Chapter 9

The Analysis of Competitive Markets

Topics to be Discussed

- Evaluating the Gains and Losses from Government Policies--Consumer and Producer Surplus

- The Efficiency of a Competitive Market

- Minimum Prices

Topics to be Discussed

- Price Supports and Production Quotas

- Import Quotas and Tariffs

- The Impact of a Tax or Subsidy

- **Review**

  - Consumer surplus is the total benefit or value that consumers receive beyond what they pay for the good.

  - Producer surplus is the total benefit or revenue that producers receive beyond what it cost to produce a good.

Consumer and Producer Surplus

Price

10

Consumer
Surplus

S

7

5

**Between 0 and Q_0
consumers A and B
receive a net gain from
buying the product--
consumer surplus**

Producer
Surplus

**Between 0 and Q_0
producers receive
a net gain from
selling each product--
producer surplus.**

D

0

Q_0

Quantity

Consumer A   Consumer B   Consumer C

■ To determine the *welfare effect* of a governmental policy we can measure the gain or loss in consumer and producer surplus.

■ Welfare Effects

● Gains and losses caused by government intervention in the market.

Change in Consumer and Producer Surplus from Price Controls

Price

Suppose the government imposes a price ceiling P_{max} which is below the market-clearing price P_0.

S

Deadweight Loss

B
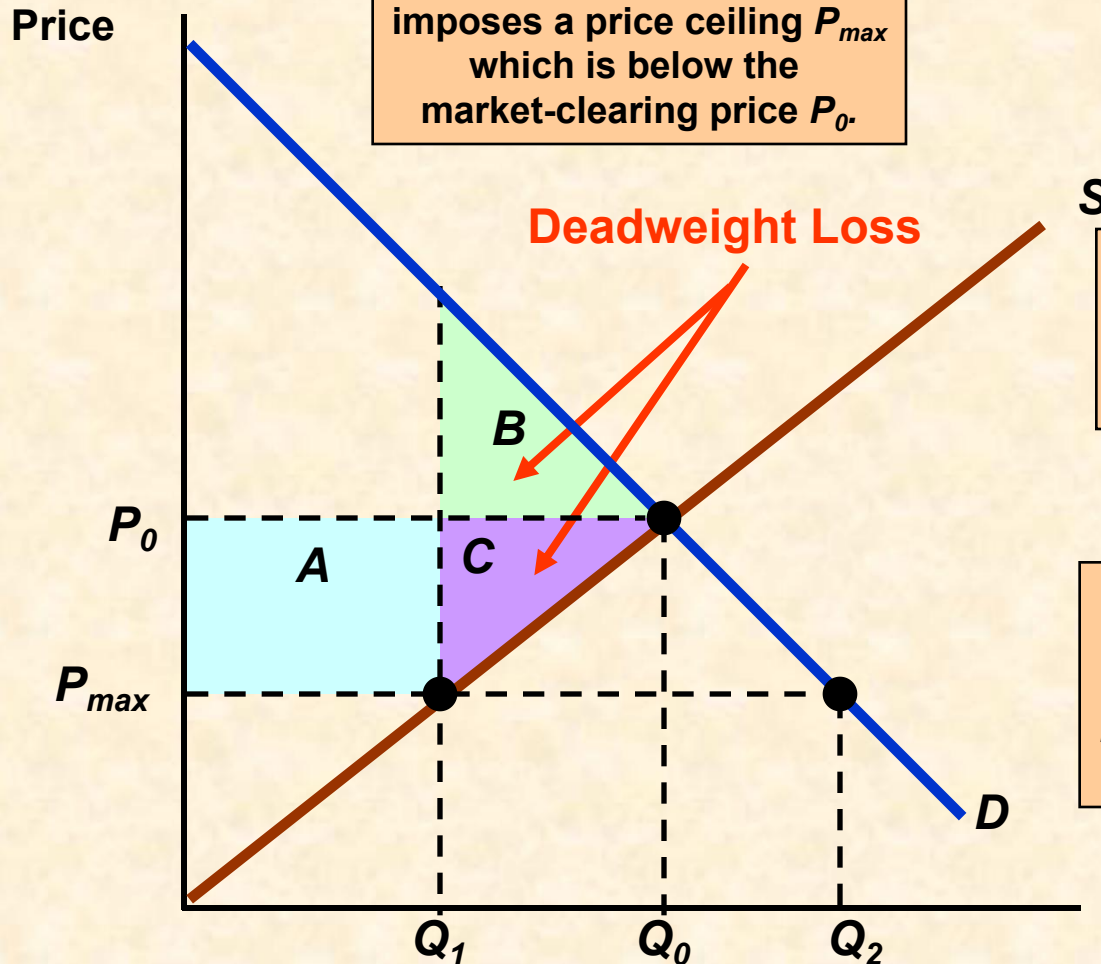
The gain to consumers is the difference between the rectangle *A* and the triangle *B*.

