CHAPTER 3

Aggregate Demand in the closed Economy

Context

- This chapter develops the *IS-LM* model, the theory that yields the aggregate demand curve.
- We focus on the short run and assume the price level is fixed.
- This chapter focus on the closed-economy case. The next chapter presents the open-economy case.

Introduction

- In the worst year, 1933, one-fourth of the U.S. labor force was unemployed, and real GDP was 30 percent below its 1929 level.
- Classical theory (national income depends on factor supplies and the available technology)seemed incapable of explaining the Depression.
  - Neither of which changed substantially from 1929 to 1933.
- In 1936 the British economist John Maynard Keynes revolutionized economics with his book *The General Theory of Employment, Interest, and Money*.
- Keynes: low aggregate demand is responsible for the economic downturns
- Economists reconcile:
  - In the long run, prices are flexible, and aggregate supply determines income.
  - But in the short run, prices are sticky, so changes in aggregate demand influence income.

The Goods Market and the *IS* Curve

- The model of aggregate demand developed in this chapter, called the ***IS–LM* model**, is the leading interpretation of Keynes's theory.The goal of the model is to show what determines national income for any given price level.
- The *IS* curve plots the relationship between the interest rate and the level of income that arises in the market for goods and services.

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:

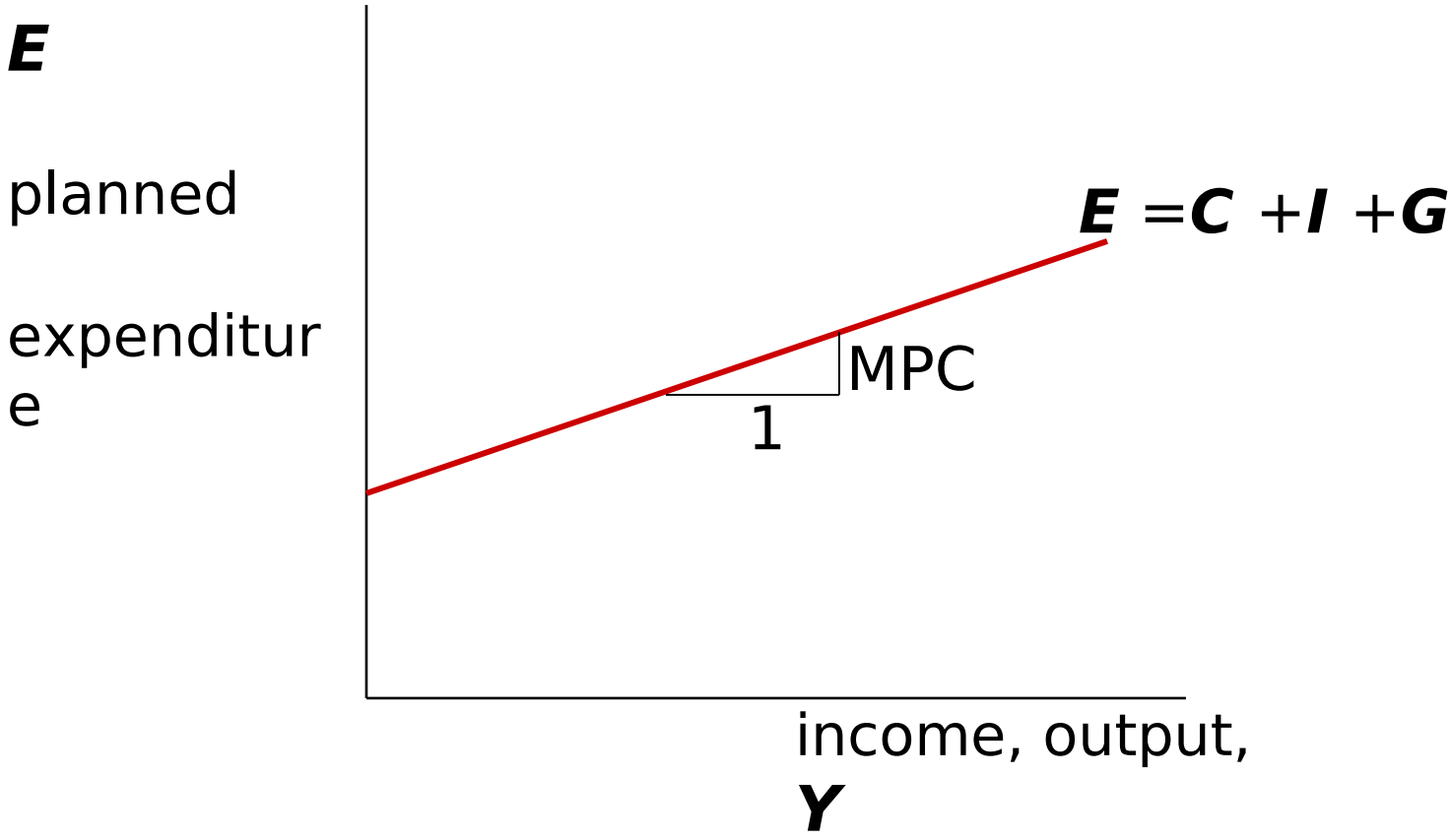
$$E = C(Y - \bar{T}) + \bar{I} + \bar{G}$$

Equilibrium condition:

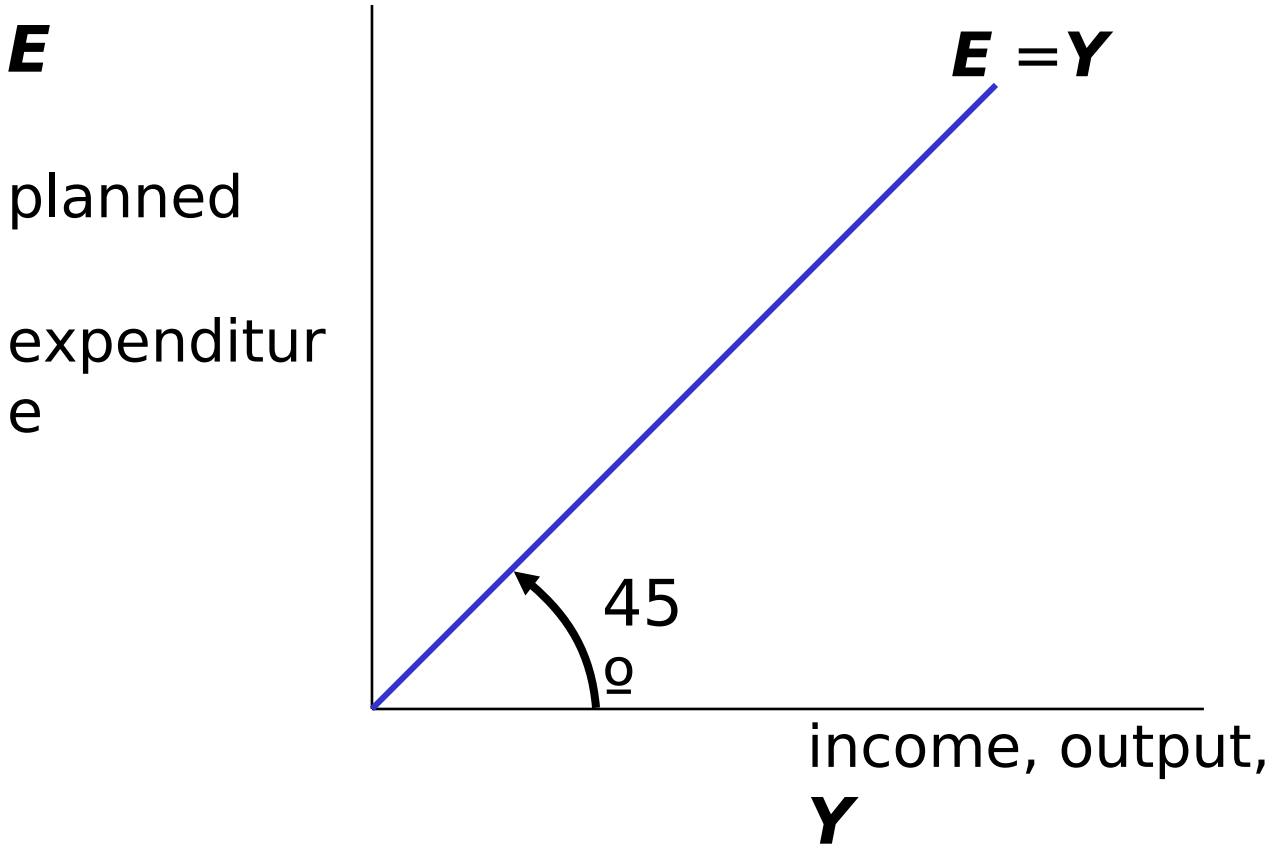
Actual expenditure = Planned expenditure

$$Y = E$$

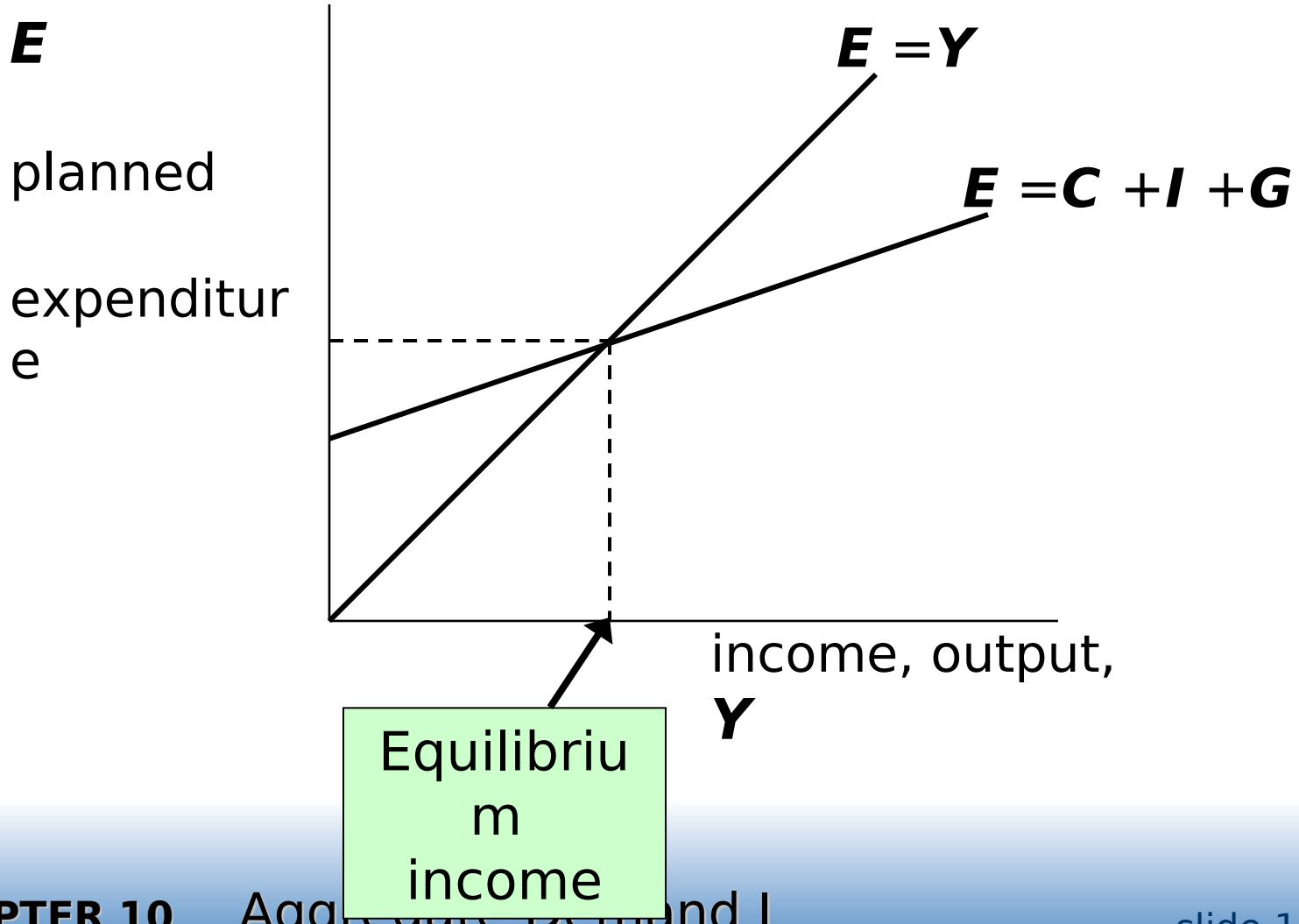
Graphing planned expenditure



Graphing the equilibrium condition

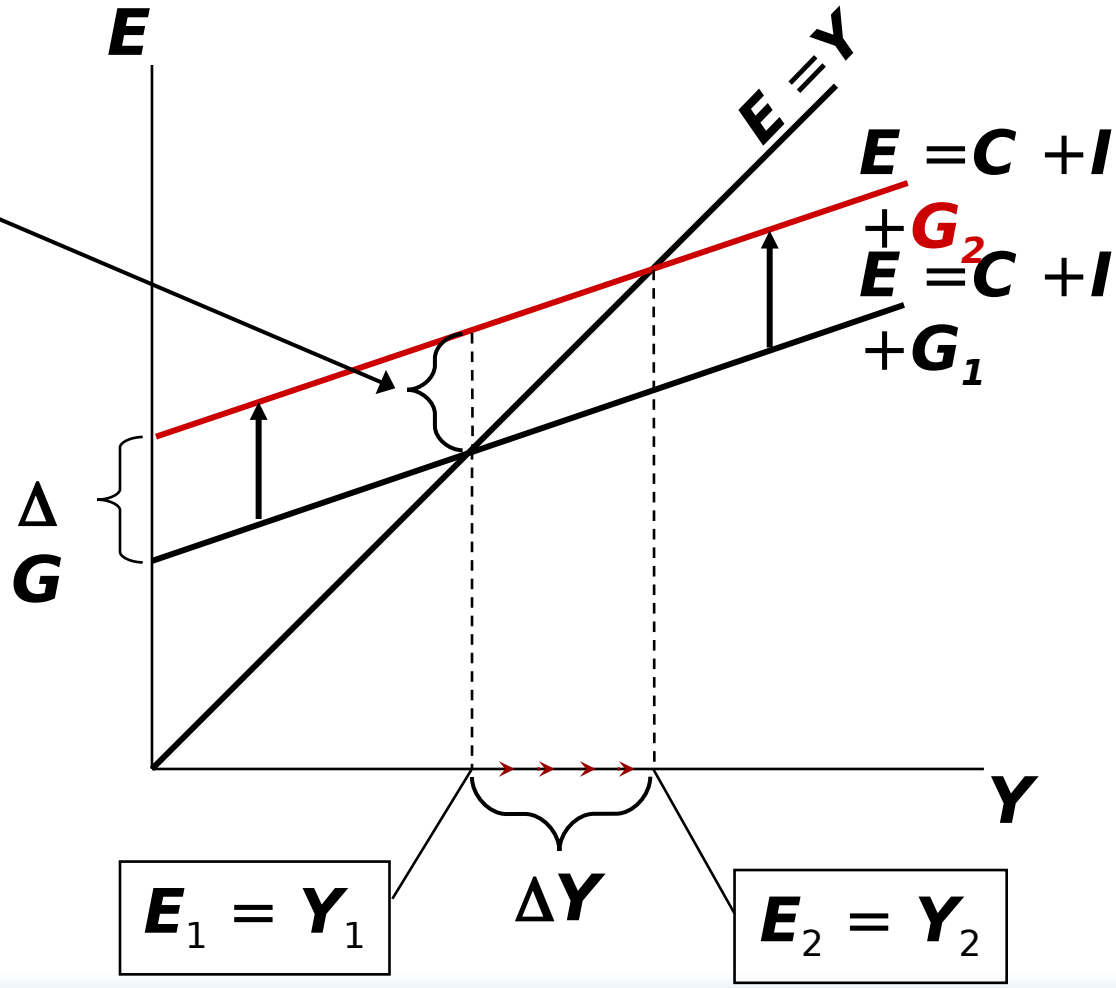


The equilibrium value of income



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 $\Delta C = \text{MPC} \times \Delta Y$

