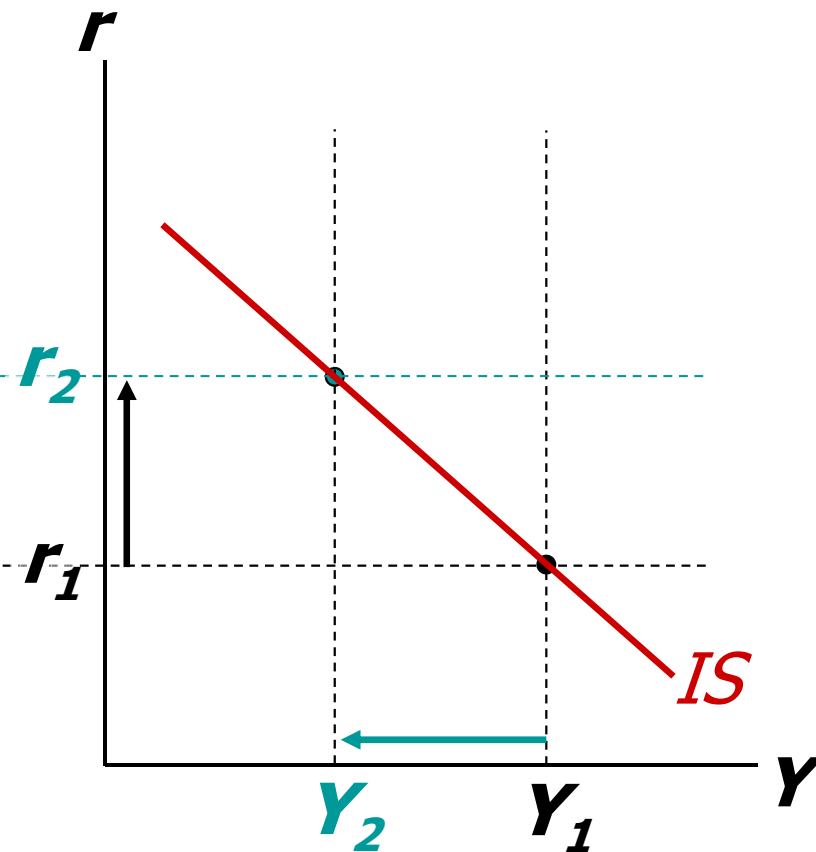


The *IS* curve and the loanable funds model

(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...

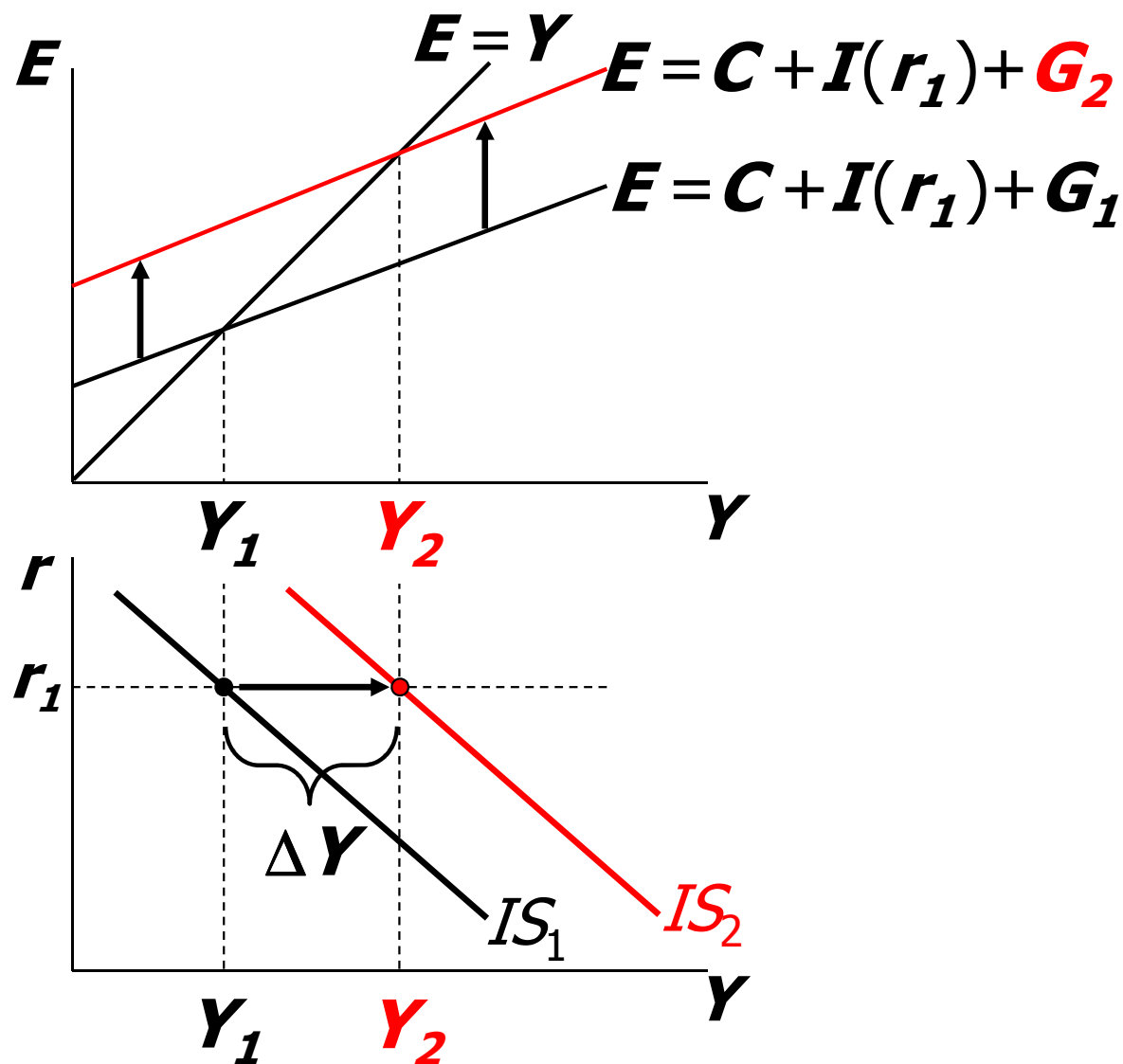


Shifting the IS curve: ΔG

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

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





The Theory of Liquidity Preference

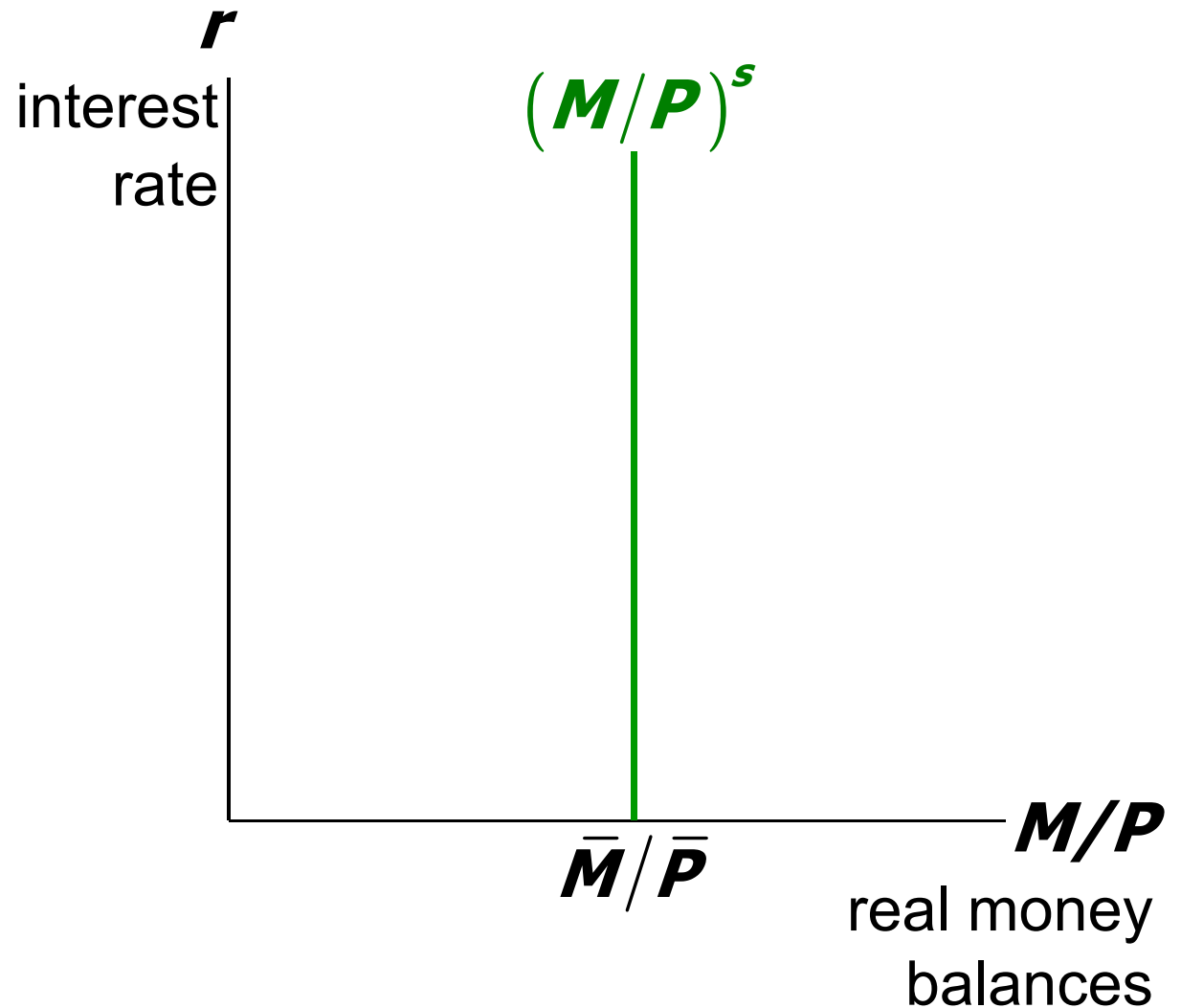
- Due to John Maynard Keynes.
- A simple theory in which the interest rate is determined by money supply and money demand.



