

# MACROECONOMICS

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PowerPoint® Slides by Ron Cronovich

SEVENTH EDITION

## CHAPTER 3

# National Income: Where it Comes From and Where it Goes

# In this chapter, you will learn:

- what determines the economy's total output/income
- how the prices of the factors of production are determined
- how total income is distributed
- what determines the demand for goods and services
- how equilibrium in the goods market is achieved

# Outline of model

A closed economy, market-clearing model

- Supply side
  - factor markets (supply, demand, price)
  - determination of output/income
- Demand side
  - determinants of C, I, and G
- Equilibrium
  - goods market
  - loanable funds market

# Factors of production

**$K$**  = capital:  
tools, machines, and structures used in  
production

**$L$**  = labor:  
the physical and mental efforts of  
workers

# The production function: $Y = F(K,L)$

- shows how much output ( $Y$ ) the economy can produce from  $K$  units of capital and  $L$  units of labor
- reflects the economy's level of technology
- exhibits constant returns to scale

# Returns to scale: A review

Initially  $Y_1 = F(K_1, L_1)$

Scale all inputs by the same factor  $z$ :

$$K_2 = zK_1 \text{ and } L_2 = zL_1$$

(e.g., if  $z = 1.2$ , then all inputs are increased by 20%)

What happens to output,  $Y_2 = F(K_2, L_2)$ ?

- If **constant returns to scale**,  $Y_2 = zY_1$

# Assumptions

1. Technology is fixed.
2. The economy's supplies of capital and labor are fixed at

$$K = \bar{K} \quad \text{and} \quad L = \bar{L}$$

# Determining GDP

Output is determined by the fixed factor supplies and the fixed state of technology:

$$\bar{Y} = F(\bar{K}, \bar{L})$$



# The distribution of national income

- determined by **factor prices**,  
the prices per unit firms pay for the factors of production
  - wage = price of  $L$
  - **rental rate** = price of  $K$

# Notation

**$W$**  = nominal wage

**$R$**  = nominal rental rate

**$P$**  = price of output

**$W/P$**  = real wage  
(measured in units of output)

**$R/P$**  = real rental rate

# How factor prices are determined

- Factor prices are determined by supply and demand in factor markets.
- Recall: Supply of each factor is fixed.
- What about demand?

# Demand for labor

- Assume markets are competitive:  
each firm takes  $W$ ,  $R$ , and  $P$  as given.
- Basic idea:  
A firm hires each unit of labor  
if the cost does not exceed the benefit.
  - cost = real wage
  - benefit = marginal product of labor

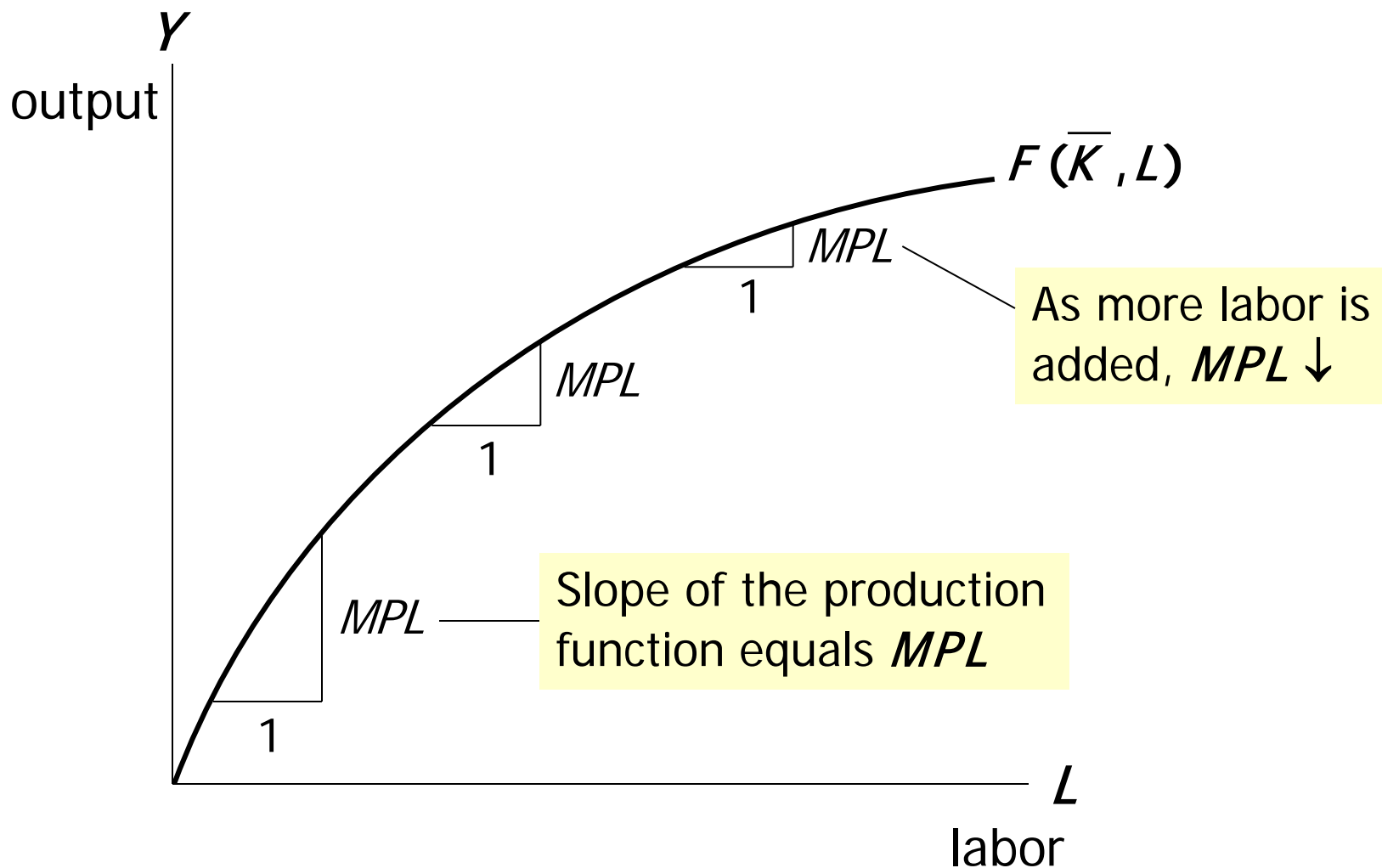
# Marginal product of labor (*MPL*)