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

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

Finally, solve for ΔY:

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

The government purchases multiplier

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

In this model, the govt purchases multiplier equals $\dfrac{\Delta \boldsymbol{Y}}{\Delta \boldsymbol{G}} = \dfrac{1}{1 - \text{MPC}}$

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 by 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 $\uparrow Y \Rightarrow \uparrow C$

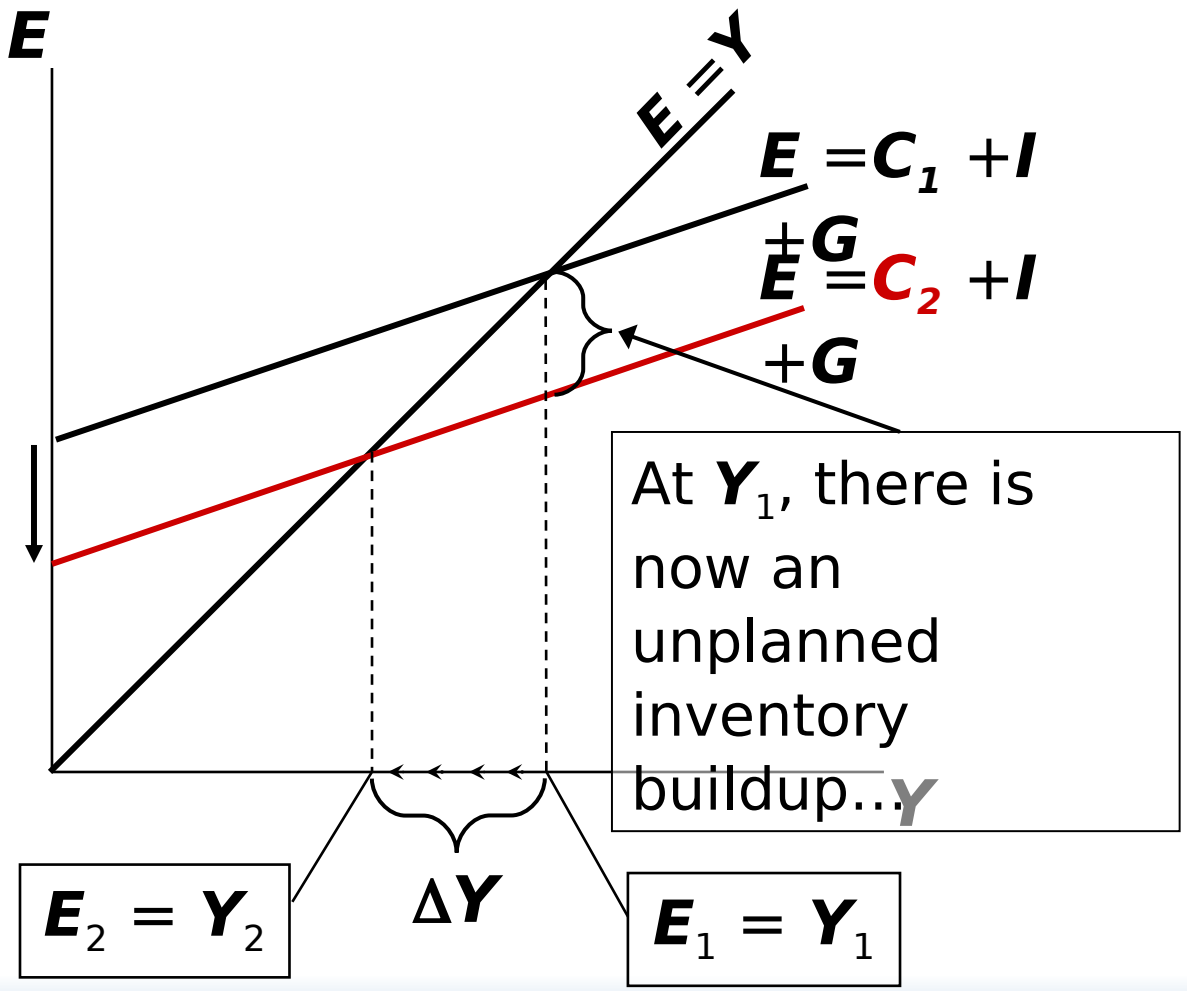
  $\Rightarrow$ further $\uparrow Y$

  $\Rightarrow$ 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

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

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 ***T*** :

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

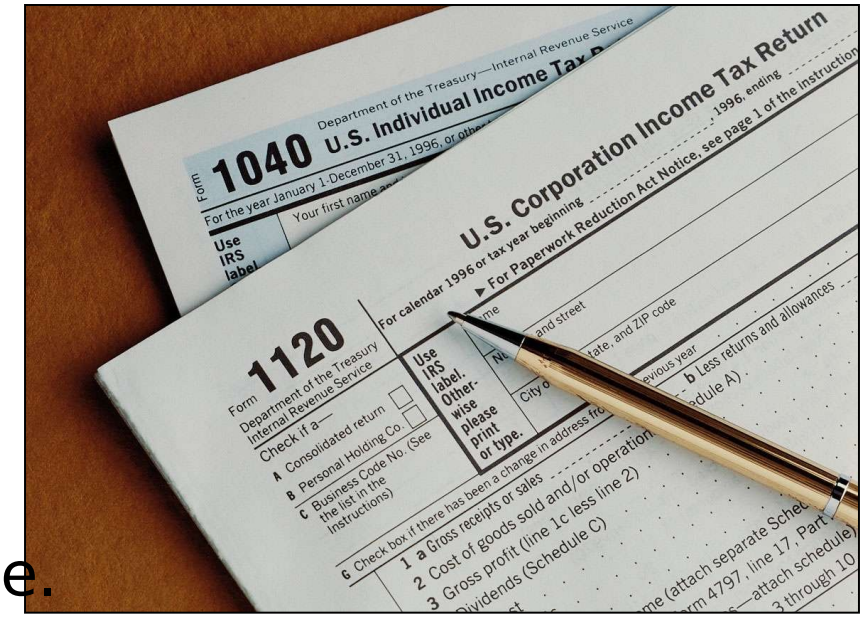
If MPC = 0.8, then the tax multiplier equals

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

The Tax Multiplier

…is *negative:*
A tax hike reduces consumer spending, 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 impact 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,

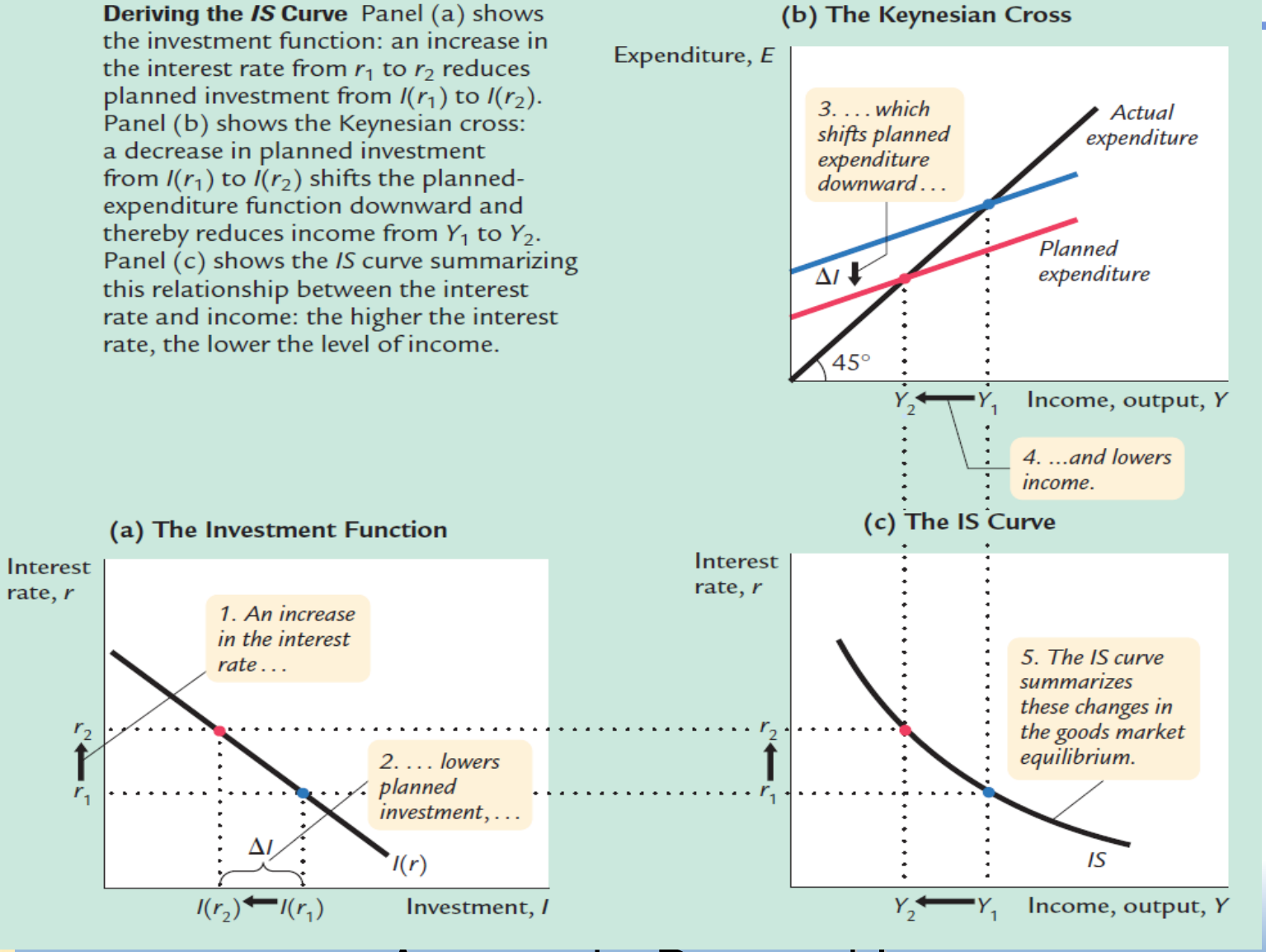
i.e. actual expenditure (output)
= planned expenditure

The equation for the *IS* curve is:

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

Deriving the *IS* curve

Deriving the *IS* Curve Panel (a) shows the investment function: an increase in the interest rate from r_1 to r_2 reduces planned investment from $I(r_1)$ to $I(r_2)$. Panel (b) shows the Keynesian cross: a decrease in planned investment from $I(r_1)$ to $I(r_2)$ shifts the planned-expenditure function downward and thereby reduces income from Y_1 to Y_2. Panel (c) shows the *IS* curve summarizing this relationship between the interest rate and income: the higher the interest rate, the lower the level of income.