Money supply

The supply of real money balances is fixed:

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

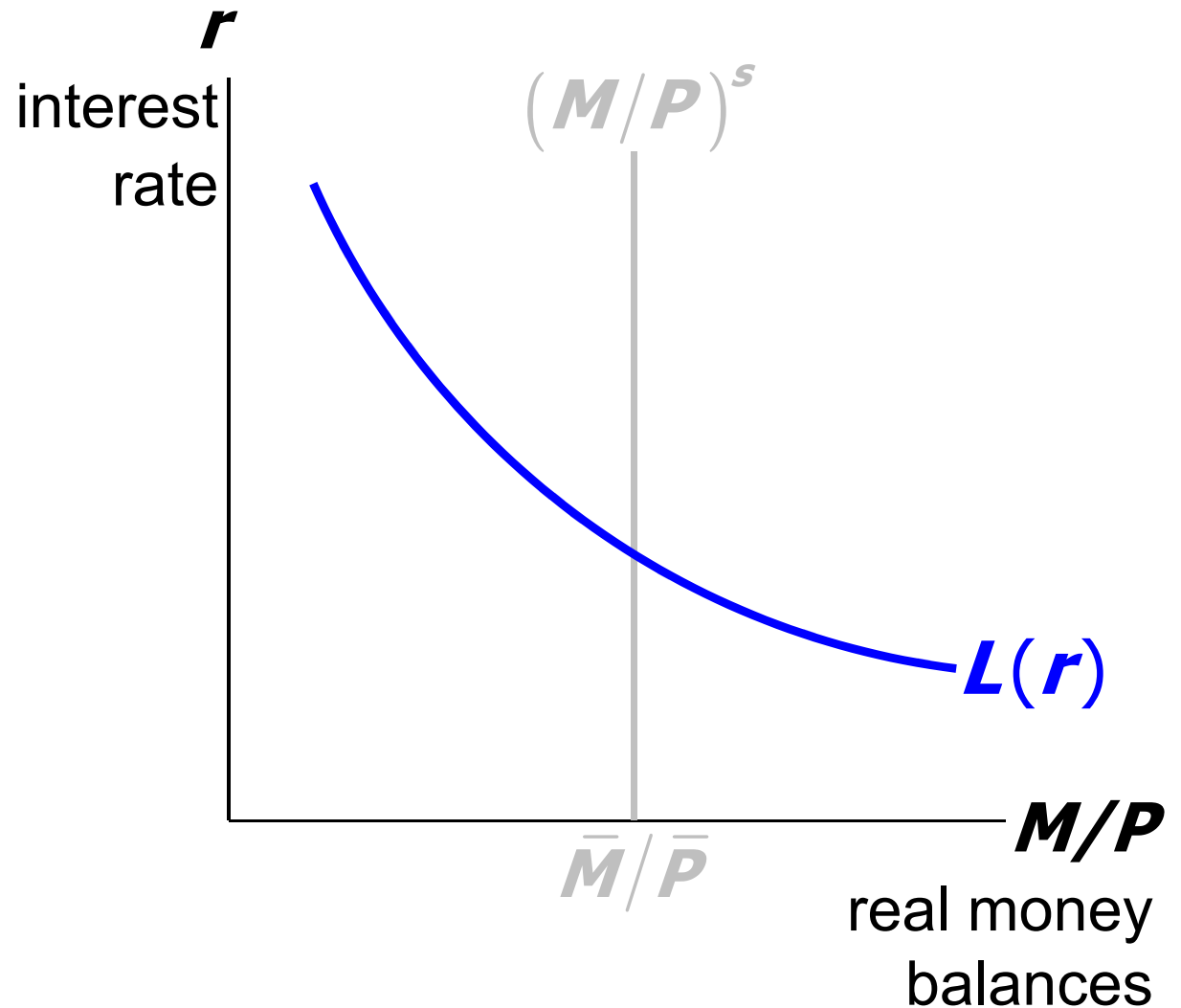




Money demand

Demand for
real money
balances:

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

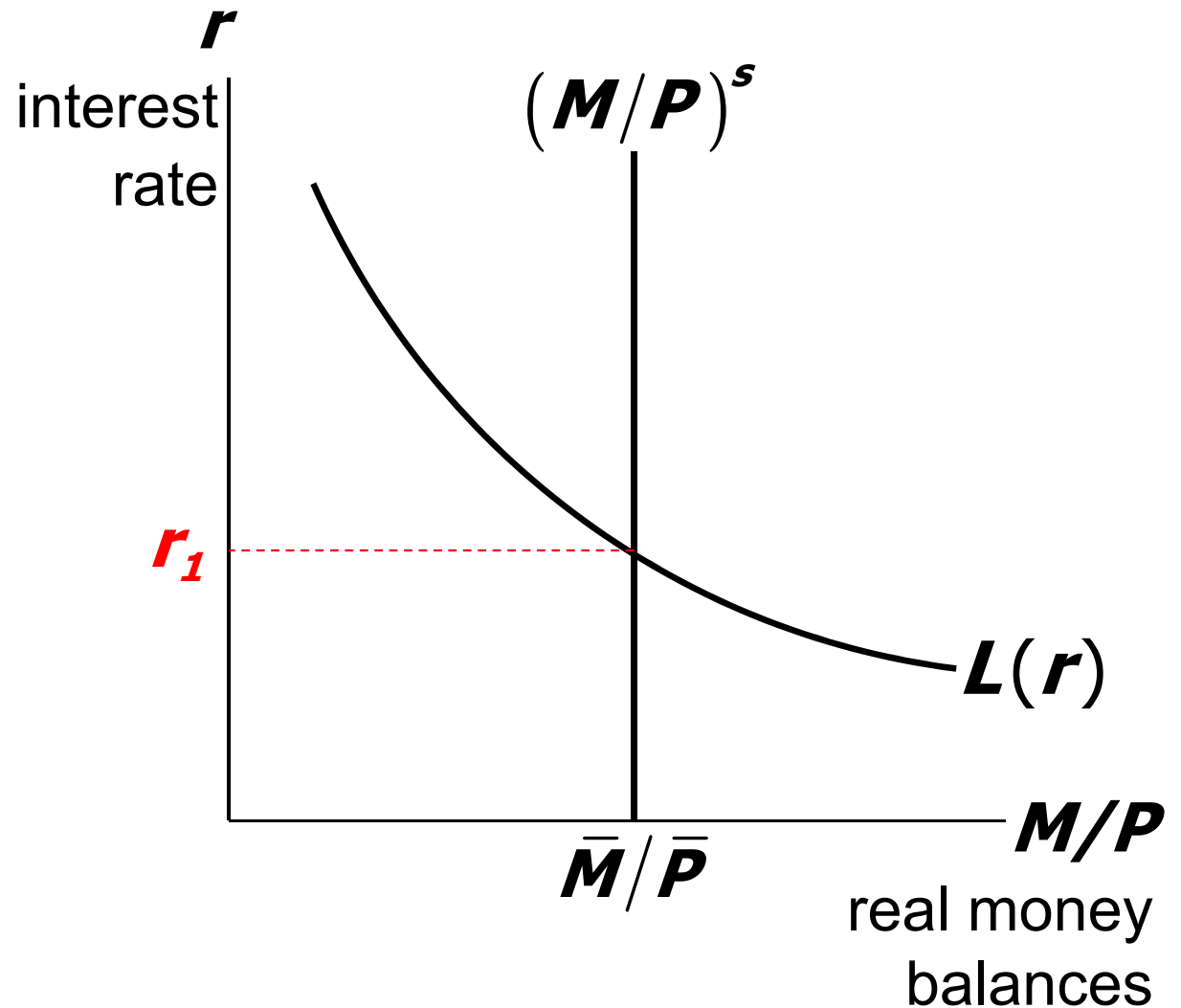




Equilibrium

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

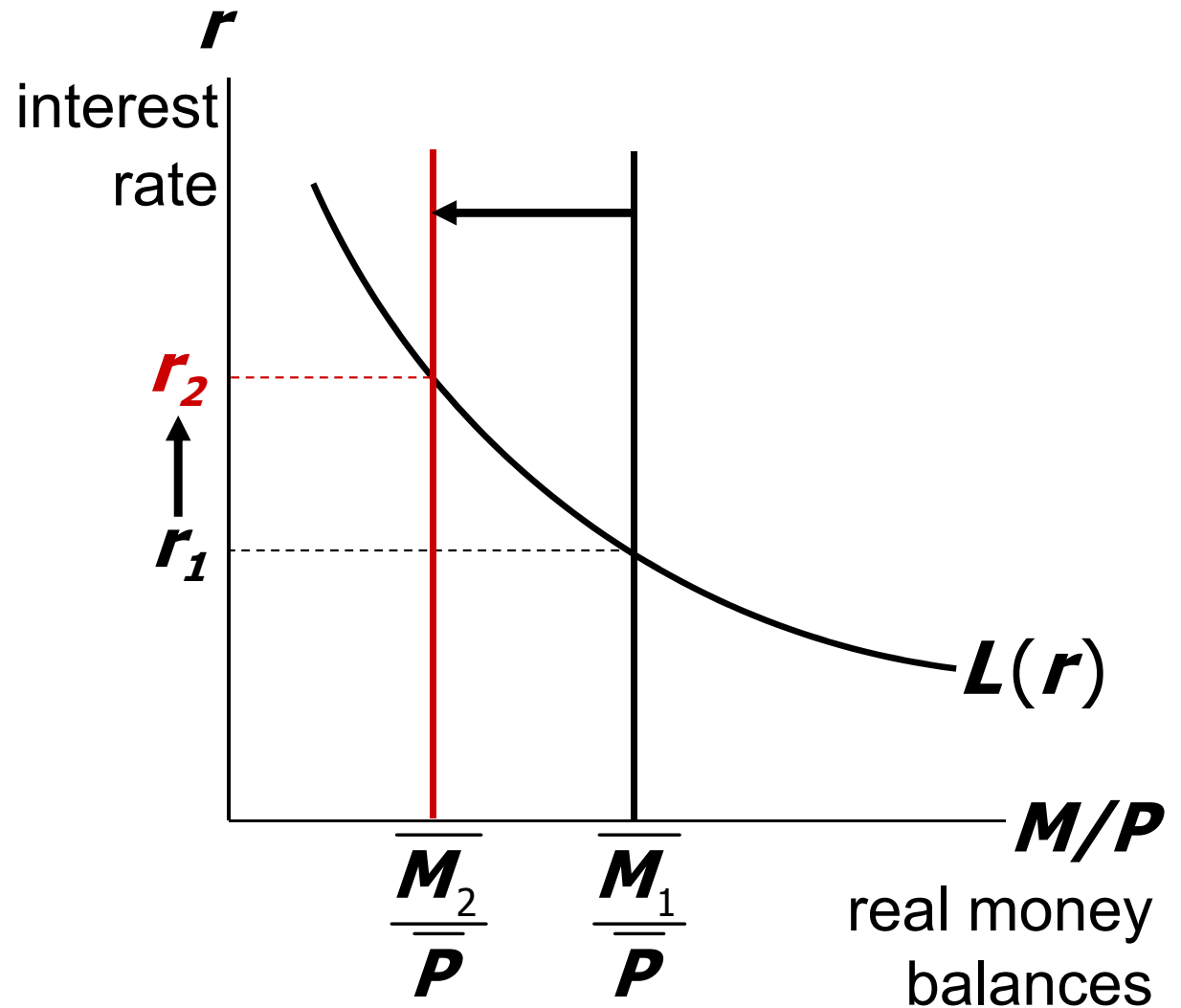
$$\bar{M}/\bar{P} = L(r)$$





How the Fed raises the interest rate

To increase r ,
Fed reduces M





CASE STUDY:

Monetary Tightening & Interest Rates

- Late 1970s: $\pi > 10\%$
- 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: $\pi = 3.7\%$

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 (<i>Keynesian</i>)	Quantity theory, Fisher effect (<i>Classical</i>)
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:

$$\left(\frac{M}{P}\right)^d = L(r, Y)$$

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

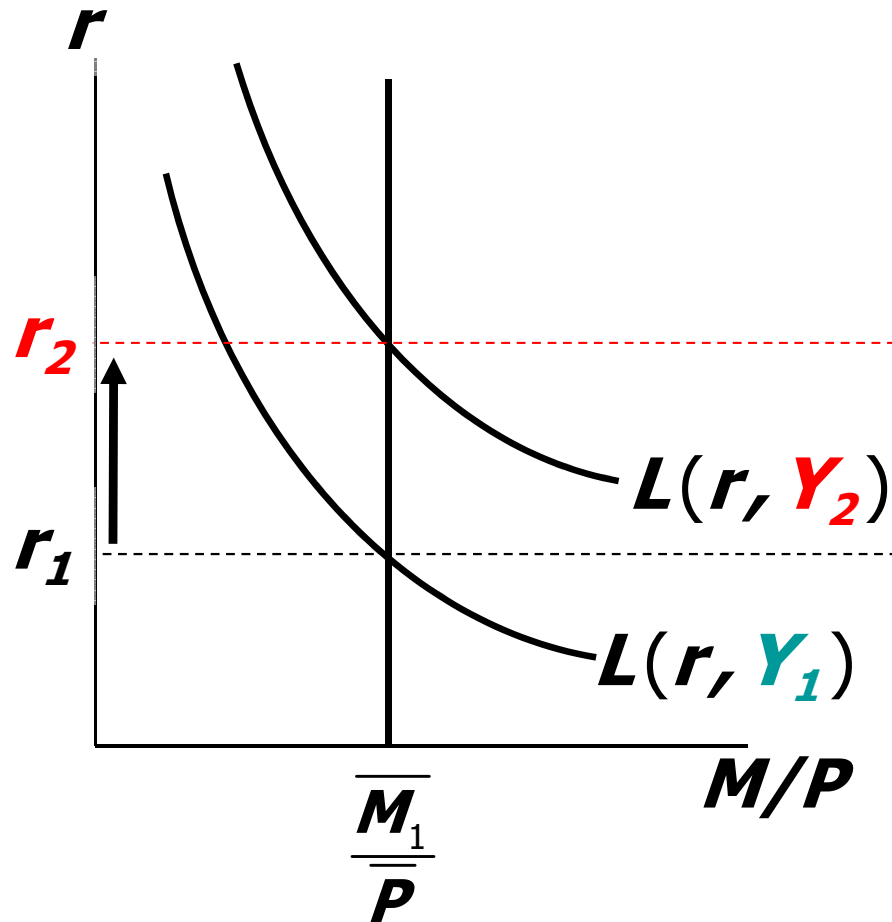
The equation for the *LM* curve is:

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

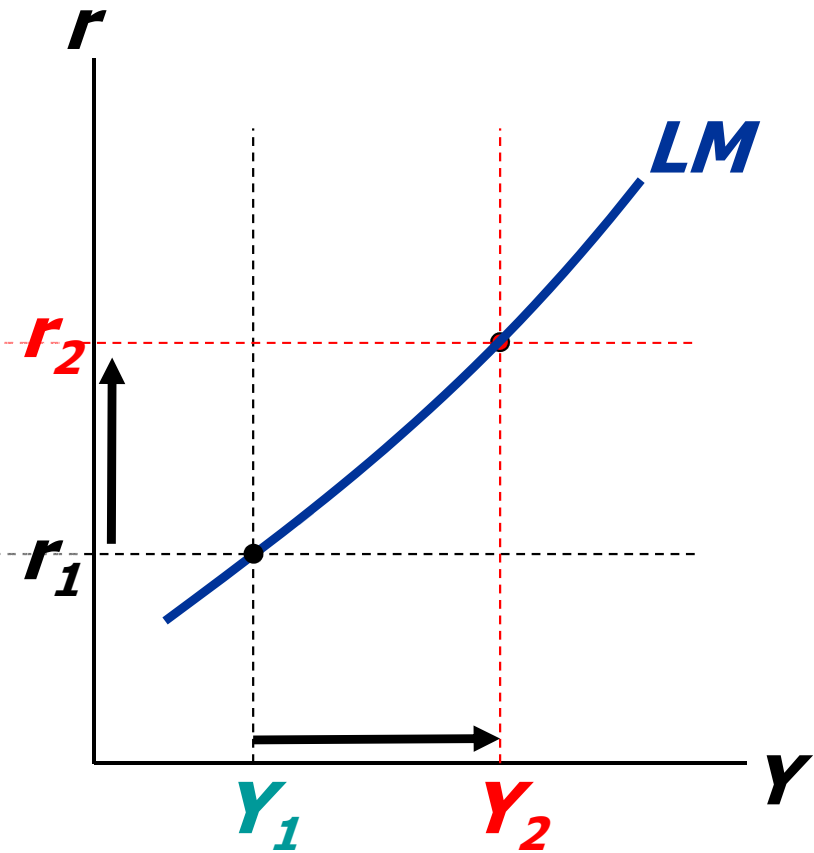


Deriving the *LM* curve

(a) The market for real money balances



(b) The *LM* curve





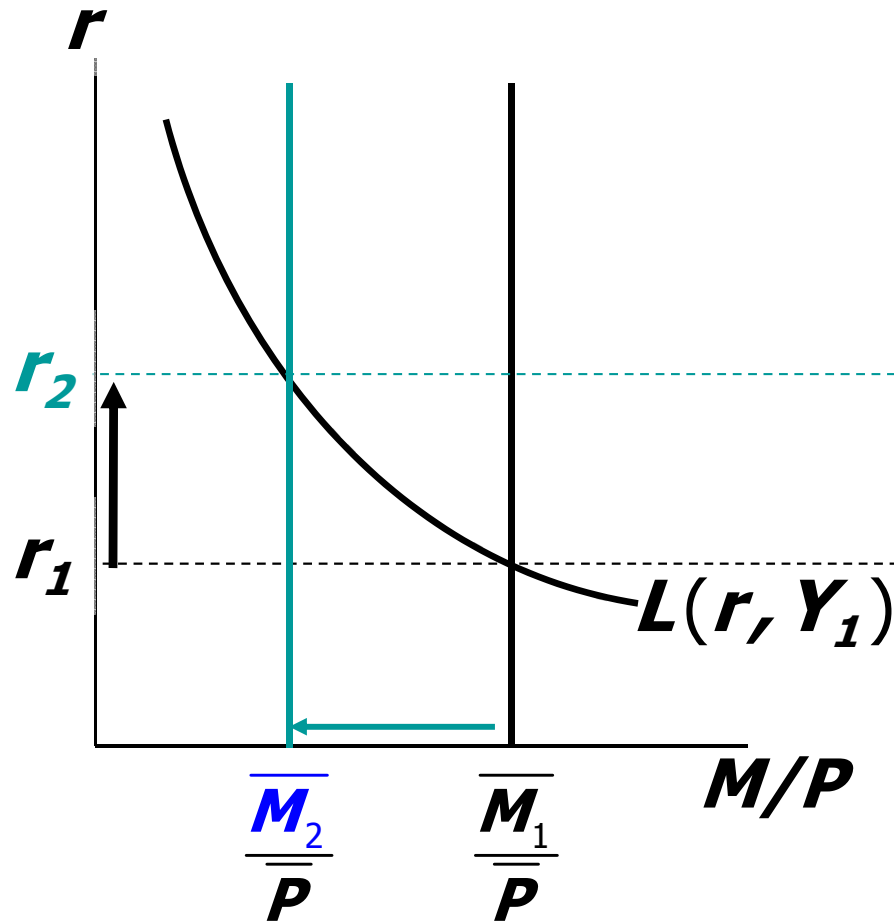
Why the *LM* curve is upward sloping

- 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.

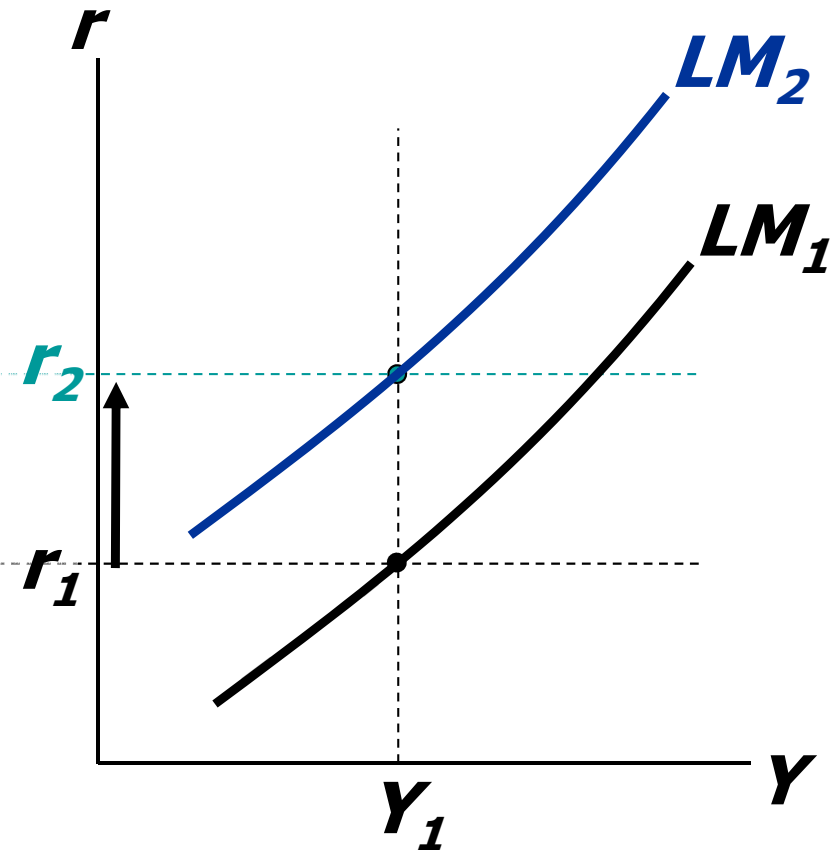


How ΔM shifts the LM curve

(a) The market for real money balances



(b) The LM curve





Equilibrium in the *IS-LM* model

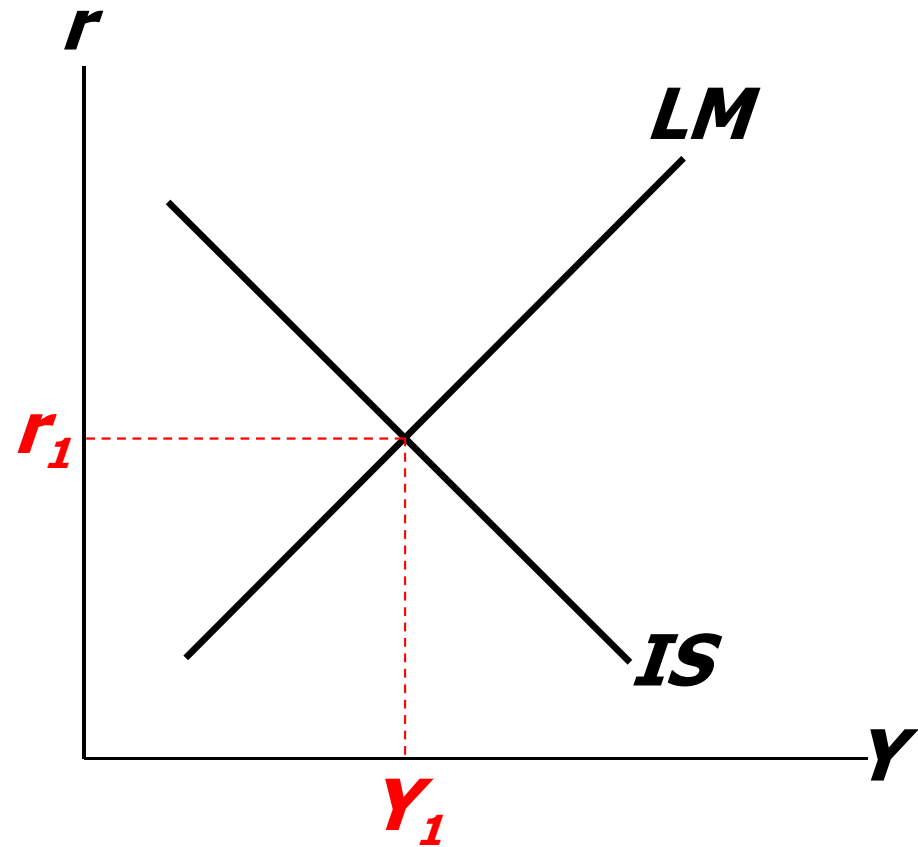
The *IS* curve represents equilibrium in the goods market.

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

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.