P_0

A   **C**

P_{max}

The loss to producers is the sum of rectangle *A* and triangle *C*. Triangle *B* and *C* together measure the deadweight loss.

D

Q_1 Q_0 Q_2

Quantity

Change in Consumer and Producer Surplus from Price Controls

- ■ Observations:

  - The total loss is equal to area B + C.

  - The total change in surplus =

    (A - B) + (-A - C) = -B - C

  - The deadweight loss is the inefficiency of the price controls or the loss of the producer surplus exceeds the gain from consumer surplus.

Change in Consumer and Producer Surplus from Price Controls

- **Observation**
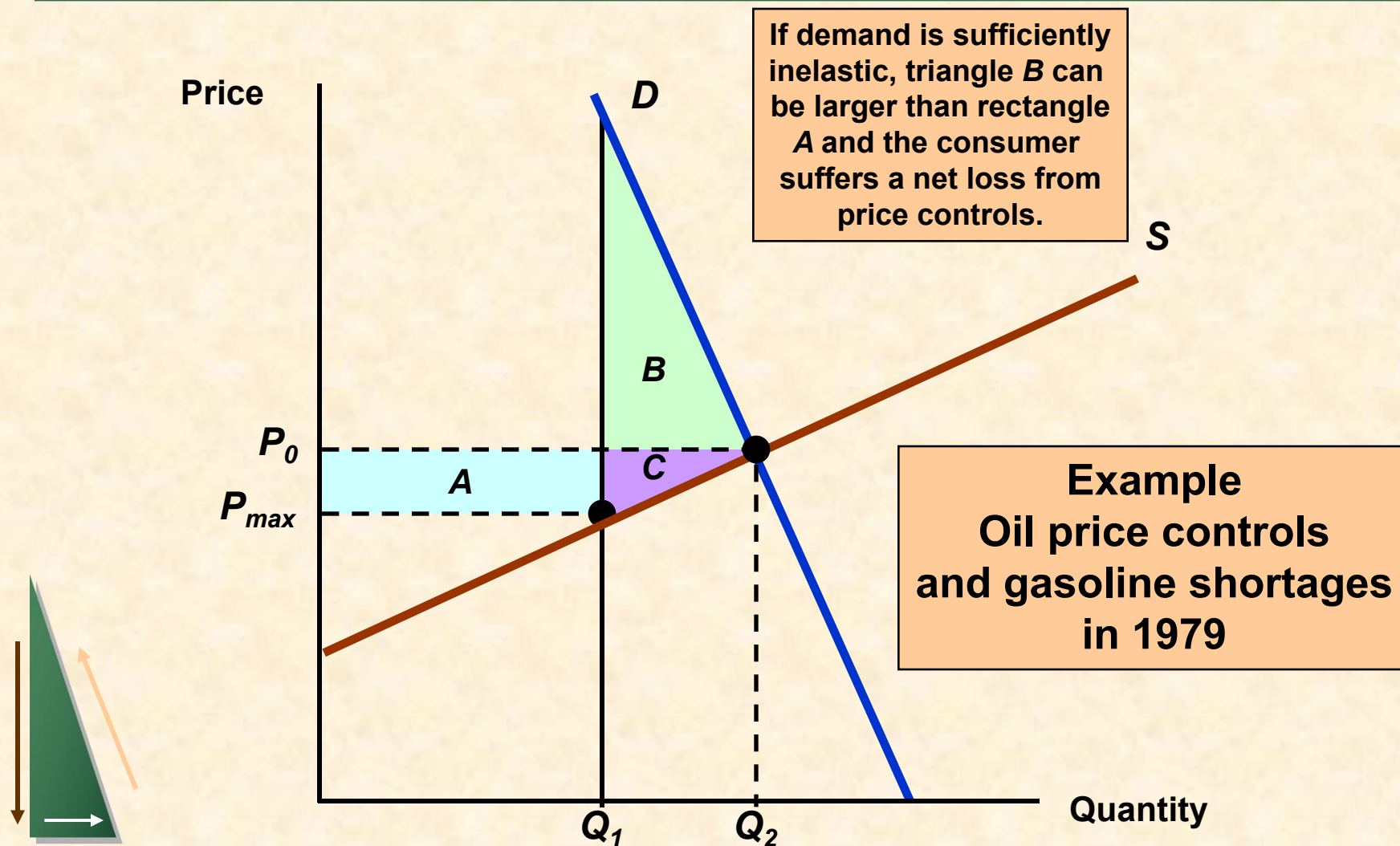
  - Consumers can experience a net loss in consumer surplus when the demand is sufficiently inelastic