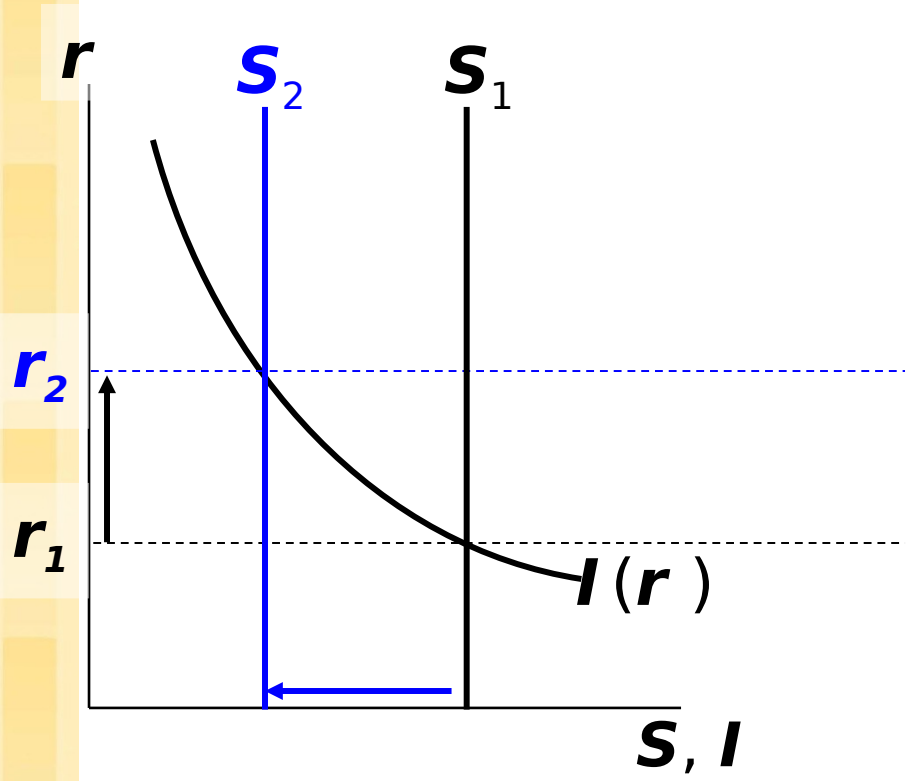


Why the *IS* curve is negatively sloped

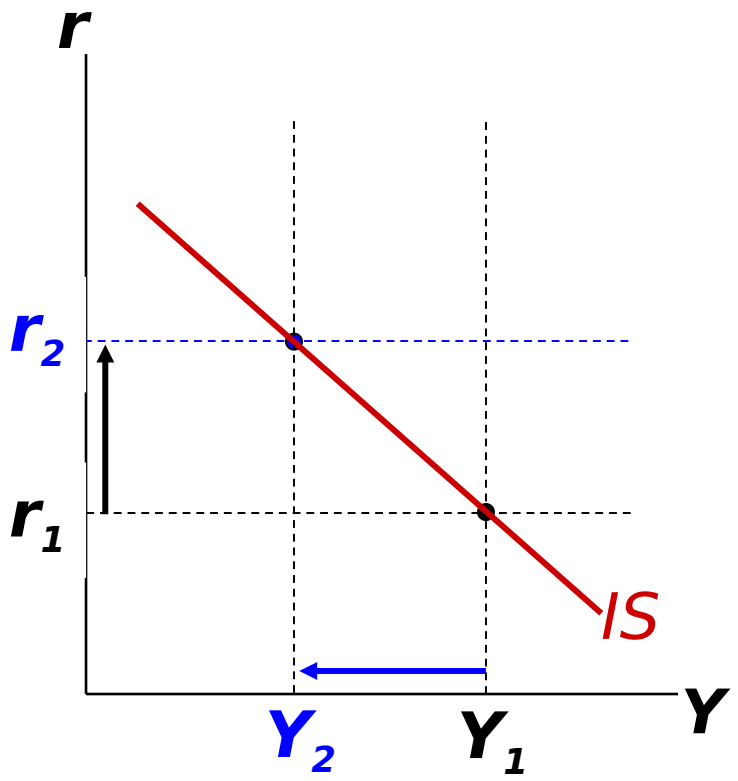
- A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending (***E***).
- To restore equilibrium in the goods market, output (a.k.a. actual expenditure, ***Y***) must increase.

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***) can affect aggregate demand and output.
- Let's start by using the Keynesian Cross to see how fiscal policy shifts the *IS* curve…

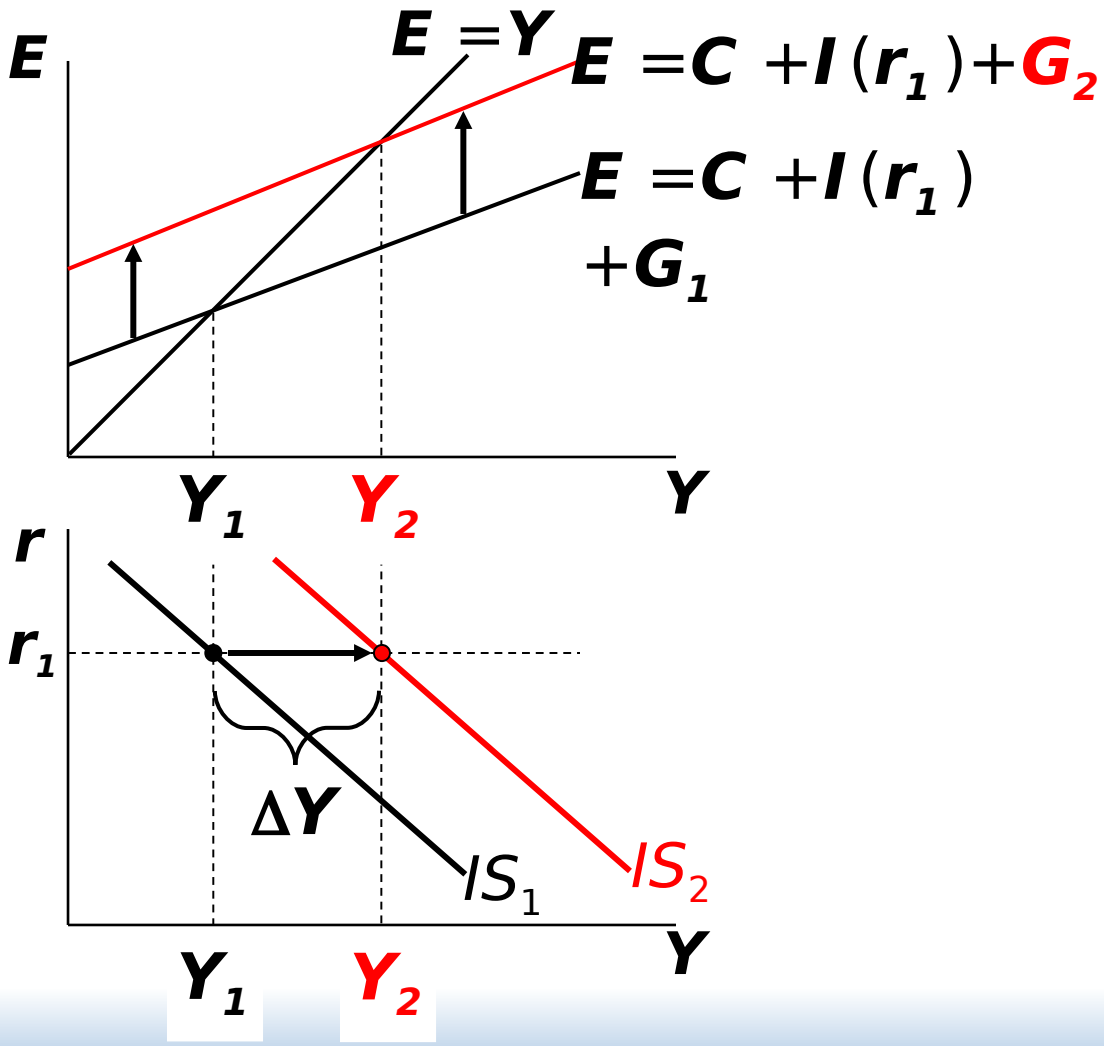
Shifting the *IS* curve: ΔG

At any value of r, $\uparrow G \Rightarrow \uparrow E \Rightarrow \uparrow Y$

…so the IS curve shifts to the right.

The horizontal distance of the IS shift equals

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



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.

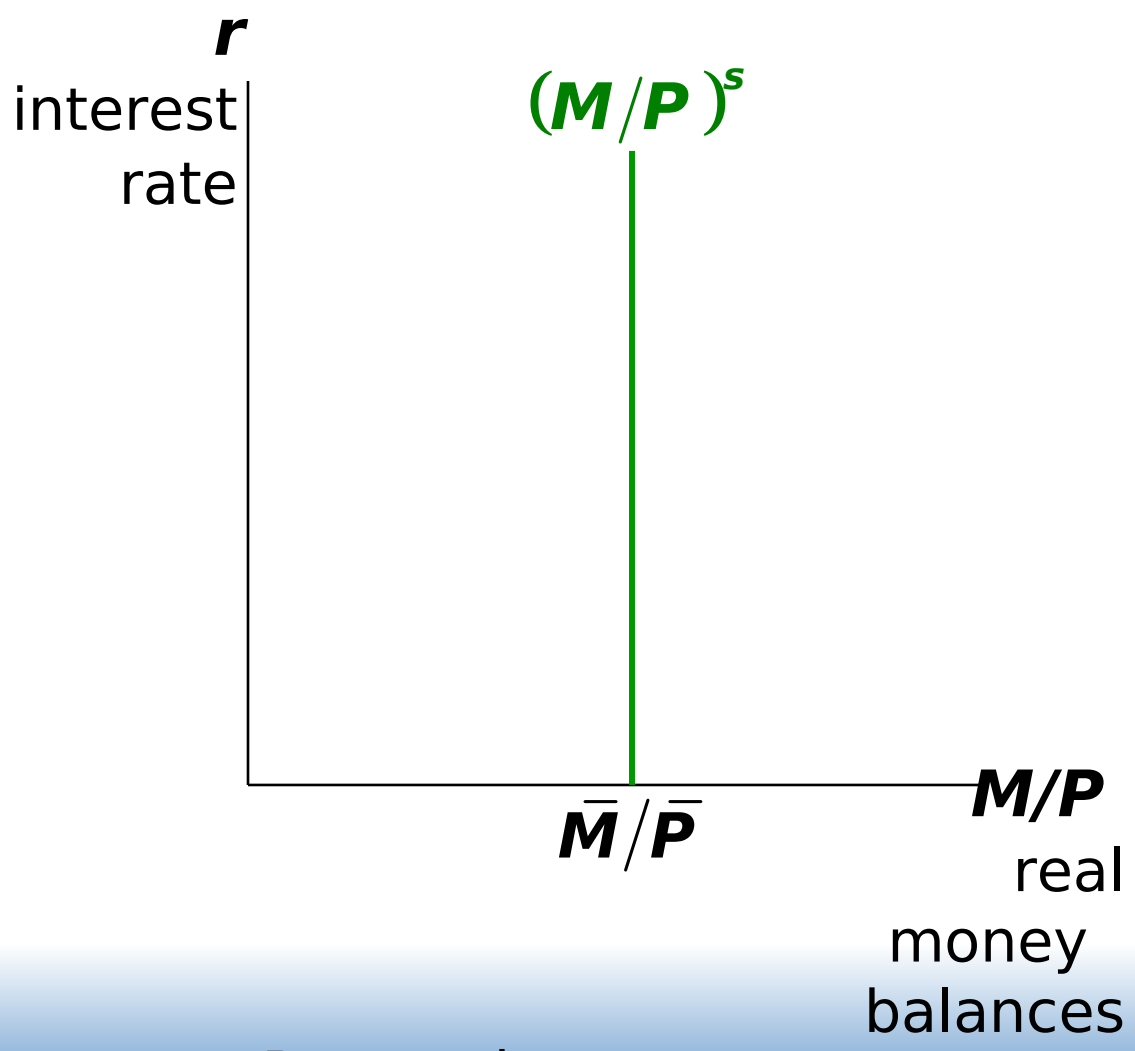
The Theory of Liquidity Preference

- 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:

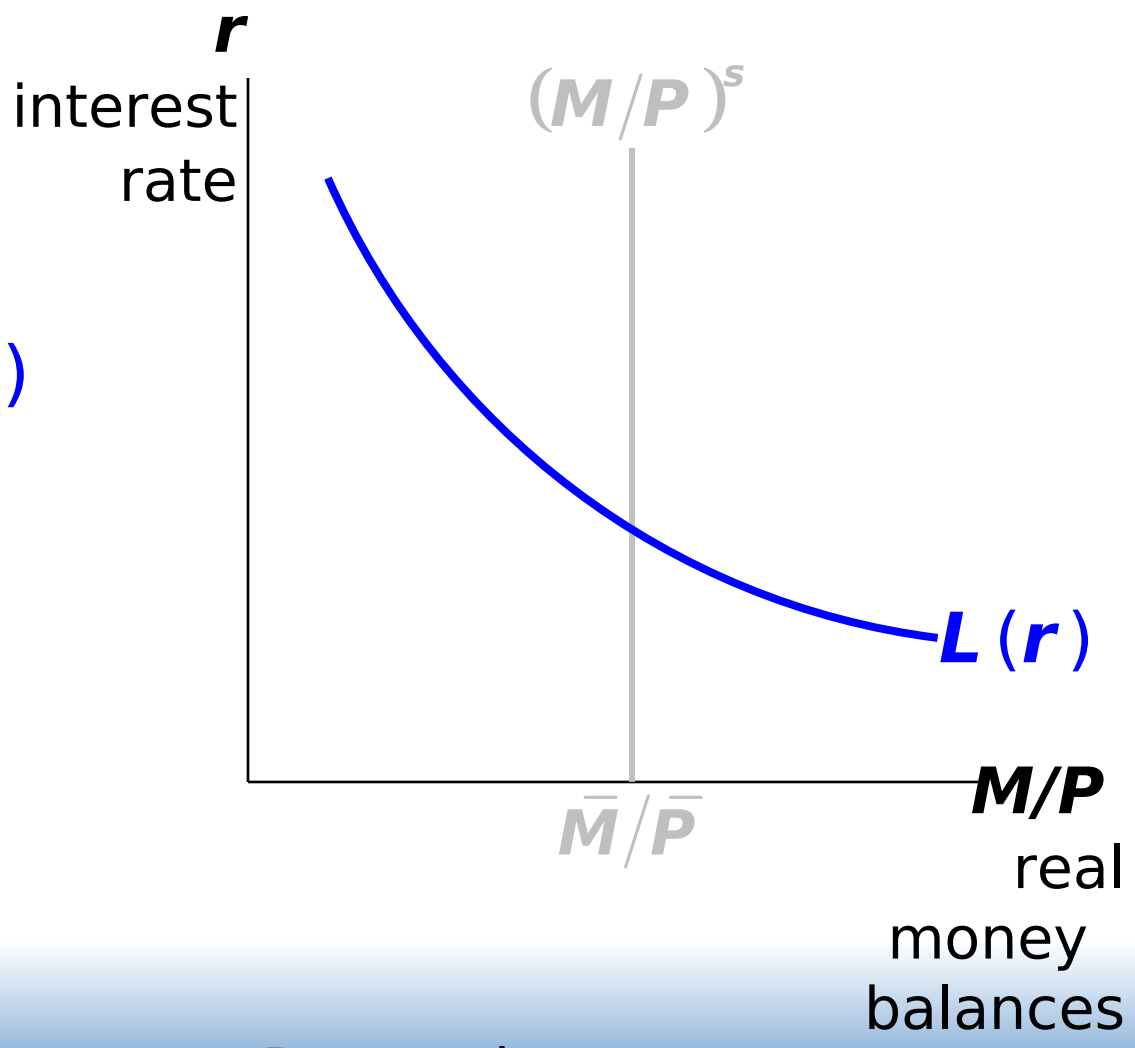
$$(M/P)^s = \bar{M}/\bar{P}$$



Money Demand

Demand for real money balances:

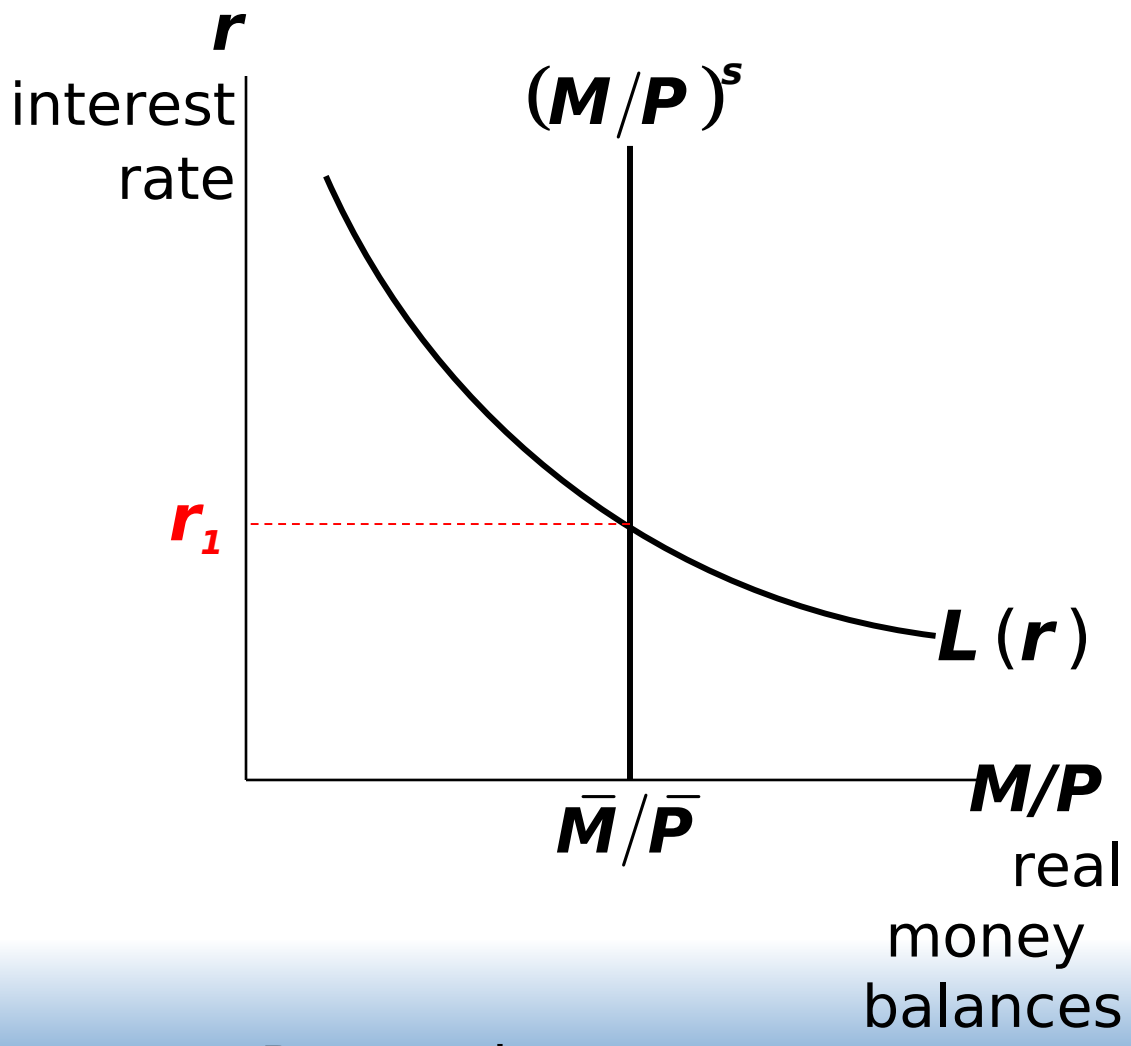
$$(M/P)^d = L(r)$$



Equilibrium

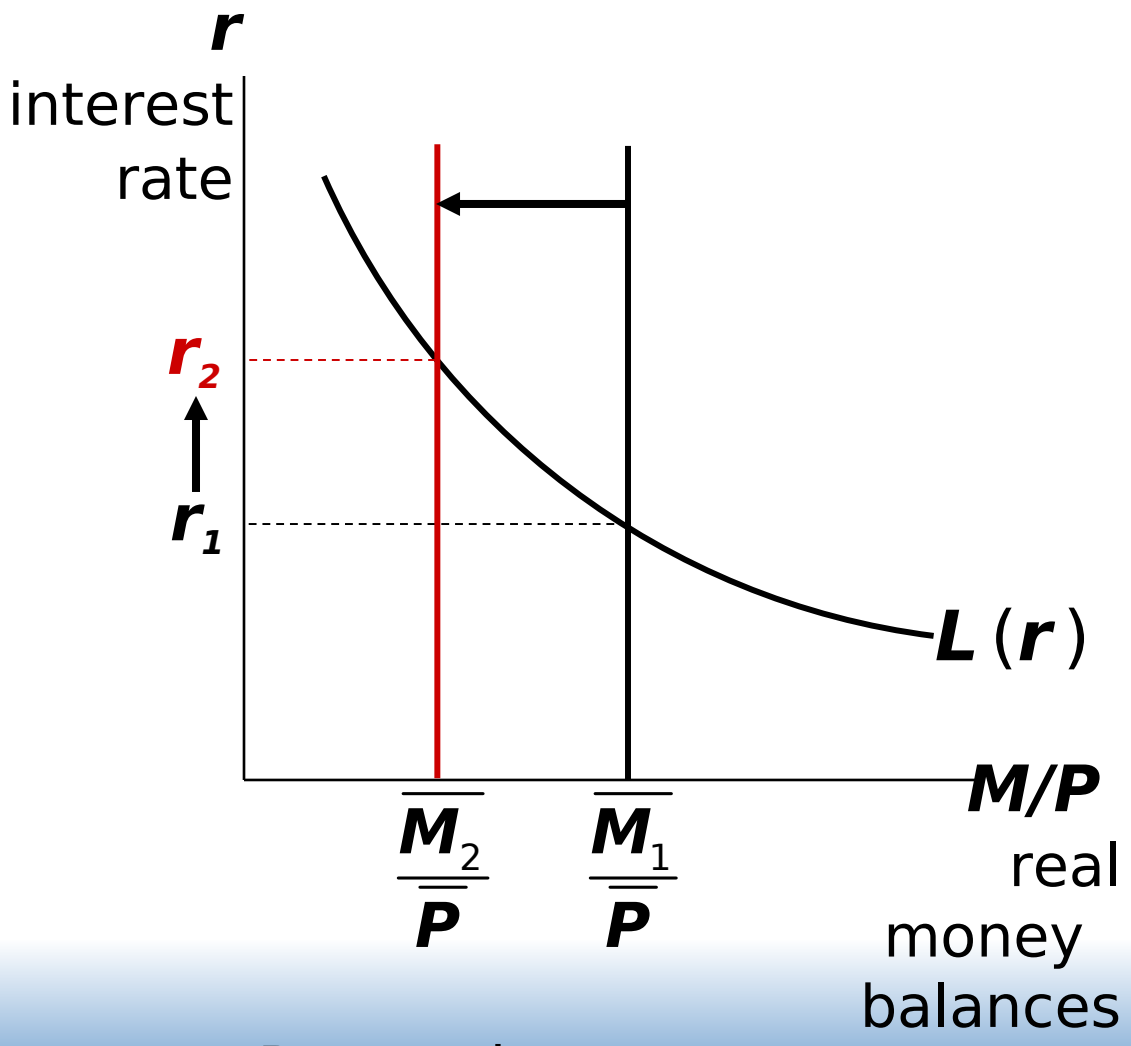
The interest rate adjusts to equate the supply and demand for money:

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



How the Fed raises the interest rate

To increase ***r***, Fed reduces ***M***



CASE STUDY

Volcker's Monetary Tightening

- Late 1970s: $\pi > 10\%$
- Oct 1979: Fed Chairman Paul Volcker announced 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 interest rates?

Volcker's Monetary Tightening, *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: $i = 15.8\%$	1/1983: $i = 8.2\%$

The LM curve

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

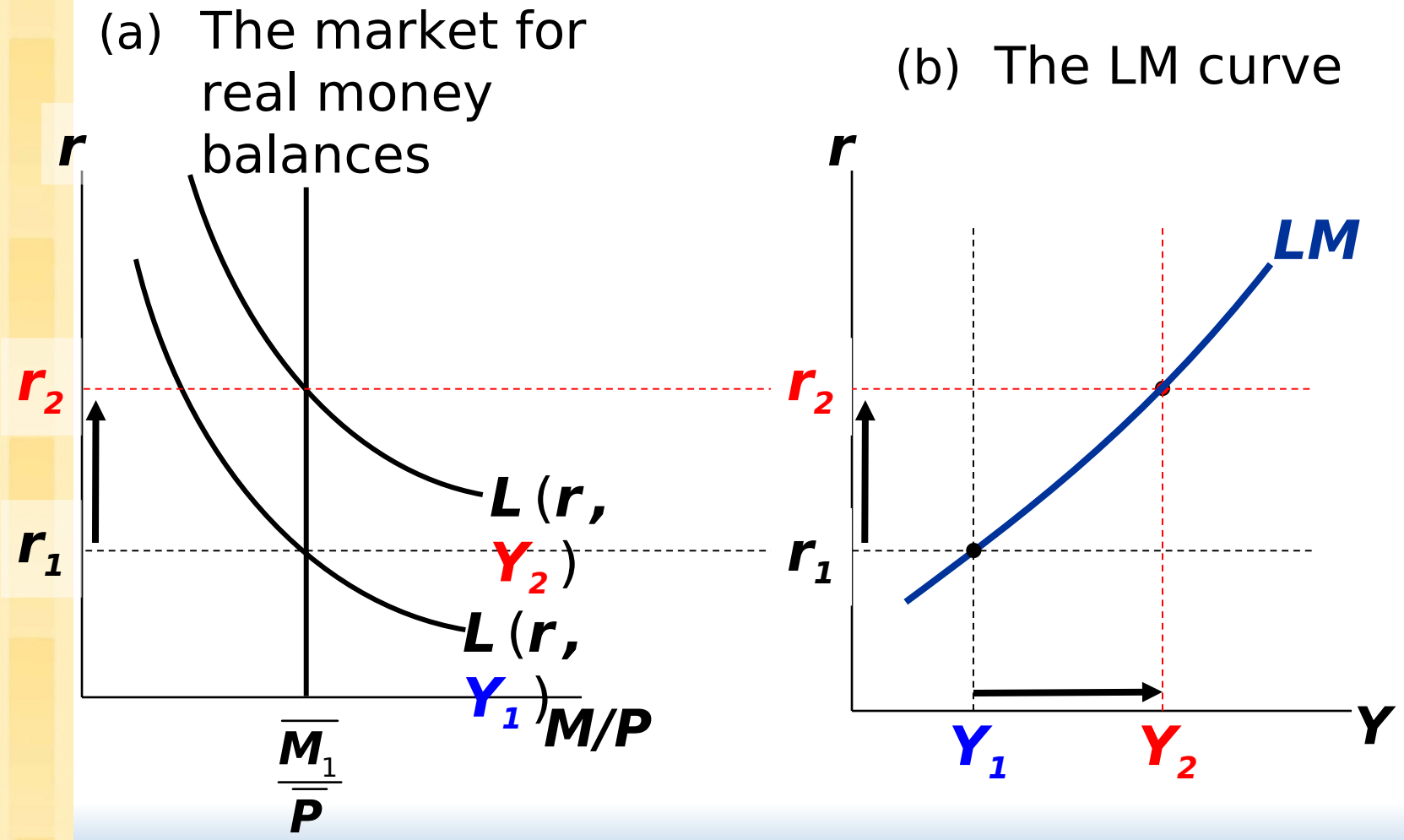
$$(M/P)^d = L(r, Y)$$

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:

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

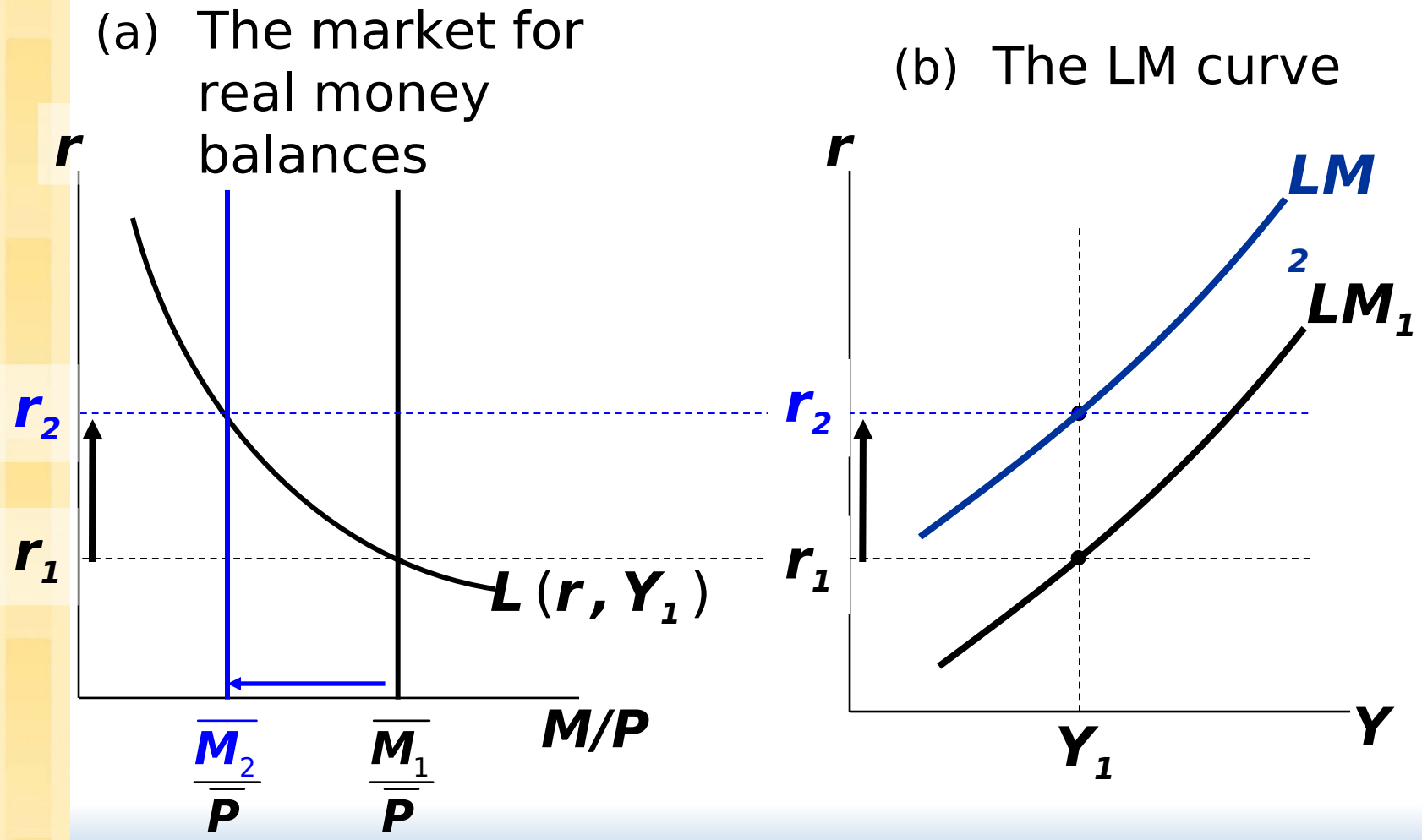
Deriving the LM curve



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



Exercise: Shifting the LM curve

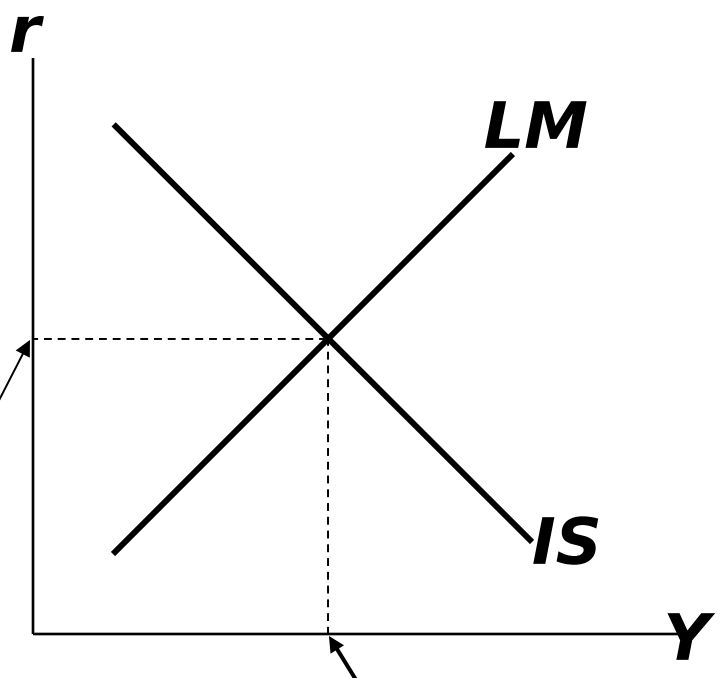
- Suppose a wave of credit card fraud causes consumers to use cash more frequently in transactions.
- Use the Liquidity Preference model to show how these events shift the *LM* curve.

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:

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

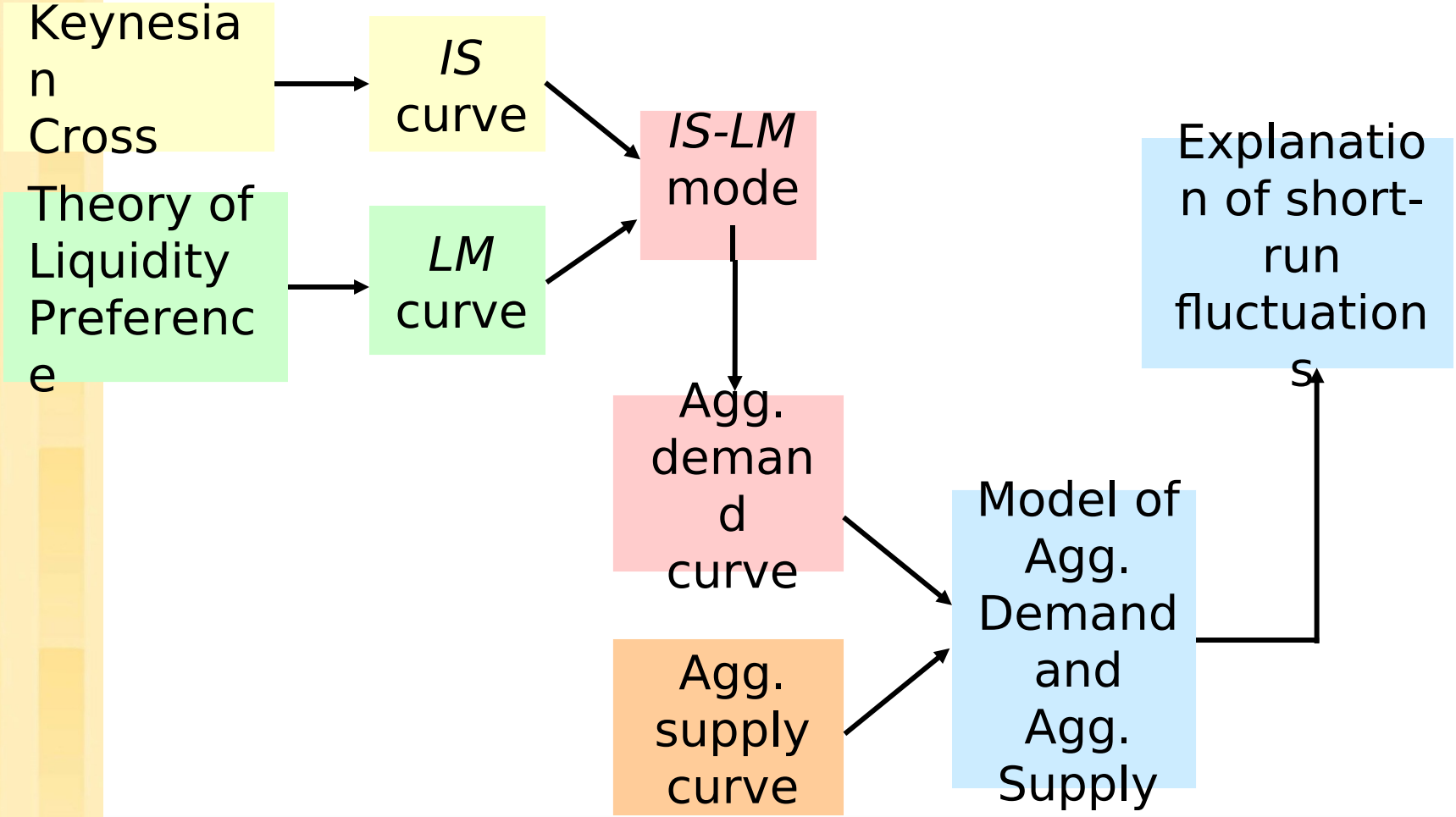
$$\bar{M}/\bar{P} = L(r, Y)$$



Equilibrium interest rate

Equilibrium level of income

The Big Picture



Chapter summary

1. Keynesian Cross
   - basic model of income determination
   - takes fiscal policy & investment as exogenous
   - fiscal policy has a 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.

Preview of Chapter 3

In Chapter 3, 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

Context

- In the next section, we will use the IS-LM model to
  - see how policies and shocks affect income and the interest rate in the short run when prices are fixed
  - derive the aggregate demand curve
  - explore various explanations for the Great Depression

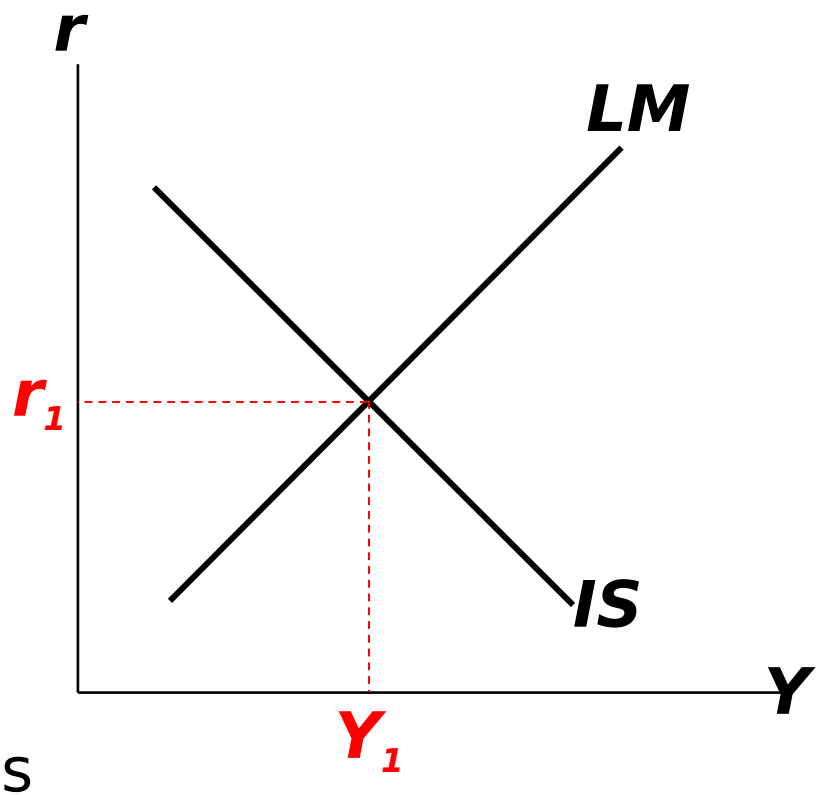
Equilibrium in the *IS*-*LM* Model

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

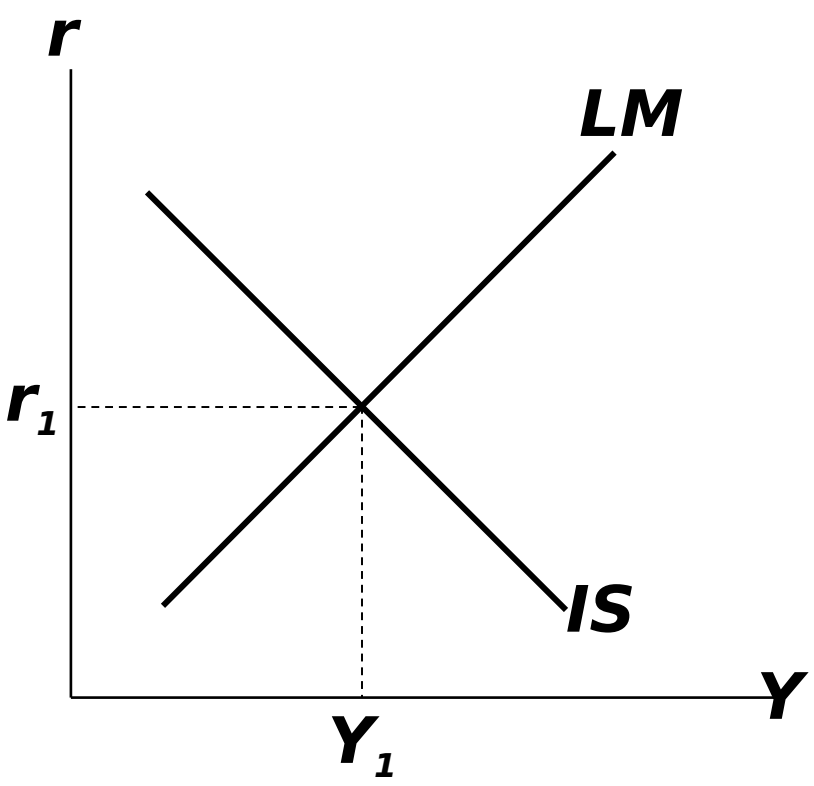
$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

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

Policymakers can affect macroeconomic variables with

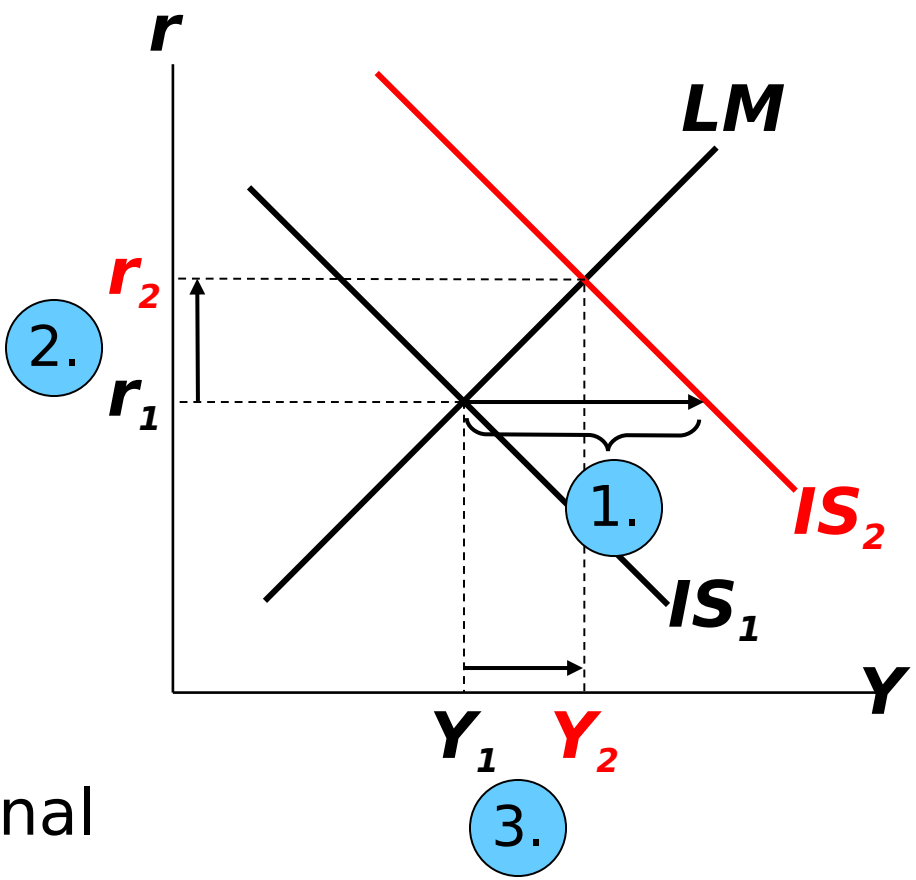
- fiscal policy: G and/or T
- monetary policy: M

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



An increase in government purchases

1. *IS* curve shifts right by $\frac{1}{1- MPC} \Delta G$ 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 $\frac{1}{1- MPC} \Delta G$