- definition:

The extra output the firm can produce using an additional unit of labor (holding other inputs fixed):

$$MPL = F_L(K, L)$$

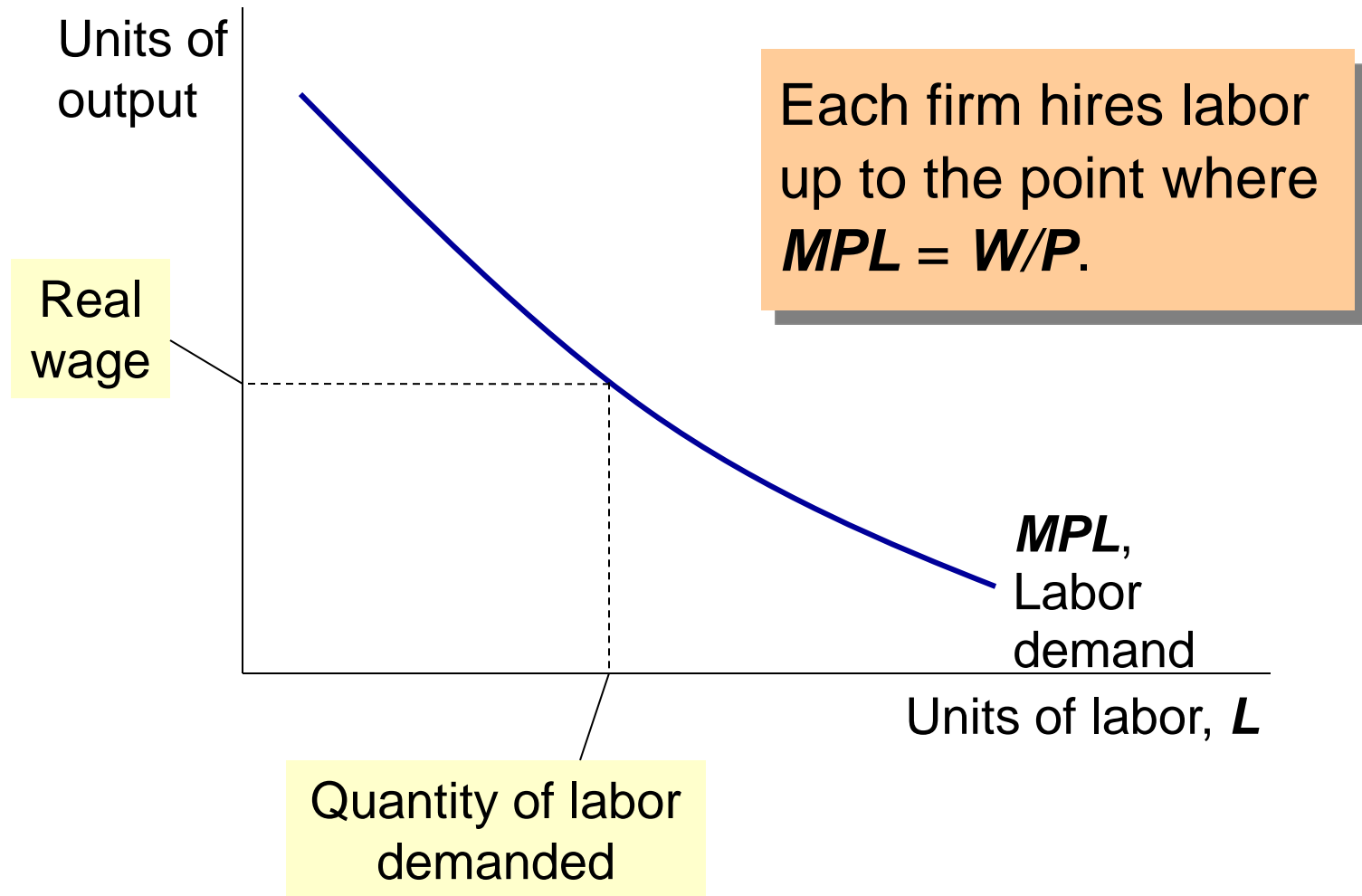
# MPL and the production function



# Diminishing marginal returns

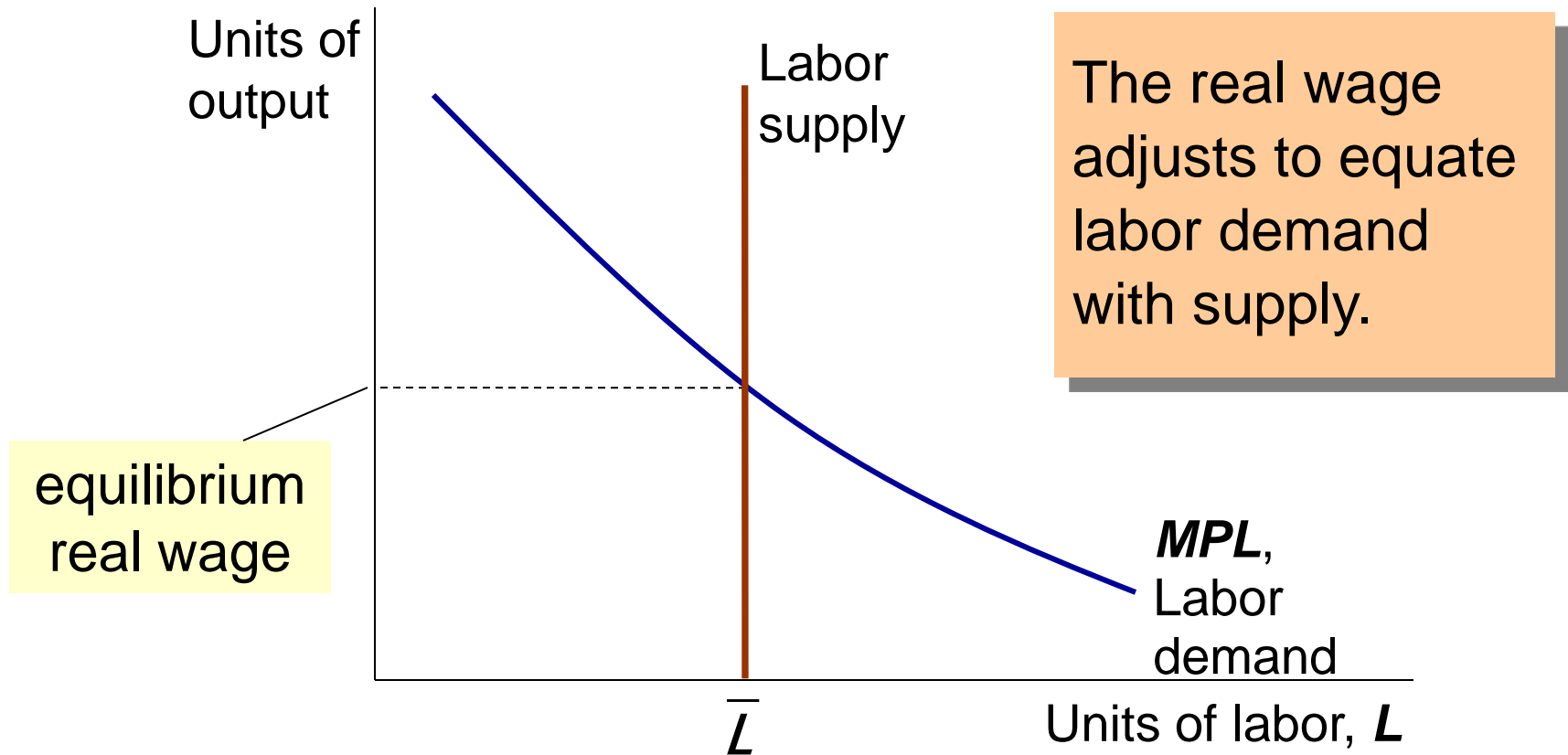
- As a factor input is increased, its marginal product falls (other things equal).
- Intuition:  
Suppose  $\uparrow L$  while holding  $K$  fixed  
 $\Rightarrow$  fewer machines per worker  
 $\Rightarrow$  lower worker productivity