Effect of Price Controls When Demand Is Inelastic

If demand is sufficiently inelastic, triangle *B* can be larger than rectangle *A* and the consumer suffers a net loss from price controls.

Example
Oil price controls
and gasoline shortages
in 1979

Price

D

S

P_0

P_{max}

A

B

C

Q_1

Q_2

Quantity

Price Controls and Natural Gas Shortages

- 1975 Price controls created a shortage of natural gas.

- What was the deadweight loss?

Data for 1975

- Supply: $Q^S = 14 + 2P_G + 0.25P_O$
  - Quantity supplied in trillion cubic feet (Tcf)

- Demand: $Q^D = -5P_G + 3.75P_O$
  - Quantity demanded (Tcf)

- P_G = price of natural gas in \$/mcf and P_O = price of oil in \$/b.
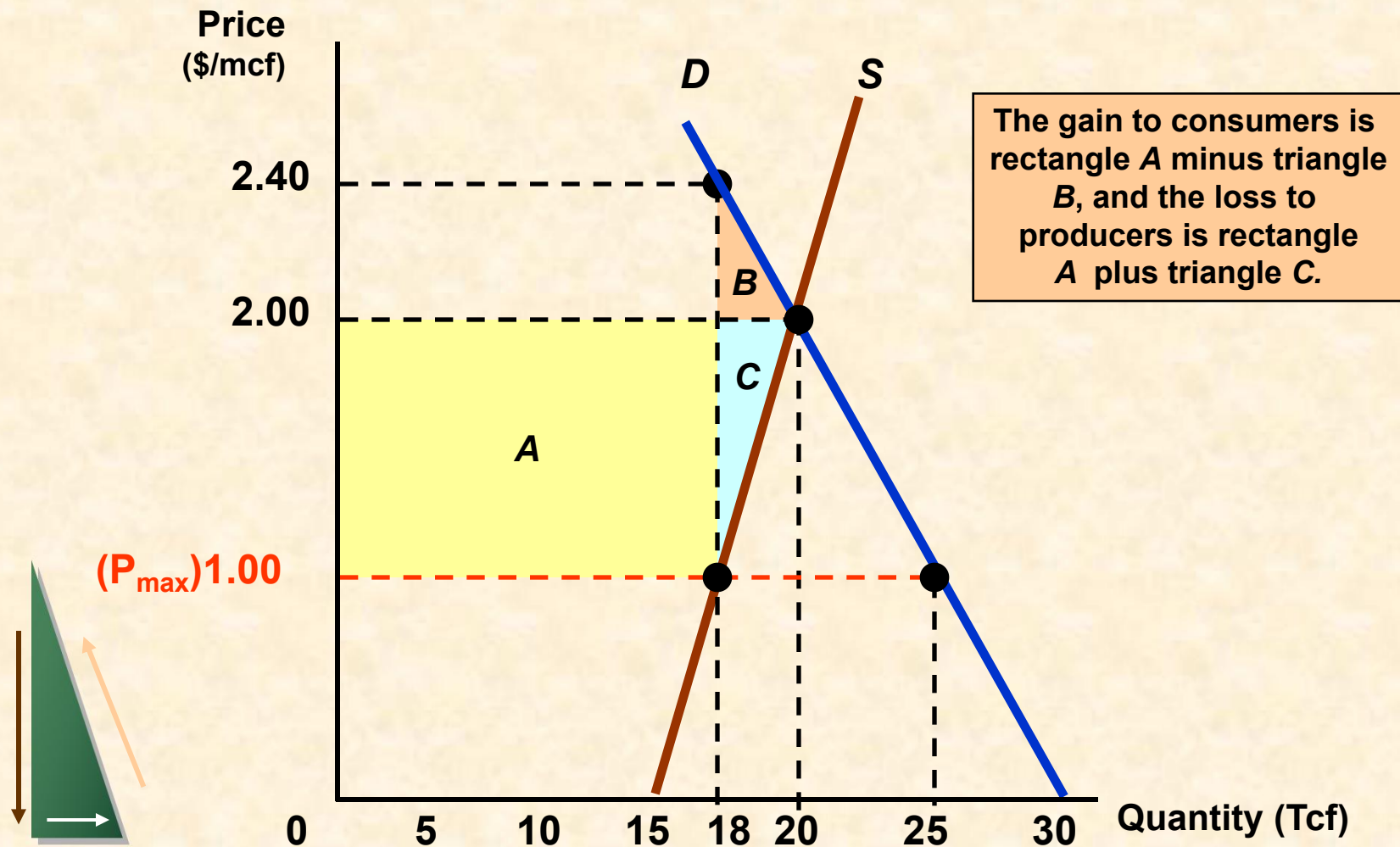
Price Controls and Natural Gas Shortages

Data for 1975

- P_O = $8/b

- Equilibrium P_G = $2/mcf and Q = 20 Tcf

- Price ceiling set at $1

- This information can be seen graphically:

Price Controls and Natural Gas Shortages

Price ($/mcf)

2.40

2.00

(P$_{max}$)1.00

D

S

B

C

A

The gain to consumers is rectangle *A* minus triangle *B*, and the loss to producers is rectangle *A* plus triangle *C.*

Quantity (Tcf)

0   5   10   15 18 20   25   30

Price Controls and Natural Gas Shortages