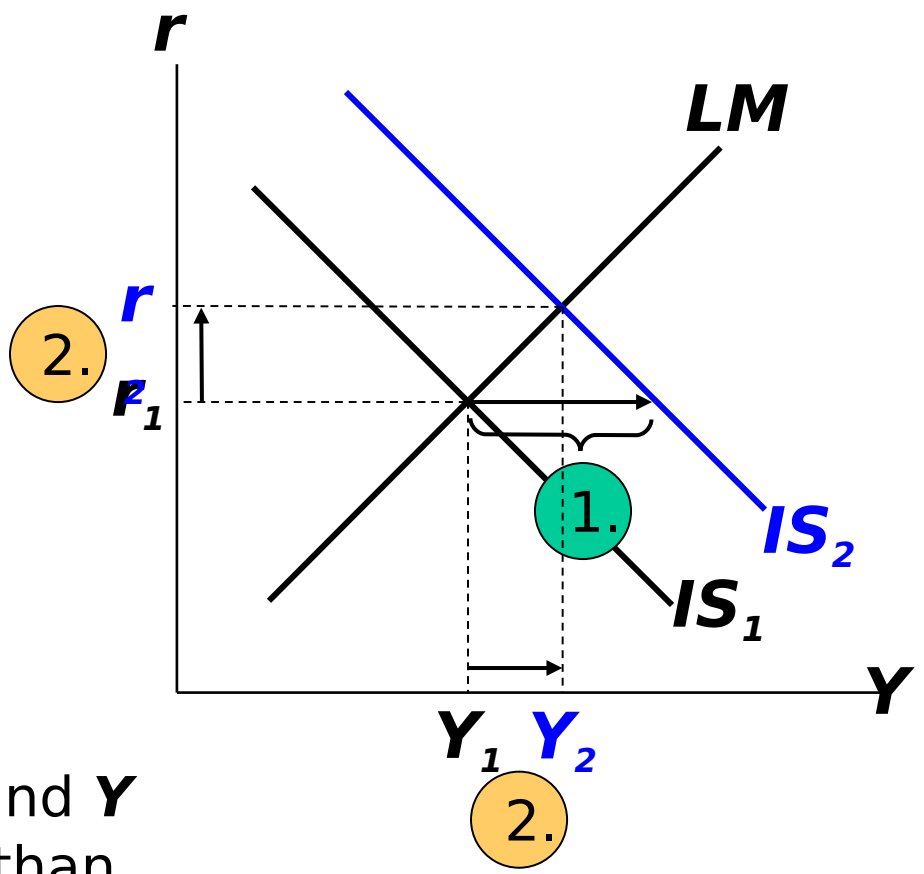


A tax cut

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

and the *IS* curve shifts by

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



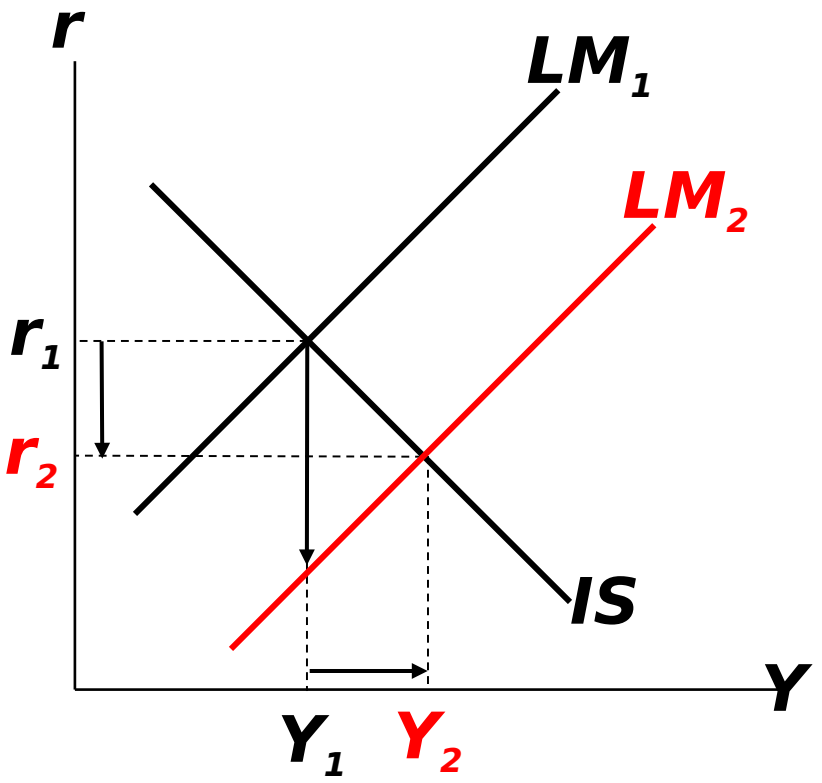
2. …so the effects on r and Y are smaller for a ΔT than for an equal ΔG.

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

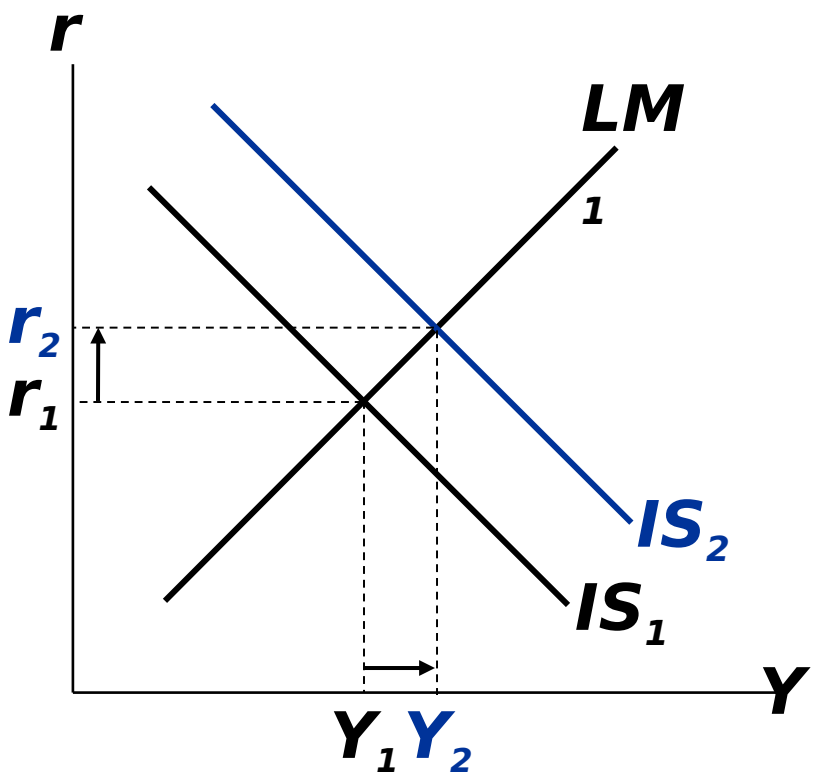
If Congress raises ***G***, the *IS* curve shifts right

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

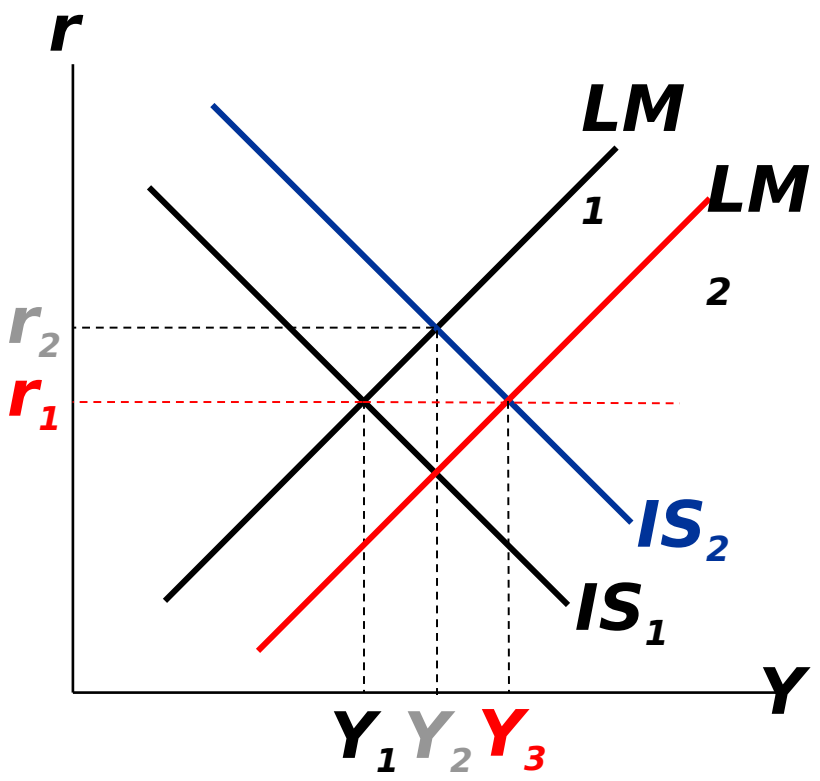
If Congress raises ***G***,
the *IS* curve shifts right

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

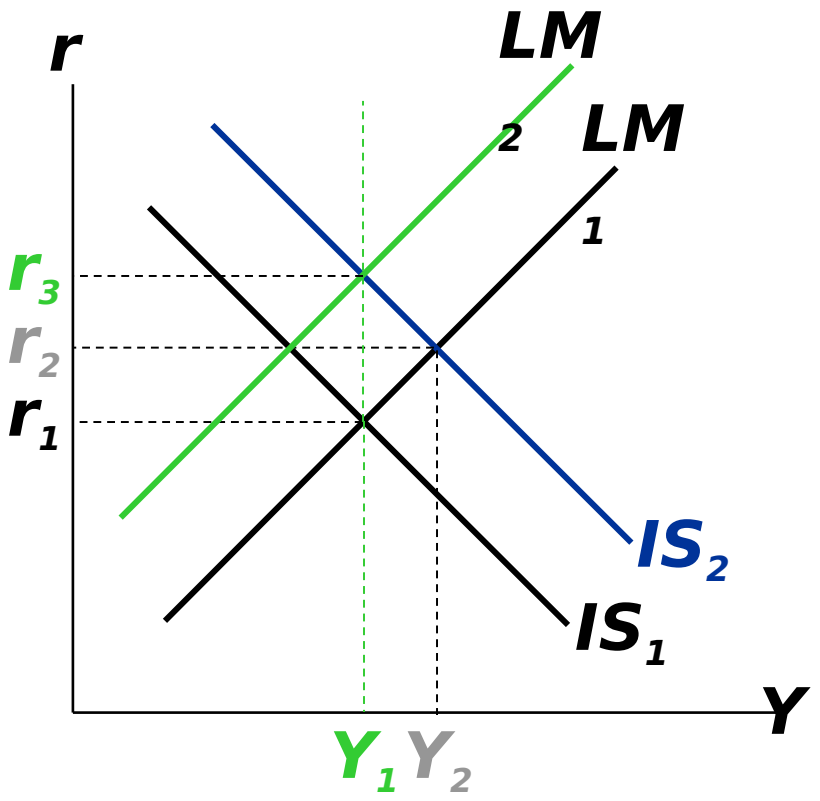
If Congress raises ***G***,
the *IS* curve shifts right

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

Shocks in the *IS-LM* Model

***IS* shocks**: exogenous changes in the demand for goods & services.

Examples:

- stock market boom or crash
  ⇒ change in households' wealth
  ⇒ ΔC
- change in business or consumer confidence or expectations
  ⇒ ΔI and/or ΔC

Shocks in the *IS-LM* Model

***LM* shocks**: exogenous changes in the demand for money.

Examples:

- a wave of credit card fraud increases demand for money
- more ATMs or the Internet reduce money demand

EXERCISE: *Analyze shocks with the IS-LM model*

Use the *IS-LM* model to analyze the effects of

1. A boom in the stock market makes consumers wealthier.
2. After a wave of credit card fraud, consumers use cash more frequently in transactions.

For each shock,

a. use the *IS-LM* diagram to show the effects of the shock on ***Y*** and ***r***.
b. determine what happens to ***C***, ***I***, and the unemployment rate.

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 the *LM* curve 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:

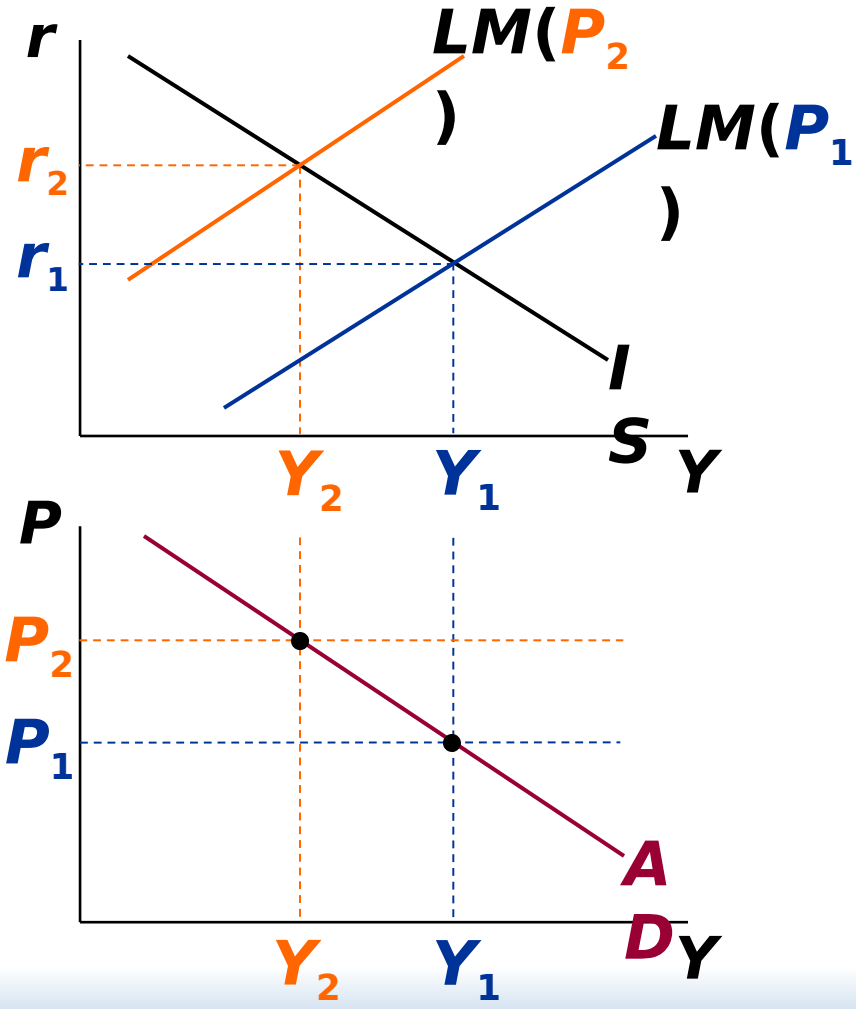
$\uparrow P \Rightarrow \downarrow (M/P)$