# *MPL* and the demand for labor





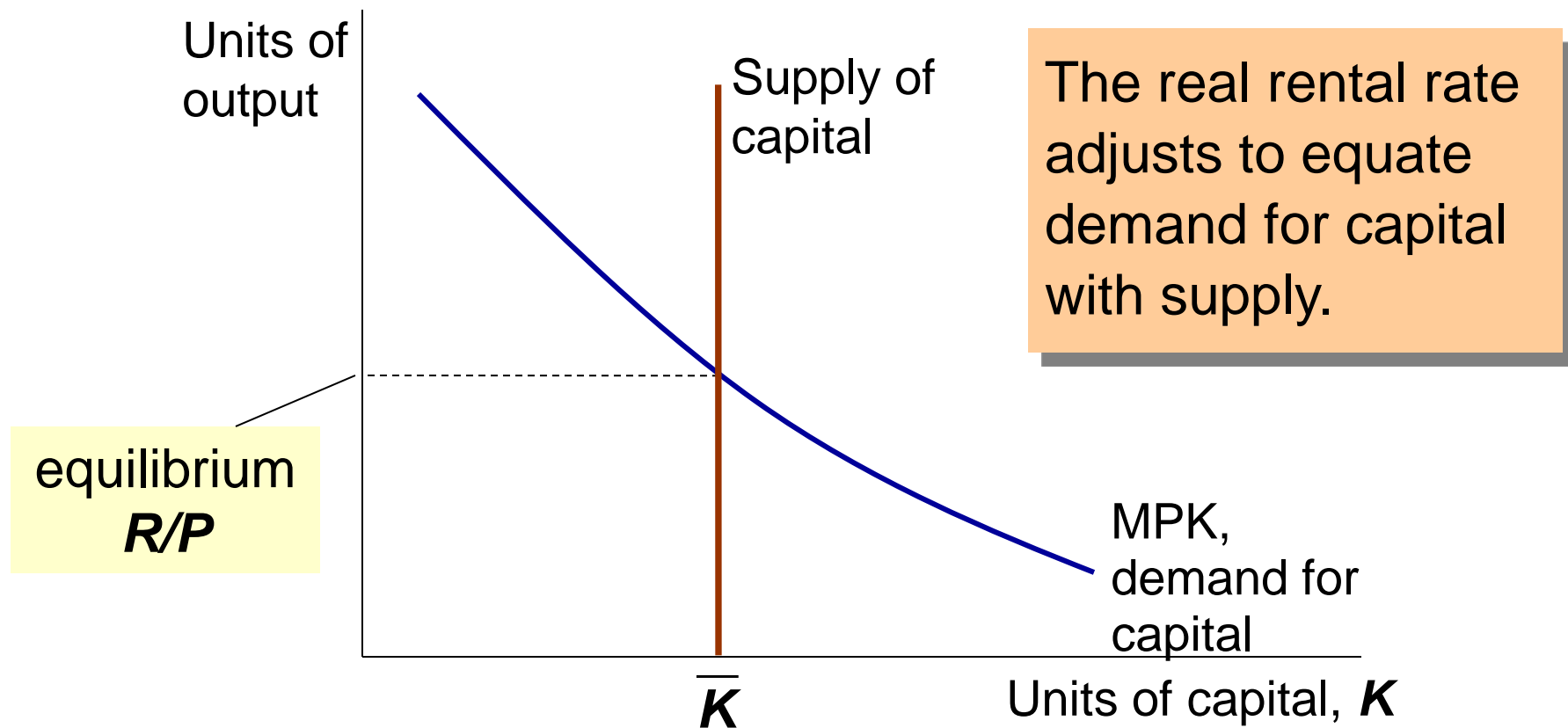
# The equilibrium real wage



# Determining the rental rate

- We have just seen that  $MPL = W/P$ .
- The same logic shows that  $MPK = R/P$ :
  - diminishing returns to capital:  $MPK \downarrow$  as  $K \uparrow$
  - The  $MPK$  curve is the firm's demand curve for renting capital.
  - Firms maximize profits by choosing  $K$  such that  $MPK = R/P$ .