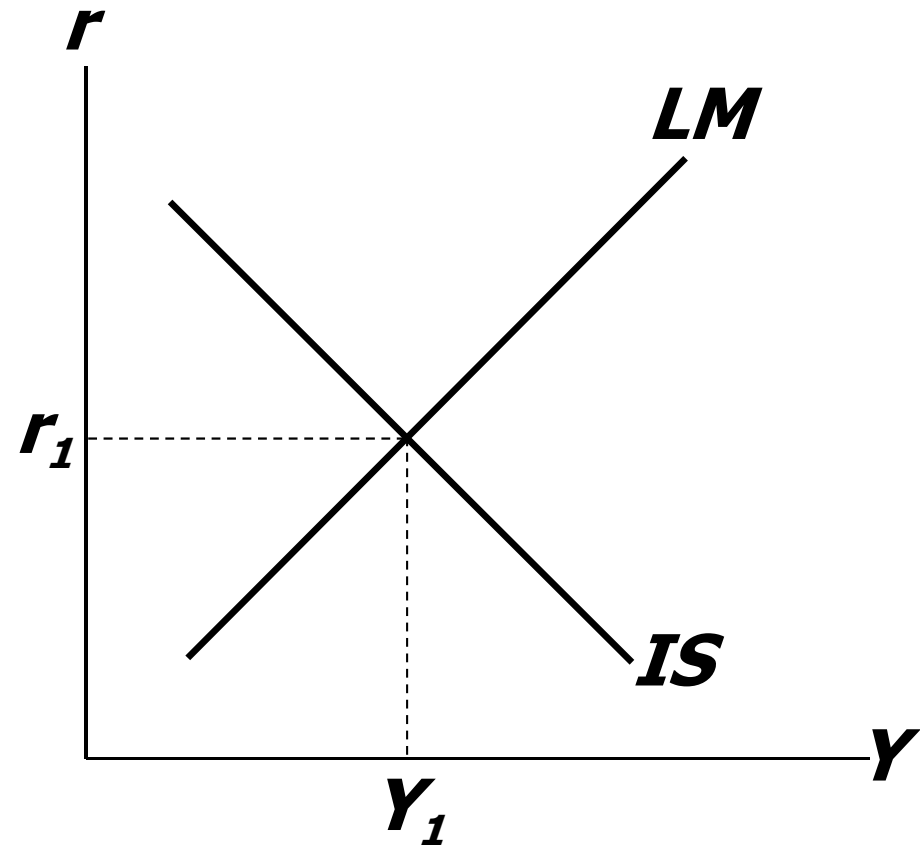
Policy analysis with the *IS-LM* model

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

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

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

- fiscal policy: \mathbf{G} and/or \mathbf{T}
- monetary policy: \mathbf{M}





An increase in government purchases

1. *IS* curve shifts right

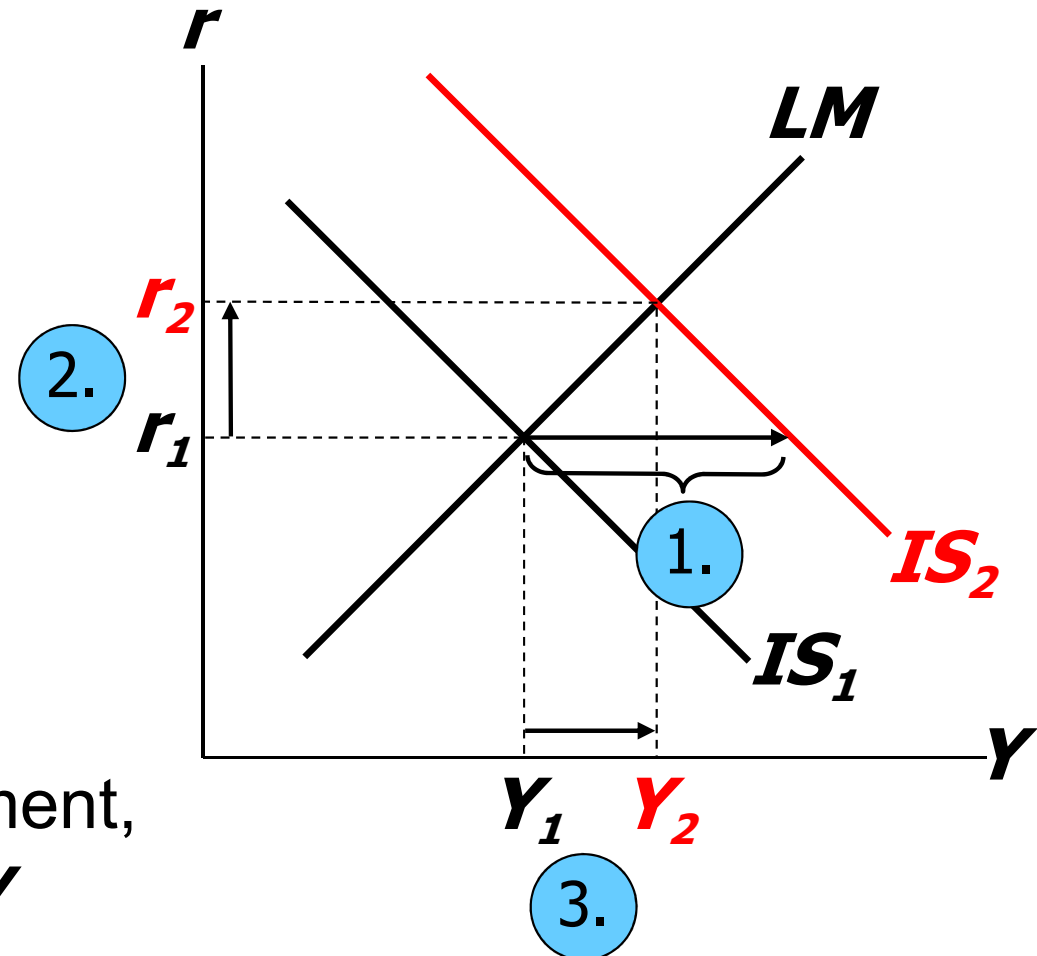
$$\text{by } \frac{1}{1-\text{MPC}} \Delta \mathbf{G}$$

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

$$\text{is smaller than } \frac{1}{1-\text{MPC}} \Delta \mathbf{G}$$



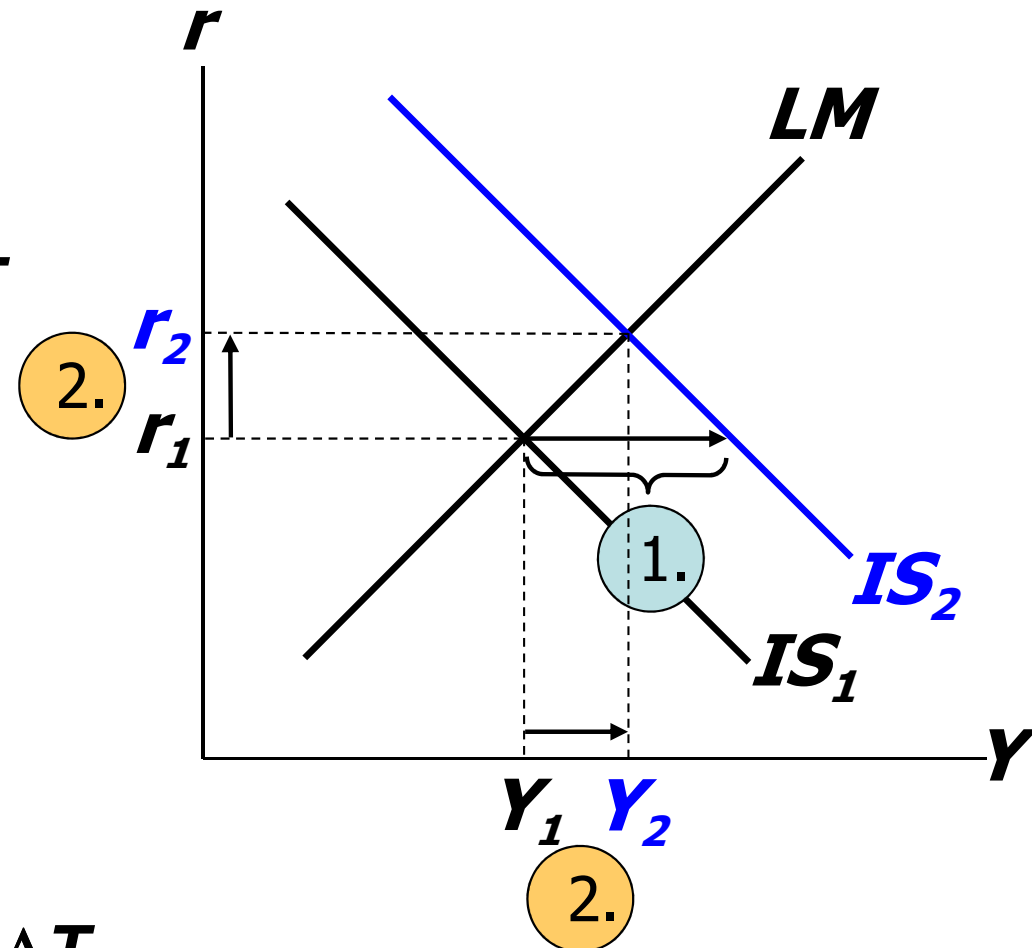


A tax cut

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

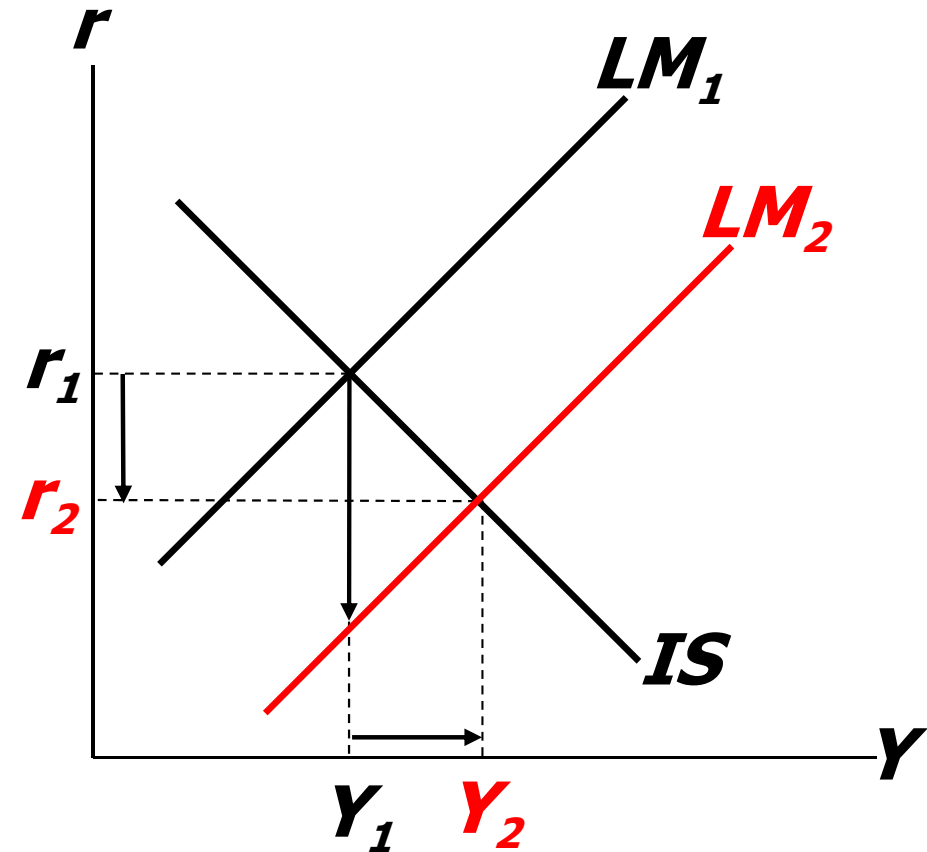
2. ...so the effects on r and Y are smaller for ΔT than for an equal ΔG .