$\Rightarrow$ *LM* shifts left

$\Rightarrow \uparrow r$

$\Rightarrow \downarrow I$

$\Rightarrow \downarrow Y$



Monetary policy and the *AD* curve

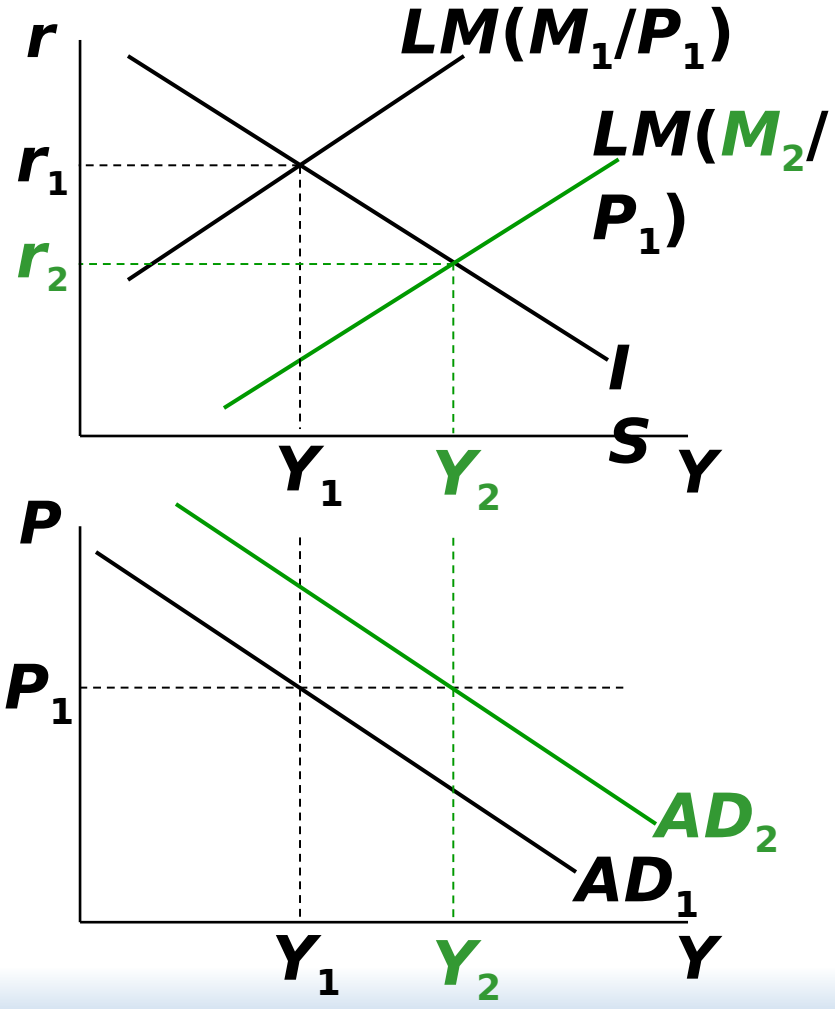
The Fed can increase aggregate demand:

↑**M** ⇒ *LM* shifts right

⇒ ↓**r**

⇒ ↑**I**

⇒ ↑**Y** at each value of **P**



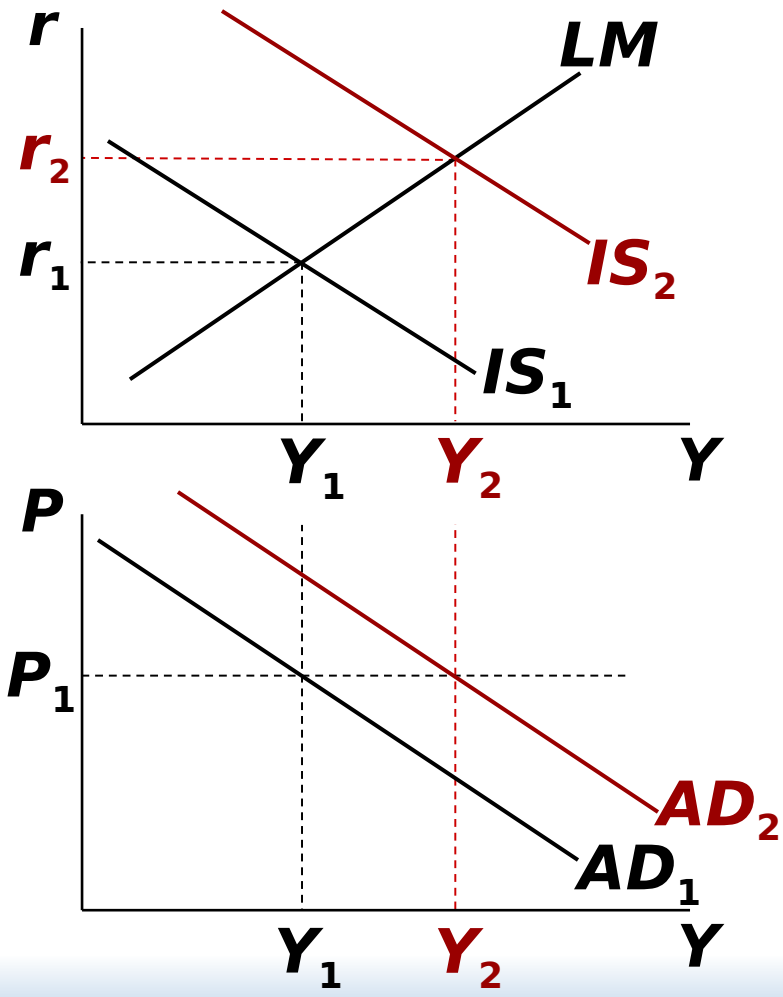
Fiscal policy and the *AD* curve

Expansionary fiscal policy (↑***G*** and/or ↓***T***) increases agg. demand:

↓***T*** ⇒ ↑***C***

⇒ IS shifts right

⇒ ↑***Y*** at each value of ***P***



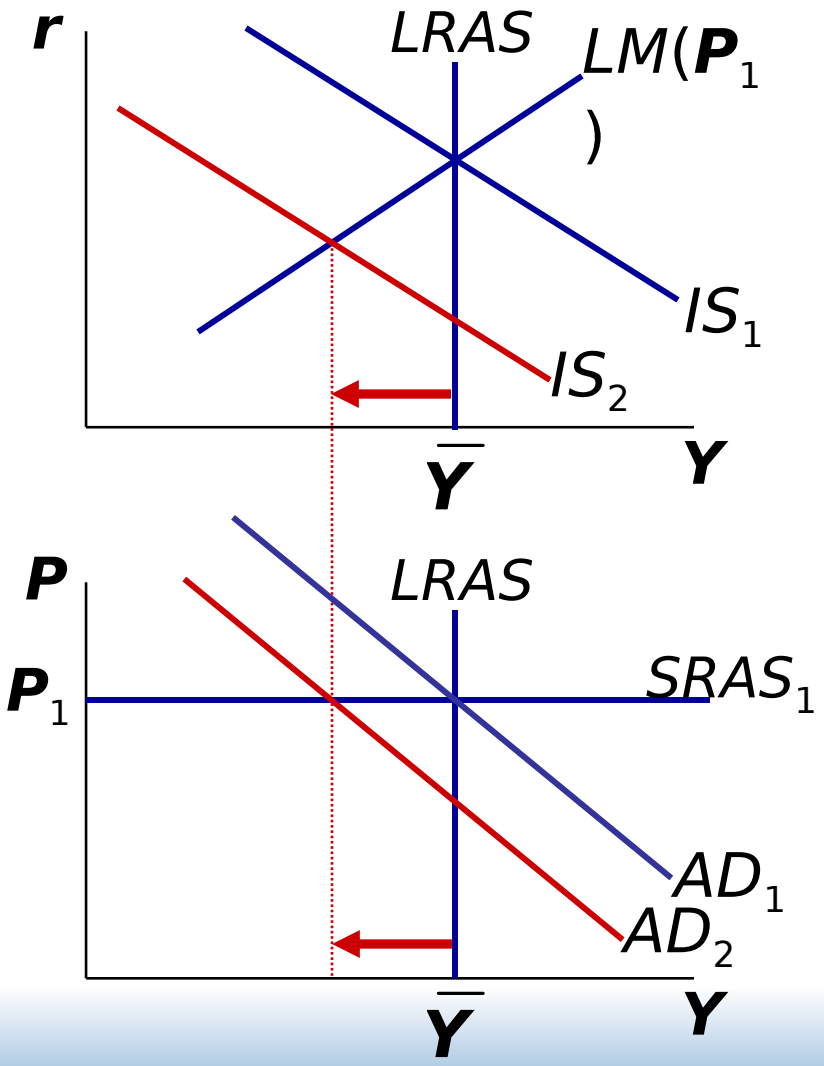
IS-LM and *AD-AS* in the short run & long run

Recall : 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
$Y > \bar{Y}$	will rise
$Y < \bar{Y}$	fall
$Y = \bar{Y}$	remain constant

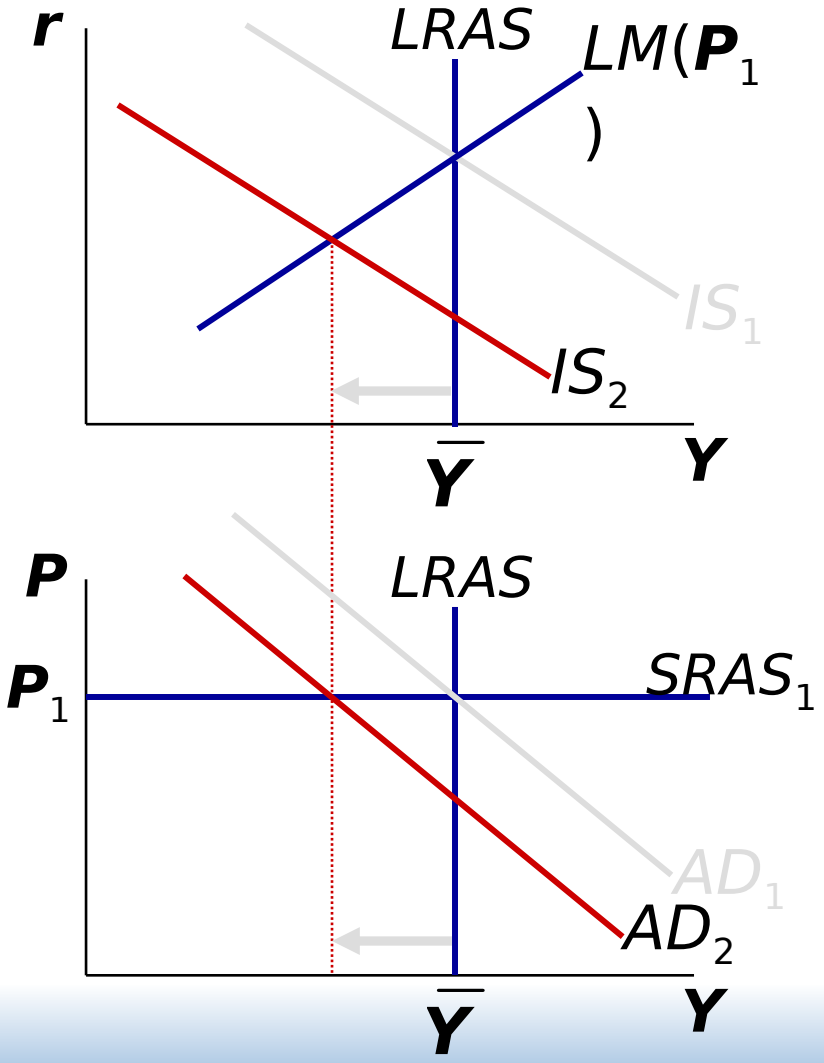
The SR and LR effects of an *IS* shock

A negative *IS* shock shifts *IS* and *AD* left, causing **Y** to fall.