# The equilibrium real rental rate



# The Neoclassical Theory of Distribution

- states that each factor input is paid its marginal product
- a good starting point for thinking about income distribution

# How income is distributed to L and K

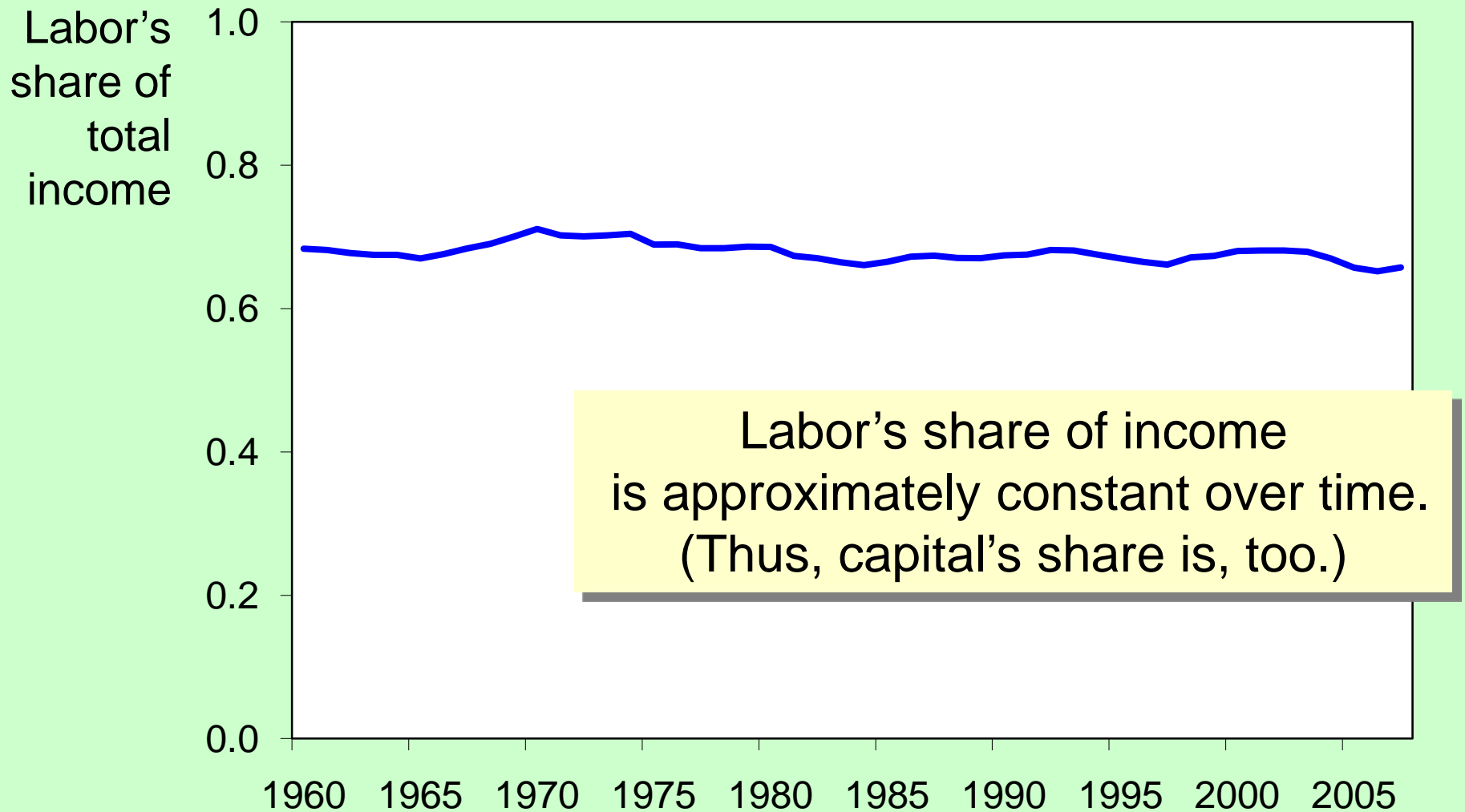
$$\text{total labor income} = \frac{W}{P} \bar{L} = \mathbf{MPL} \times \bar{L}$$

$$\text{total capital income} = \frac{R}{P} \bar{K} = \mathbf{MPK} \times \bar{K}$$