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

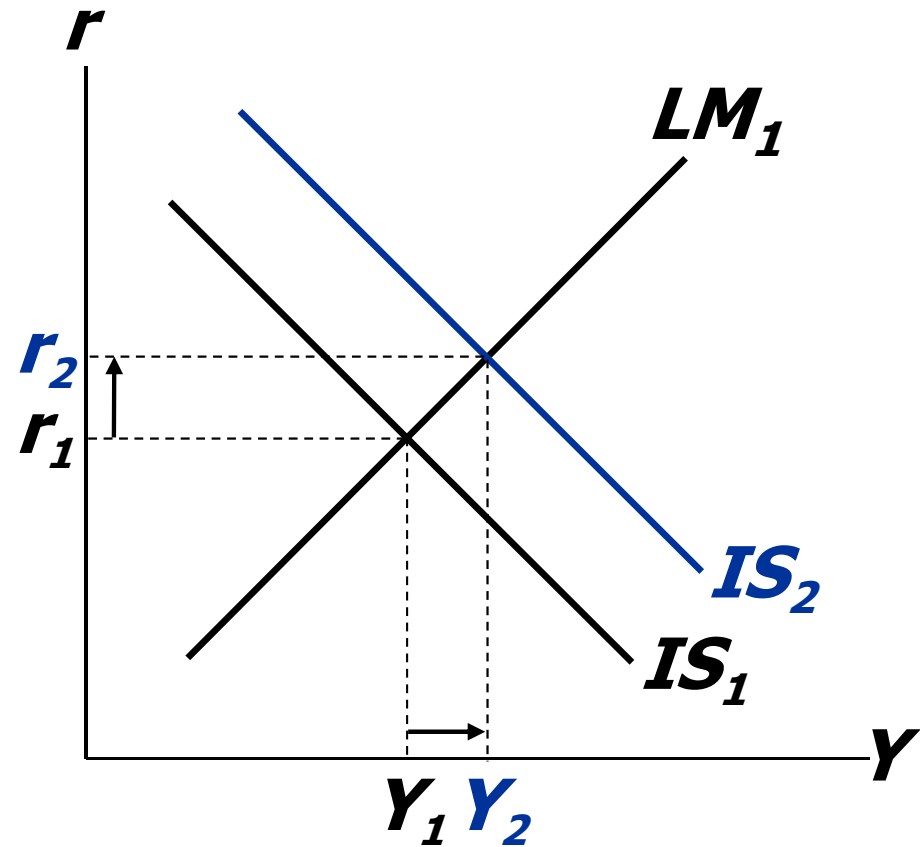
If Congress raises G ,
the IS curve shifts right.

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

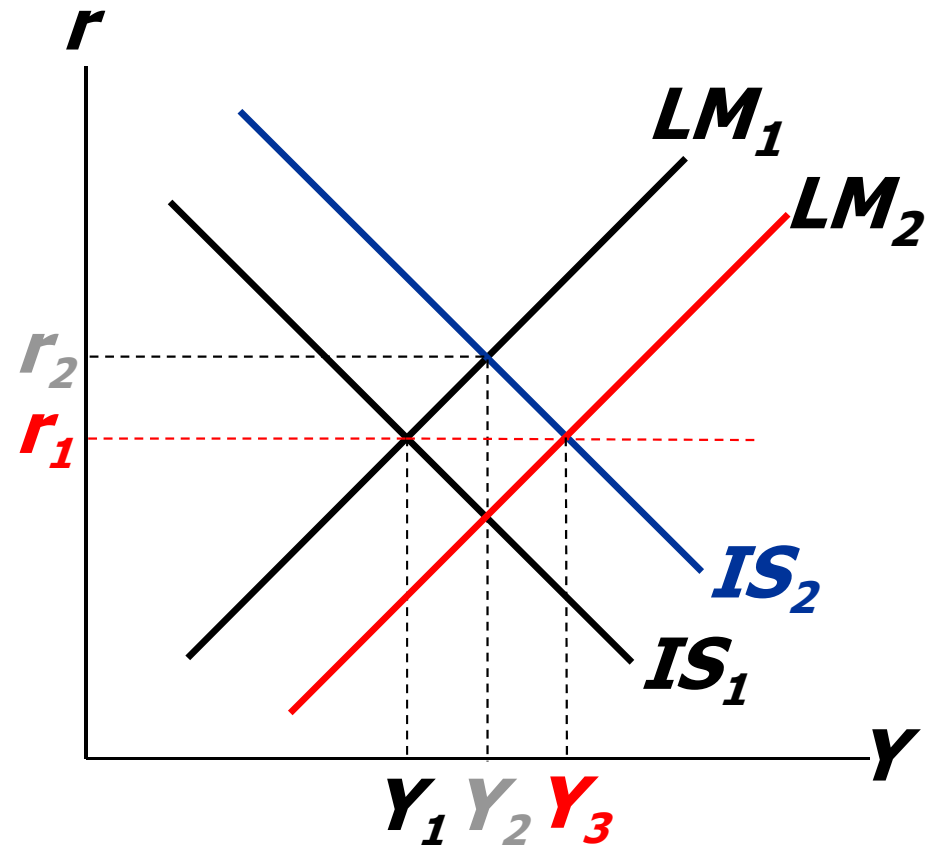
If Congress raises G ,
the IS curve shifts right.

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

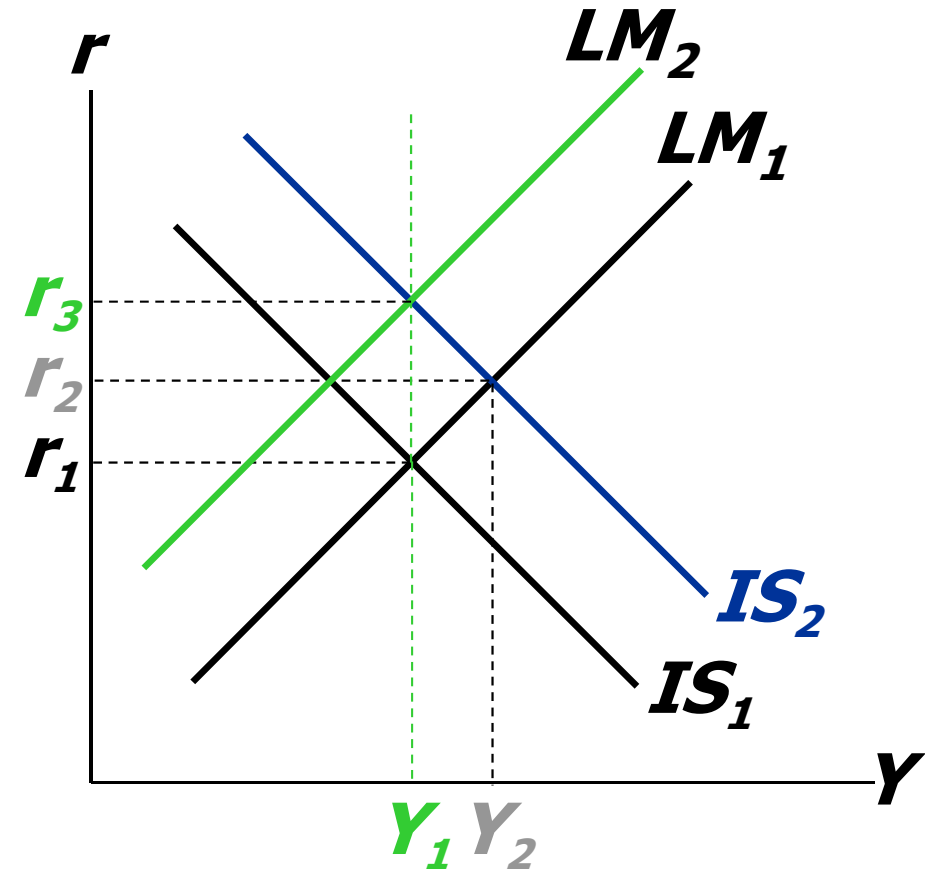
If Congress raises G ,
the IS curve shifts right.