- **Measuring the Impact of Price Controls**

  - 1 Tcf = 1 billion mcf

  - If Q^D = 18, then P = $2.40

    - $[18 = -5P_G + 3.75(8)]$

  - A = (18 billion mcf) x ($1/mcf) = $18 billion

  - B = (1/2) x (2 b. mcf) x ($0.40/mcf) = $0.4 billion

  - C = (1/2) x (2 b. mcf) x ($1/mcf) = $1 billion

Price Controls and Natural Gas Shortages

- ■ Measuring the Impact of Price Controls
  - ● 1975
    - ◆ Change in consumer surplus
      - ● = *A* - *B* = 18 - 0.04 = $17.6 billion
    - ◆ Change in producer surplus
      - ● = -*A* - *C* = -18-1 = -$19.0 billion

Price Controls and Natural Gas Shortages

- **Measuring the Impact of Price Controls**
  - 1975 dollars, deadweight loss
    - $= -B - C = -0.4 - 1 = -\$1.4$ billion
    - In 2000 dollars, the deadweight loss is more than $4 billion per year.

The Efficiency of a Competitive Market

- When do competitive markets generate an inefficient allocation of resources or *market failure*?

1) Externalities

  - Costs or benefits that do not show up as part of the market price (e.g. pollution)

The Efficiency of a Competitive Market

■ When do competitive markets generate an inefficient allocation of resources or *market failure*?