If production function has constant returns to scale, then

$$\begin{array}{ccccc} \bar{Y} & = & \mathbf{MPL} \times \bar{L} & + & \mathbf{MPK} \times \bar{K} \\ \swarrow & & \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} \\ \text{national} & & \text{labor} & & \text{capital} \\ \text{income} & & \text{income} & & \text{income} \end{array}$$

# The ratio of labor income to total income in the U.S., 1960-2007



# The Cobb-Douglas Production Function

- The Cobb-Douglas production function has constant factor shares:

$\alpha$  = capital's share of total income:

$$\text{capital income} = MPK \times K = \alpha Y$$

$$\text{labor income} = MPL \times L = (1 - \alpha) Y$$

- The Cobb-Douglas production function is:

$$Y = AK^\alpha L^{1-\alpha}$$

where  $A$  represents the level of technology.

# The Cobb-Douglas Production Function

- Each factor's marginal product is proportional to its average product:

$$MPK = \alpha AK^{\alpha-1} L^{1-\alpha} = \frac{\alpha Y}{K}$$

$$MPL = (1-\alpha) AK^{\alpha} L^{-\alpha} = \frac{(1-\alpha)Y}{L}$$



# Outline of model

## *A closed economy, market-clearing model*

### Supply side

**DONE** ✓ factor markets (supply, demand, price)

**DONE** ✓ determination of output/income

### Demand side

**Next** ➔ □ determinants of  $C$ ,  $I$ , and  $G$

### Equilibrium

□ goods market

□ loanable funds market

# Demand for goods & services

Components of aggregate demand:

$C$  = consumer demand for g & s

$I$  = demand for investment goods

$G$  = government demand for g & s

(closed economy: no  **$NX$** )

# Consumption, $C$

- def: **Disposable income** is total income minus total taxes:  $Y - T$ .
- Consumption function:  $C = C(Y - T)$   
Shows that  $\uparrow(Y - T) \Rightarrow \uparrow C$
- def: **Marginal propensity to consume (MPC)** is the change in  $C$  when disposable income increases by one dollar.

# Investment, $I$

- The investment function is  $I = I(r)$ ,  
where  $r$  denotes the **real interest rate**,  
the nominal interest rate corrected for inflation.
- The real interest rate is
  - the cost of borrowing
  - the opportunity cost of using one's own funds to finance investment spending

So,  $\uparrow r \Rightarrow \downarrow I$

# Government spending, $G$

- $G$  = govt spending on goods and services.
- $G$  excludes transfer payments  
(e.g., social security benefits,  
unemployment insurance benefits).
- Assume government spending and total taxes  
are exogenous:

$$G = \bar{G} \quad \text{and} \quad T = \bar{T}$$

# The market for goods & services

- Aggregate demand:  $C(\bar{Y} - \bar{T}) + I(r) + \bar{G}$

- Aggregate supply:  $\bar{Y} = F(\bar{K}, \bar{L})$

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

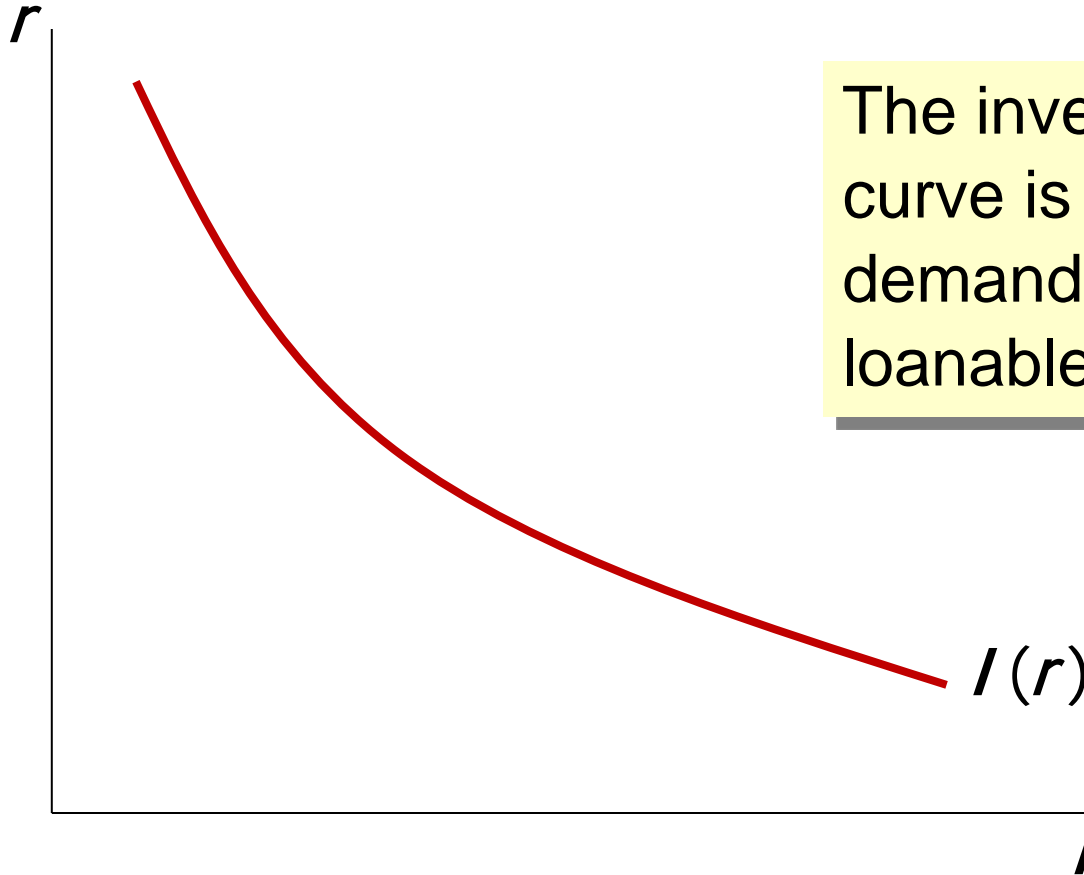


The real interest rate adjusts  
to equate demand with supply.