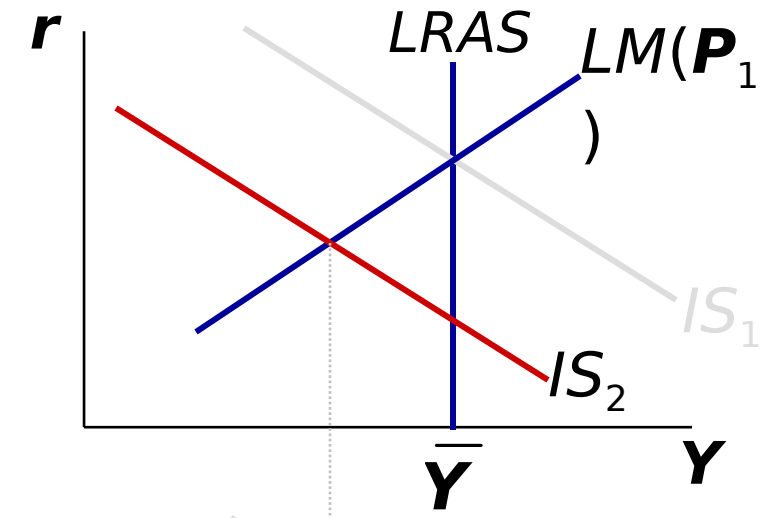
The SR and LR effects of an *IS* shock

In the new short-run equilibrium, $Y < \overline{Y}$

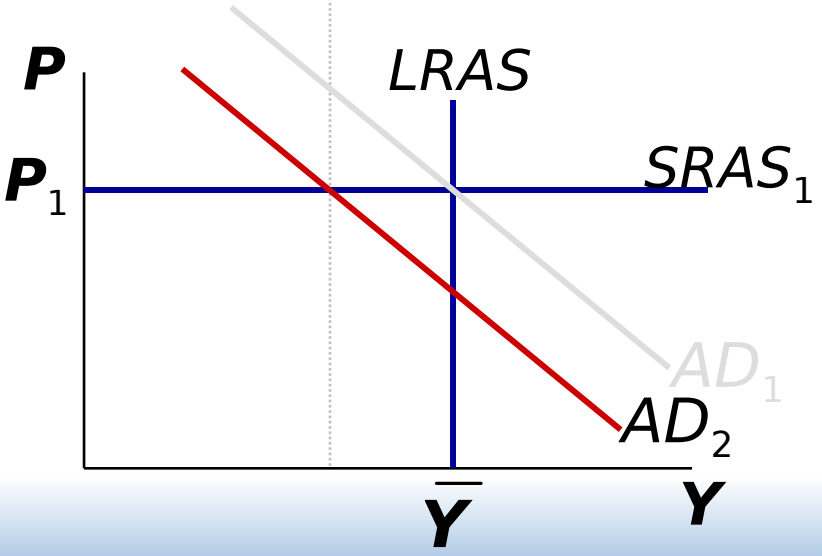


The SR and LR effects of an *IS* shock

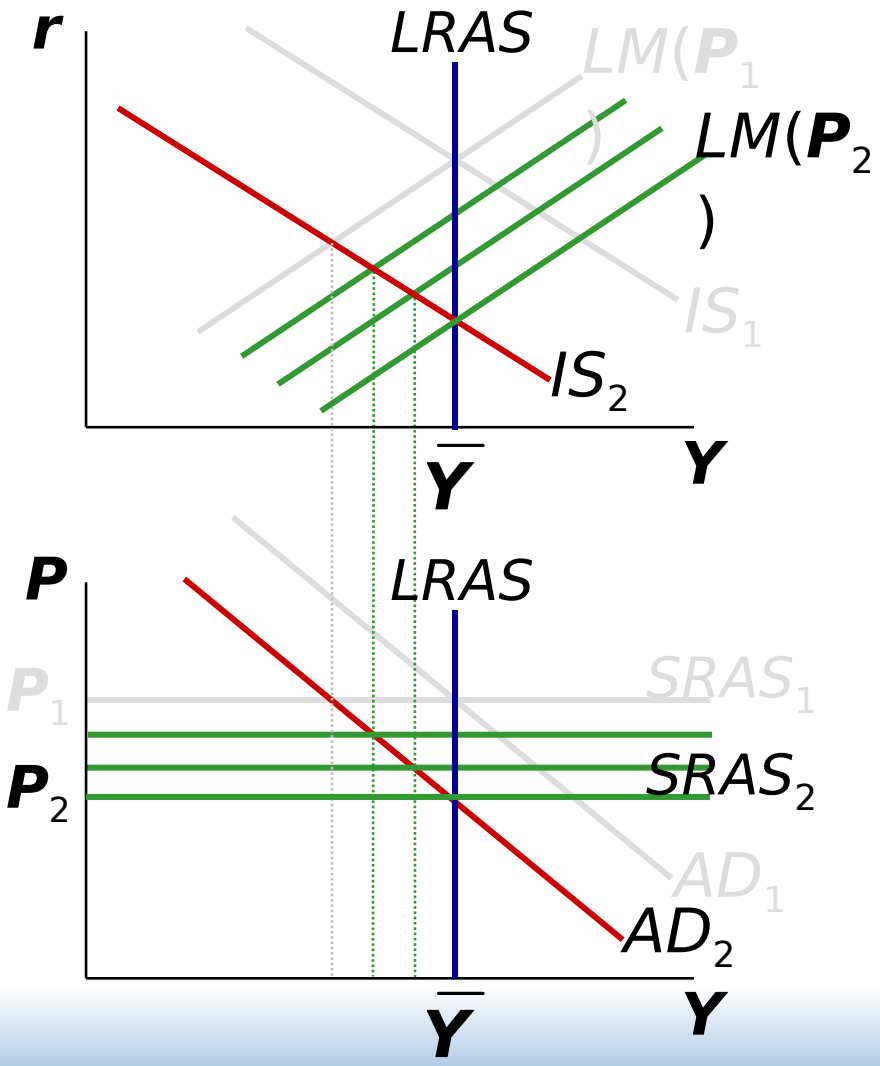
In the new short-run equilibrium, $Y < \bar{Y}$



Over time,
P gradually falls,
which causes
- *SRAS* to move down
- ***M/P*** to increase, which causes *LM* to move down



The SR and LR effects of an *IS* shock

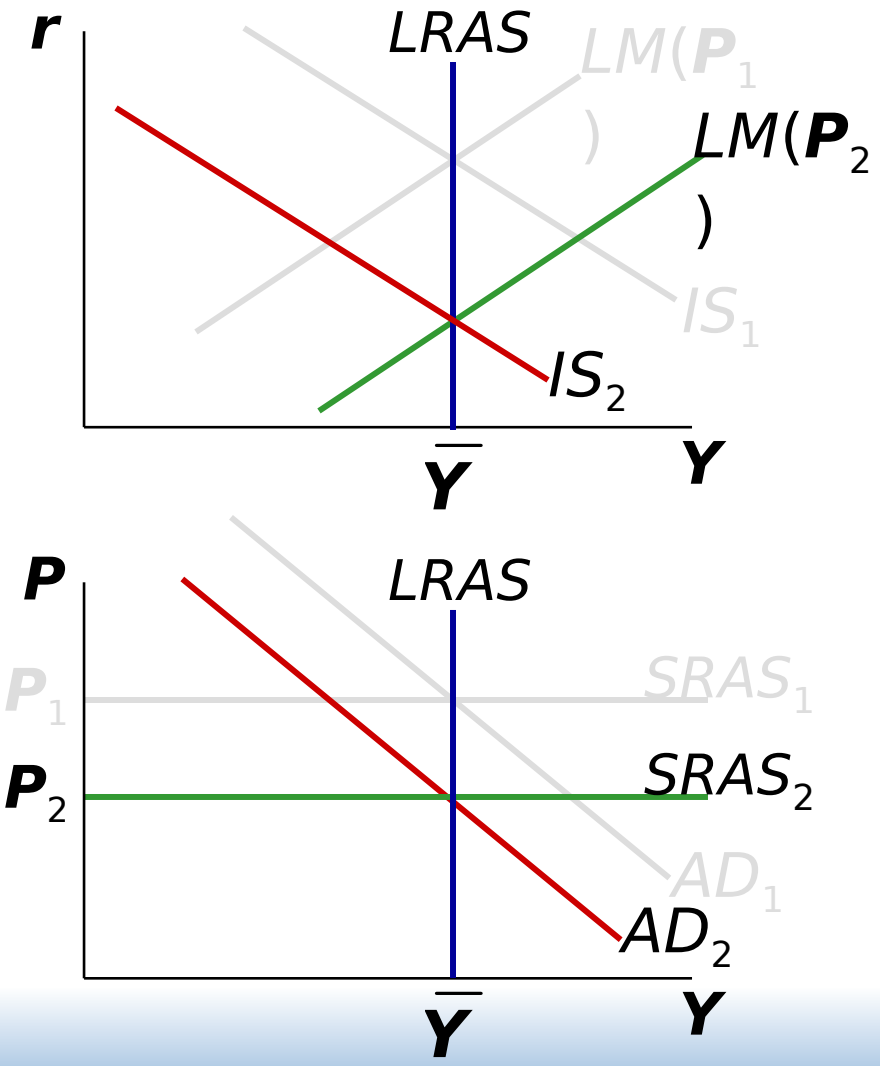


Over time,
P gradually falls,
which causes

- *SRAS* to move down
- ***M/P*** to increase, which causes *LM* to move down

The SR and LR effects of an *IS* shock

This process continues until economy reaches a long-run equilibrium with $Y = \overline{Y}$



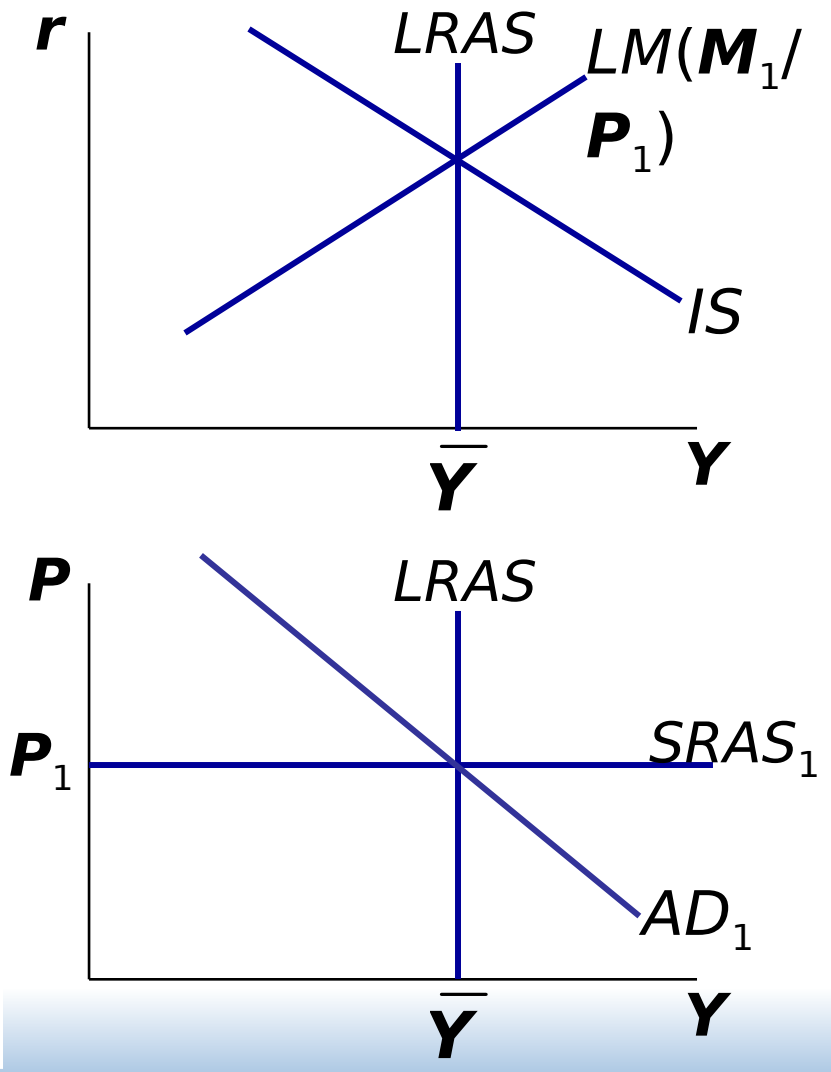
EXERCISE: *Analyze SR & LR effects of* ΔM

a. Draw the *IS-LM* and *AD-AS* diagrams as shown here.

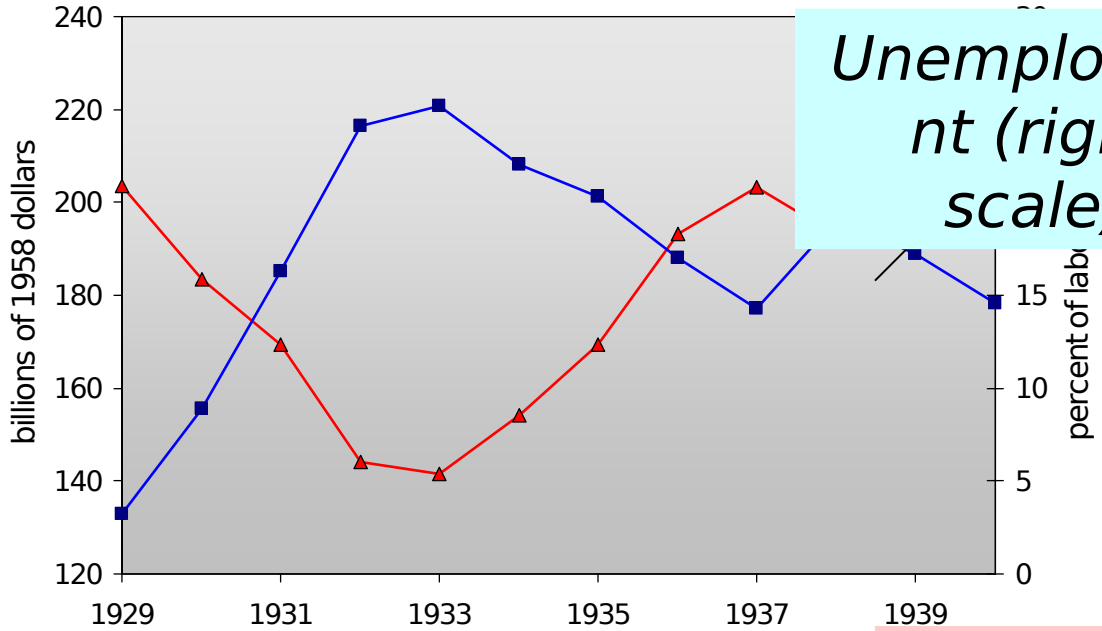
b. Suppose Fed increases ***M***. Show the short-run effects on your graphs.

c. Show what happens in the transition from the short run to the long run.

d. How do the new long-run equilibrium values of the endogenous variables compare to their initial values?



The Great Depression



Unemployment (right scale)

Real GNP (left scale)

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*

1. Stock market crash ⇒ exogenous ↓***C***
   - Oct-Dec 1929: S&P 500 fell 17%
   - Oct 1929-Dec 1933: S&P 500 fell 71%
2. Drop in investment
   - "correction" after overbuilding in the 1920s
   - widespread bank failures made it harder to obtain financing for investment
3. Contractionary fiscal policy
   - in the face of falling tax revenues and increasing deficits, politicians raised tax rates and cut spending

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:

1. ***P*** fell even more, so ***M/P*** actually rose slightly during 1929-31.
2. nominal interest rates fell, which is the opposite of what would result from a leftward *LM* shift.

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 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

The Money Hypothesis Again: *The Effects of Falling Prices*

The destabilizing effects of <u>expected</u> 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 $\downarrow$

Why another Depression is unlikely

- Policymakers (or their advisors) now know much more about macroeconomics:
  - The Fed knows better than to let ***M*** fall so much, especially during a contraction.
  - Fiscal policymakers know better than to raise taxes or cut spending during a contraction.
- Federal deposit insurance makes widespread bank failures very unlikely.
- **Automatic stabilizers** make fiscal policy expansionary during an economic downturn.

Chapter summary

1. *IS-LM* model
   - a theory of aggregate demand
   - exogenous: ***M***, ***G***, ***T***, ***P*** exogenous in short run, ***Y*** in long run
   - endogenous: ***r***, ***Y*** endogenous in short run, ***P*** in long run
   - *IS* curve: goods market equilibrium
   - *LM* curve: money market equilibrium

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