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:

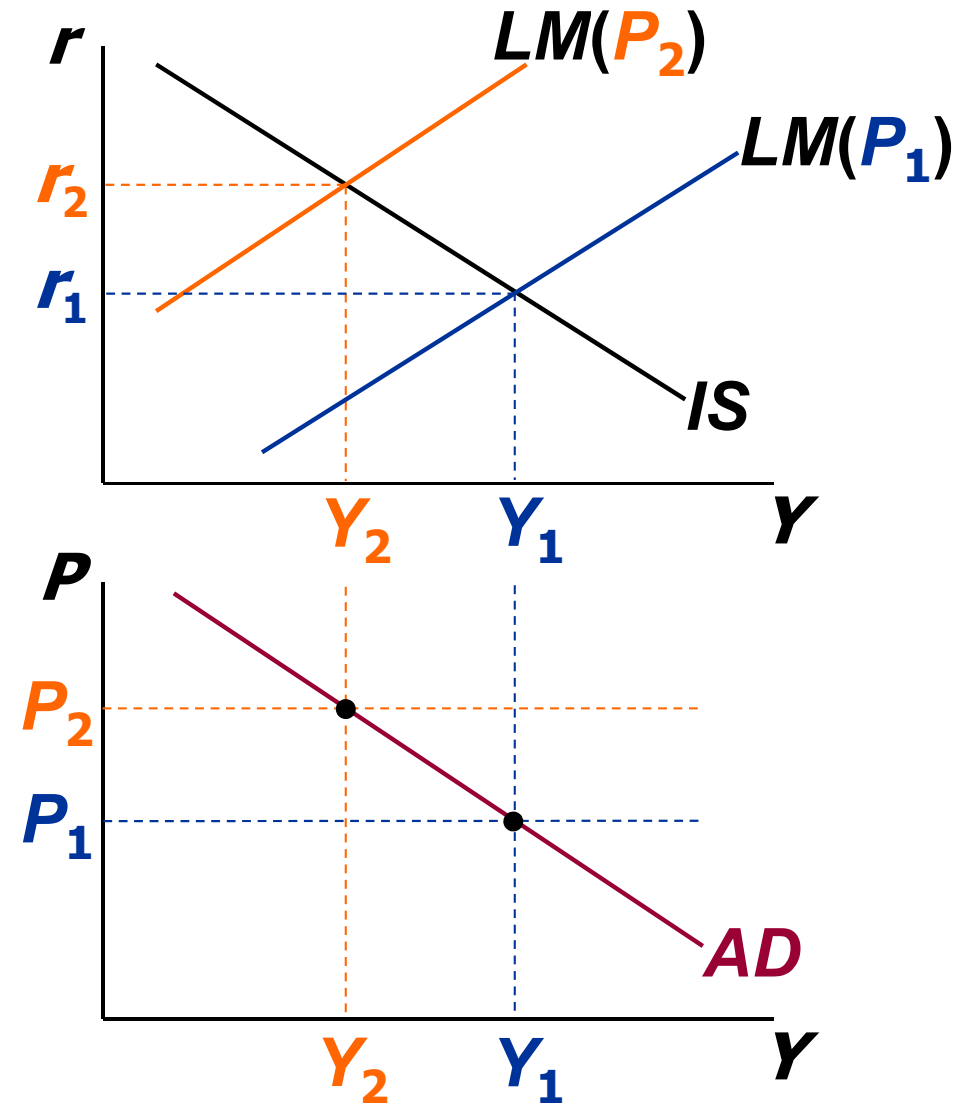
$\uparrow P \Rightarrow \downarrow (M/P)$

$\Rightarrow LM$ shifts left

$\Rightarrow \uparrow r$

$\Rightarrow \downarrow I$

$\Rightarrow \downarrow Y$





Monetary policy and the *AD* curve

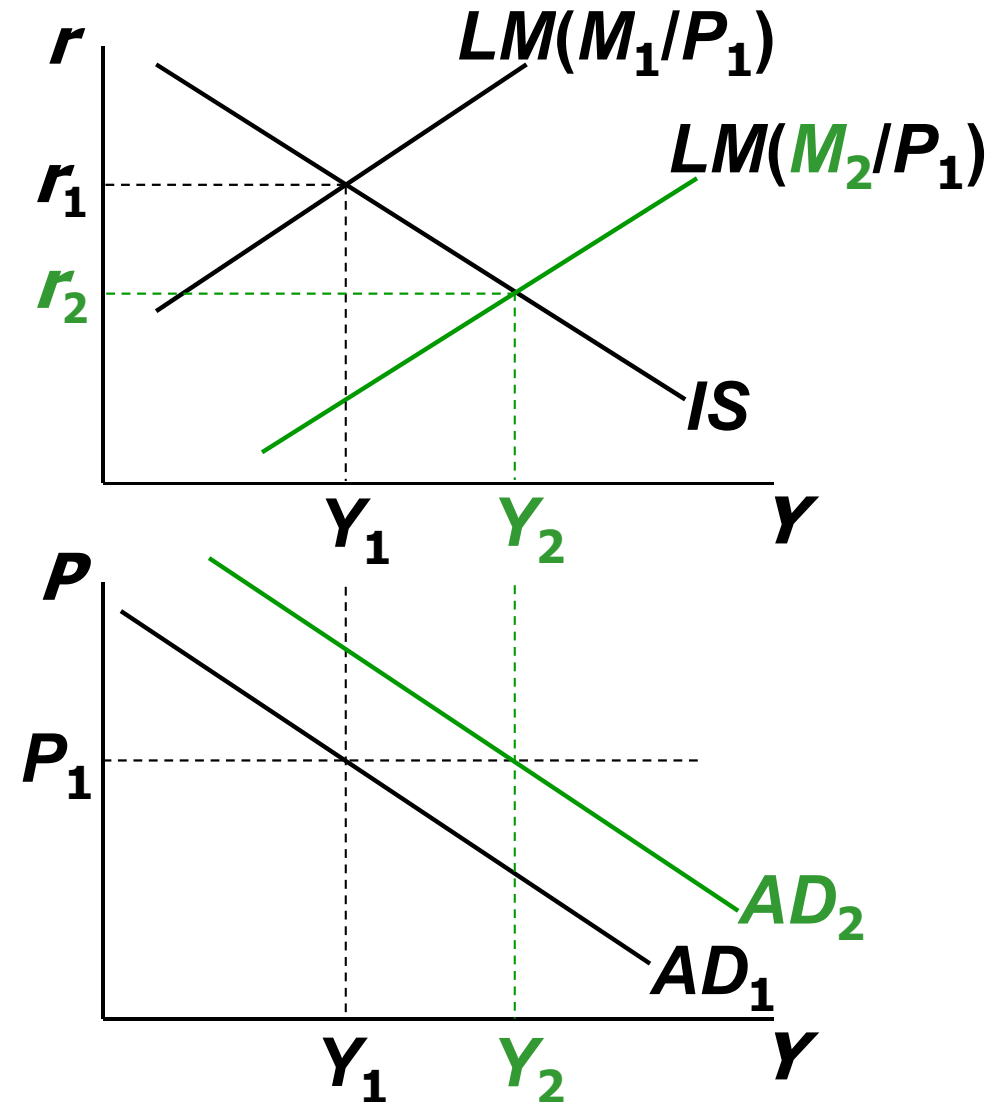
The Fed can increase aggregate demand:

$\uparrow M \Rightarrow LM$ 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:

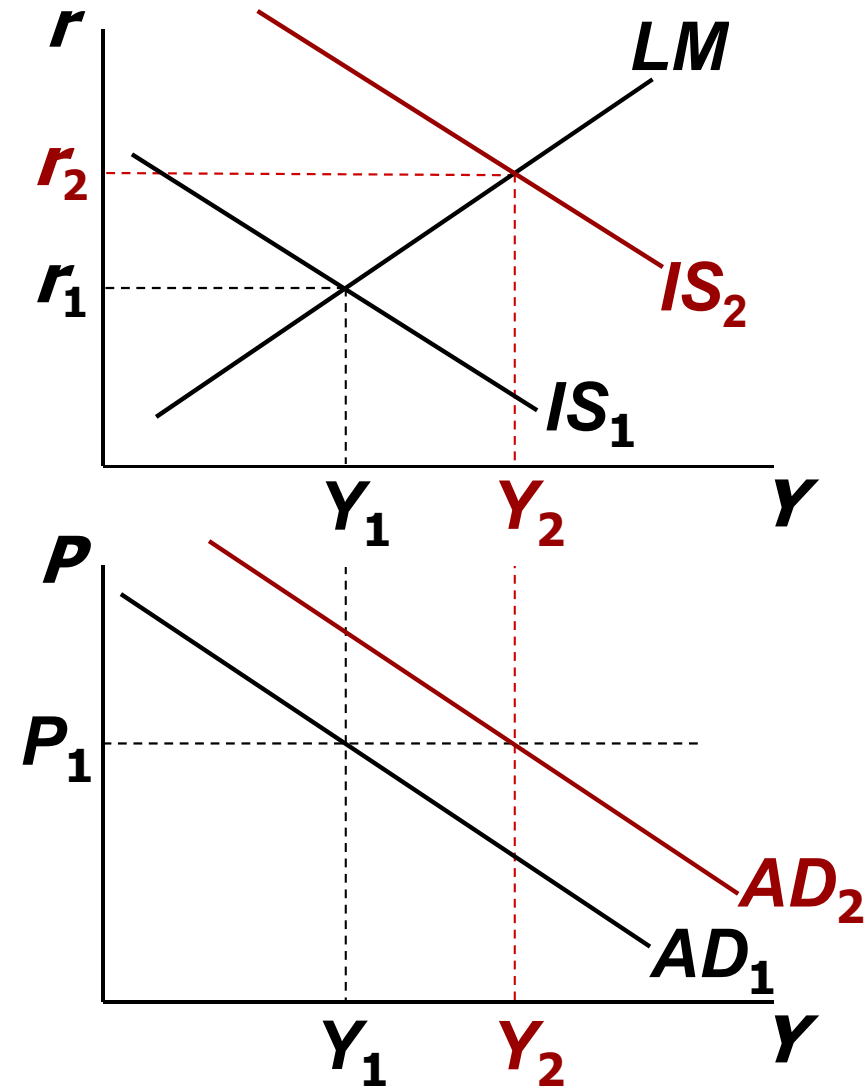
$\downarrow T \Rightarrow \uparrow C$

$\Rightarrow IS$ shifts right

$\Rightarrow \uparrow Y$ at each

value

of P





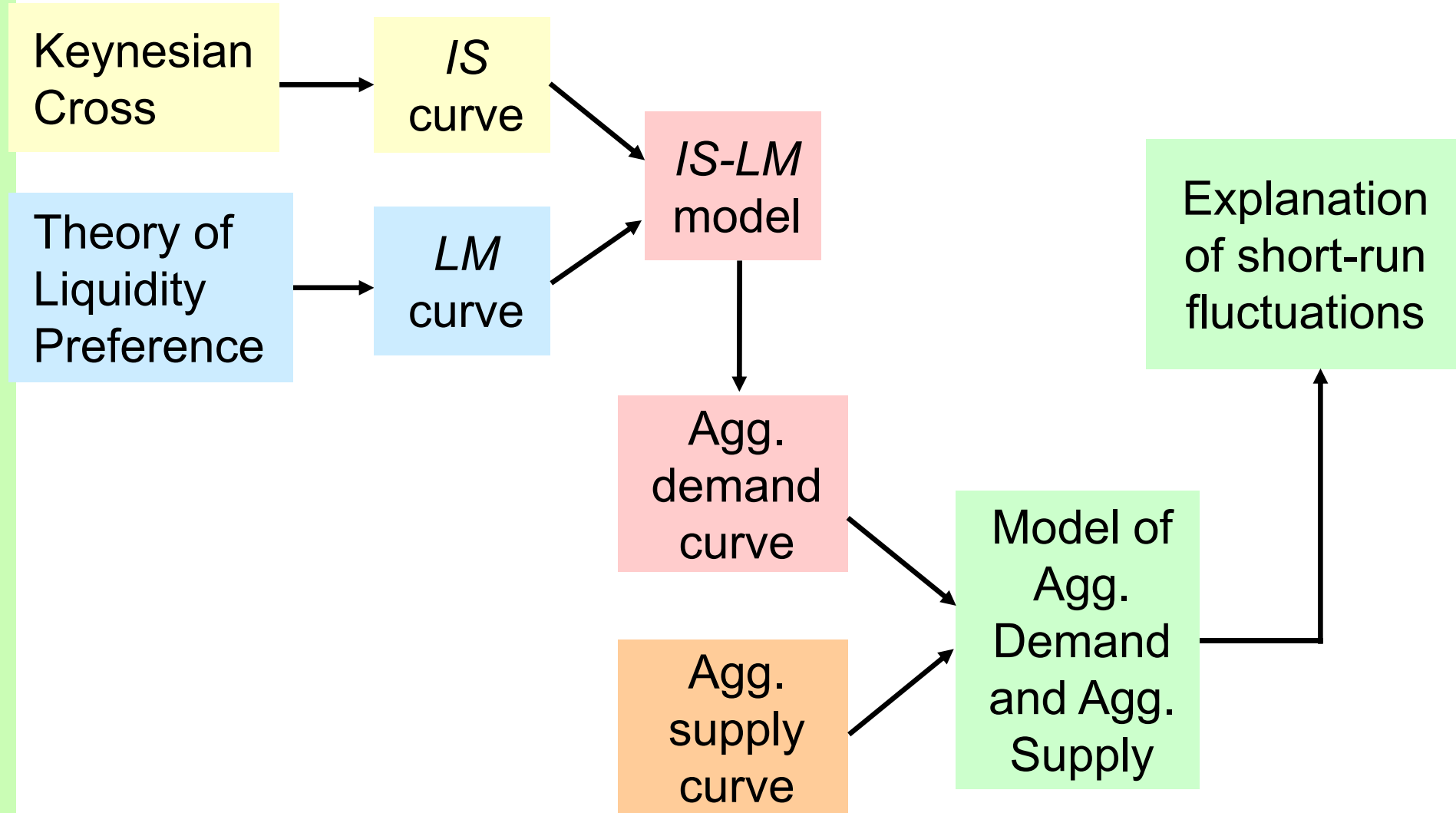
IS-LM and AD-AS **in the short run & long run**

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



The Big Picture





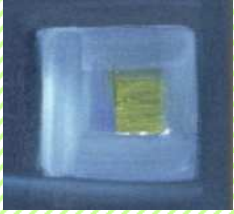
Chapter Summary

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

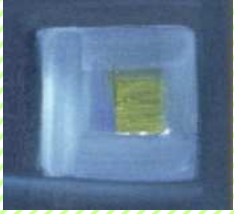
- comes from liquidity preference theory when money demand depends positively on income
- shows all combinations of r and Y that equate demand for real money balances with supply



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

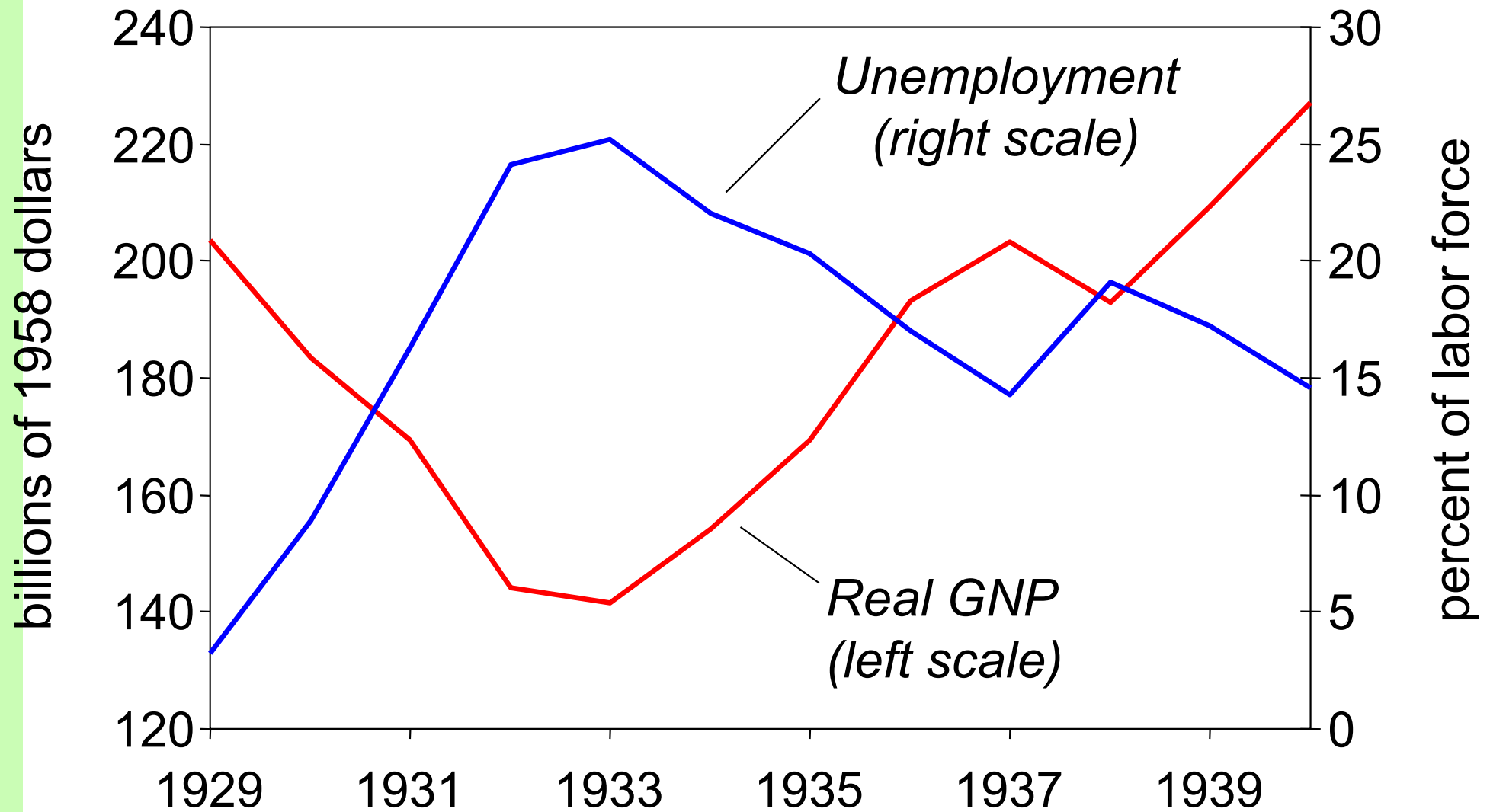
- shows relation between P and the *IS-LM* model's equilibrium Y .
- negative slope because
 $\uparrow P \Rightarrow \downarrow (M/P) \Rightarrow \uparrow r \Rightarrow \downarrow I \Rightarrow \downarrow Y$
- expansionary fiscal policy shifts *IS* curve right, raises income, and shifts *AD* curve right.
- 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:**
 - $\downarrow P \Rightarrow \uparrow (M/P)$
 - \Rightarrow consumers' wealth \uparrow
 - $\Rightarrow \uparrow C$
 - $\Rightarrow IS$ shifts right
 - $\Rightarrow \uparrow Y$



THE MONEY HYPOTHESIS AGAIN: The effects of falling prices

- The destabilizing effects of expected deflation:

$$\downarrow \pi^e$$

$\Rightarrow r \uparrow$ for each value of i

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

\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