# The loanable funds market

- A simple supply-demand model of the financial system.
- One asset: “loanable funds”
  - demand for funds: investment
  - supply of funds: saving
  - “price” of funds: real interest rate

# Loanable funds demand curve



The investment curve is also the demand curve for loanable funds.



# Types of saving

$$\text{private saving} = (Y - T) - C$$

$$\text{public saving} = T - G$$

$$\text{national saving, } S$$

$$= \text{private saving} + \text{public saving}$$

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

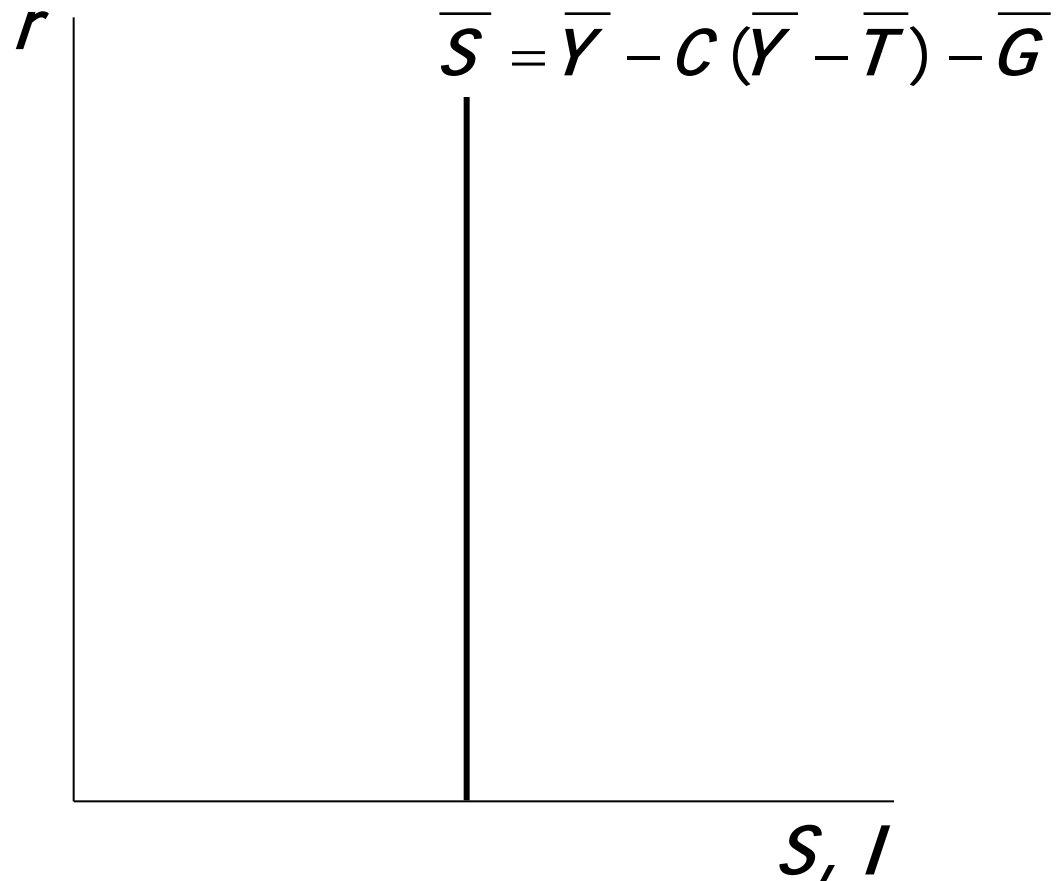
$$= Y - C - G$$

# Budget surpluses and deficits

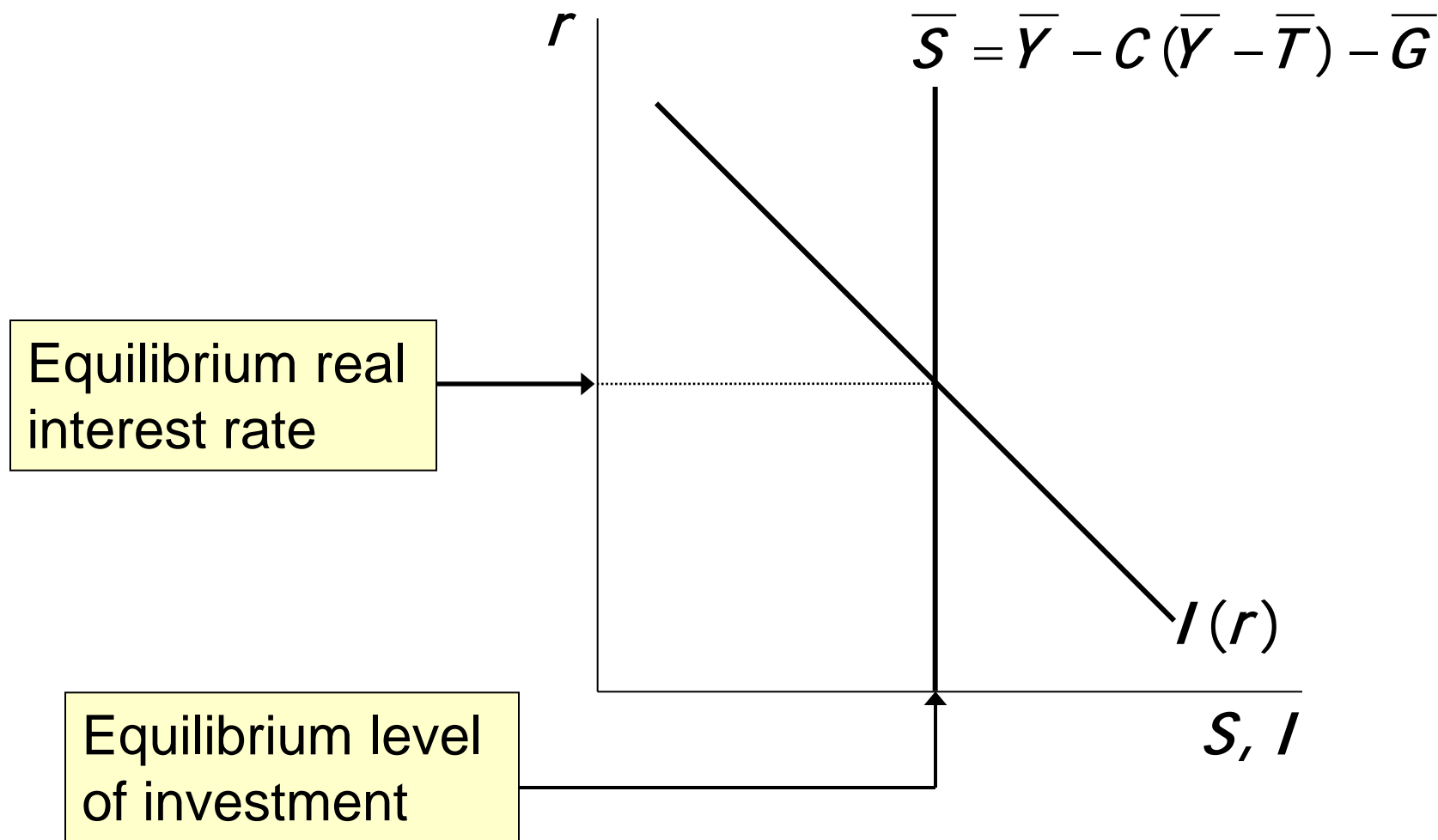
- If  $T > G$ , **budget surplus** =  $(T - G)$   
= public saving.
- If  $T < G$ , **budget deficit** =  $(G - T)$   
and public saving is negative.
- If  $T = G$ , “balanced budget,” public saving = 0.

# Loanable funds supply curve

National saving does not depend on  $r$ , so the supply curve is vertical.



# Loanable funds market equilibrium



# The special role of $r$

$r$  adjusts to equilibrate the goods market and the loanable funds market simultaneously:

If L.F. market in equilibrium, then

$$Y - C - G = I$$

Add  $(C + G)$  to both sides to get

$$Y = C + I + G \quad (\text{goods market eq'm})$$

Thus,

Eq'm in L.F.  
market



Eq'm in goods  
market

## CASE STUDY:

# The Reagan deficits

- Reagan policies during early 1980s:
  - increases in defense spending:  $\Delta \mathbf{G} > 0$
  - big tax cuts:  $\Delta \mathbf{T} < 0$
- Both policies reduce national saving:

$$\bar{S} = \bar{Y} - C(\bar{Y} - \bar{T}) - \bar{G}$$

$$\uparrow \bar{G} \Rightarrow \downarrow \bar{S}$$

$$\downarrow \bar{T} \Rightarrow \uparrow C \Rightarrow \downarrow \bar{S}$$

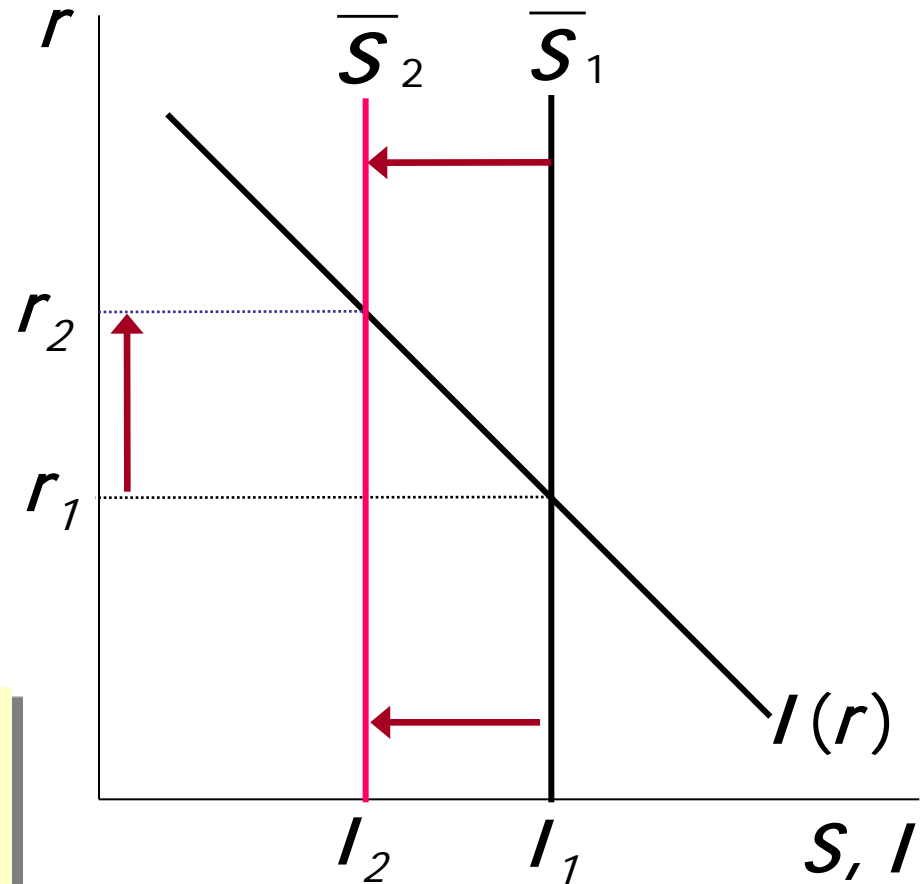
# CASE STUDY:

## The Reagan deficits

1. The increase in the deficit reduces saving...

2. ...which causes the real interest rate to rise...

3. ...which reduces the level of investment.



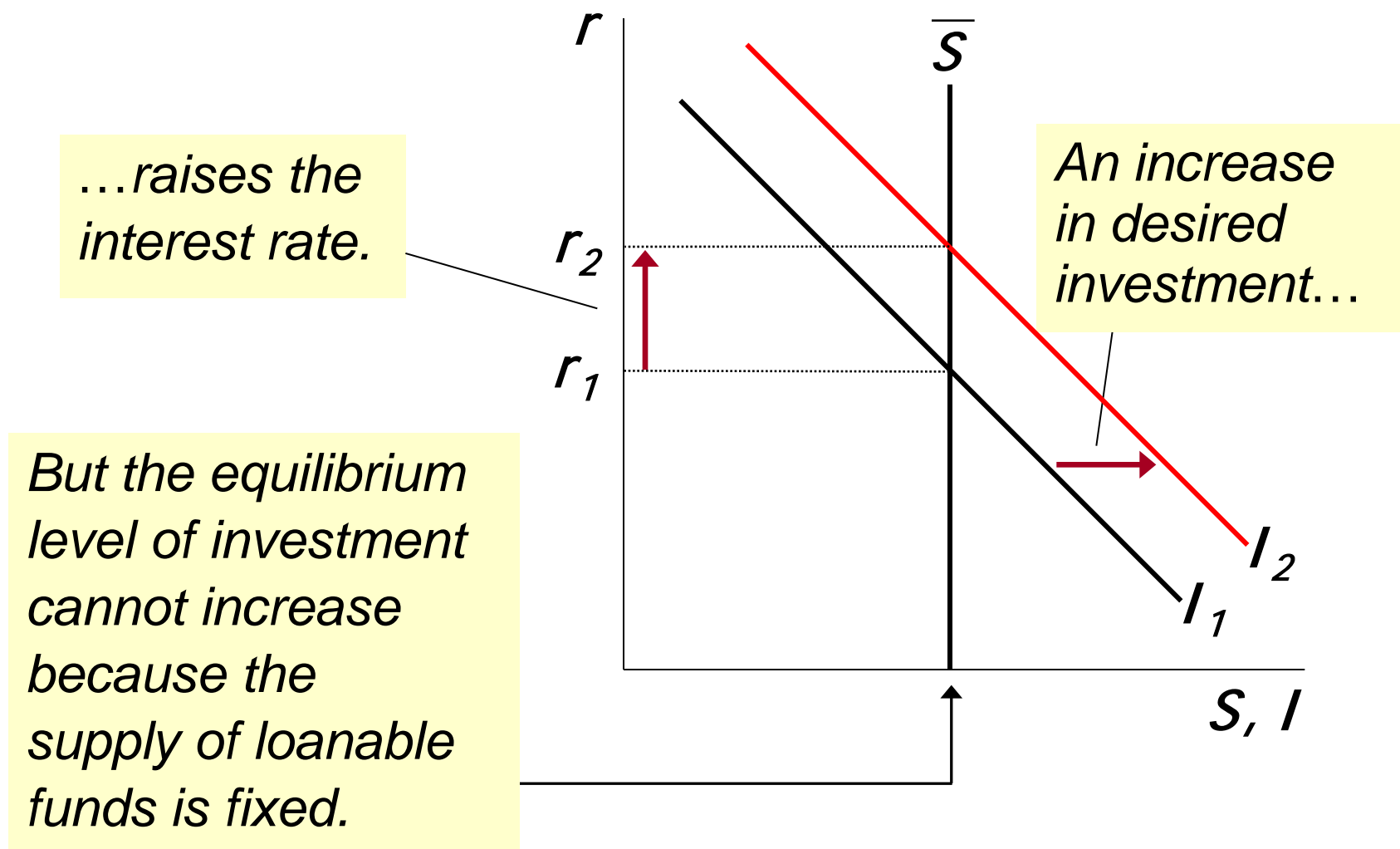
# Mastering the loanable funds model

Things that shift the investment curve:

- some technological innovations
  - to take advantage some innovations, firms must buy new investment goods
- tax laws that affect investment
  - *e.g.*, investment tax credit



# An increase in investment demand





# Chapter Summary

- Total output is determined by:
  - the economy's quantities of capital and labor
  - the level of technology
- Competitive firms hire each factor until its marginal product equals its price.
- If the production function has constant returns to scale, then labor income plus capital income equals total income (output).



# Chapter Summary

- A closed economy's output is used for:
  - consumption
  - investment
  - government spending
- The real interest rate adjusts to equate the demand for and supply of:
  - goods and services
  - loanable funds



# Chapter Summary

- A decrease in national saving causes the interest rate to rise and investment to fall.
- An increase in investment demand causes the interest rate to rise, but does not affect the equilibrium level of investment if the supply of loanable funds is fixed.