2) Lack of Information

◆ Imperfect information prevents consumers from making utility-maximizing decisions.
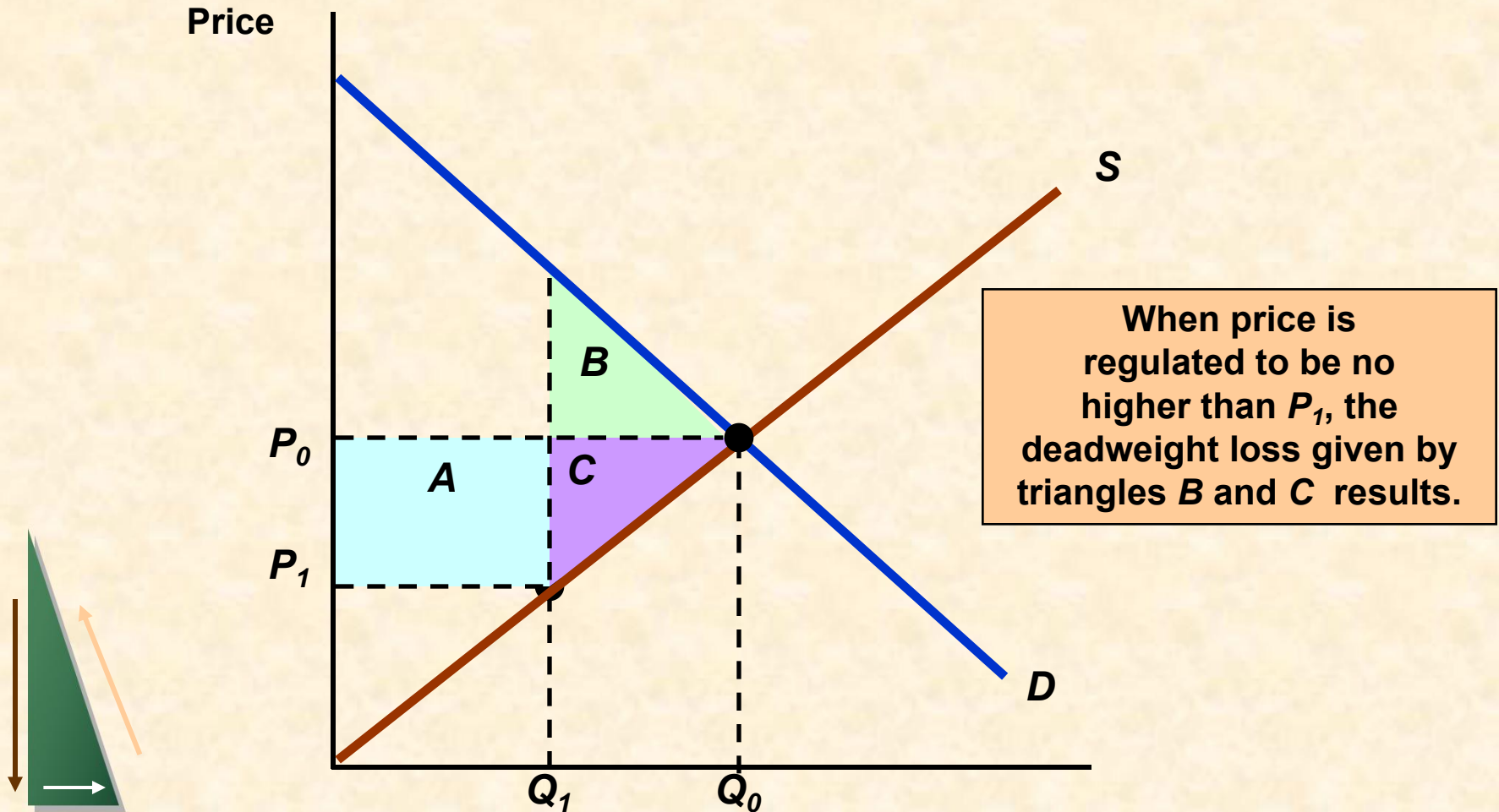
The Efficiency of a Competitive Market

- Government intervention in these markets can increase efficiency.

- Government intervention without a market failure creates inefficiency or deadweight loss.
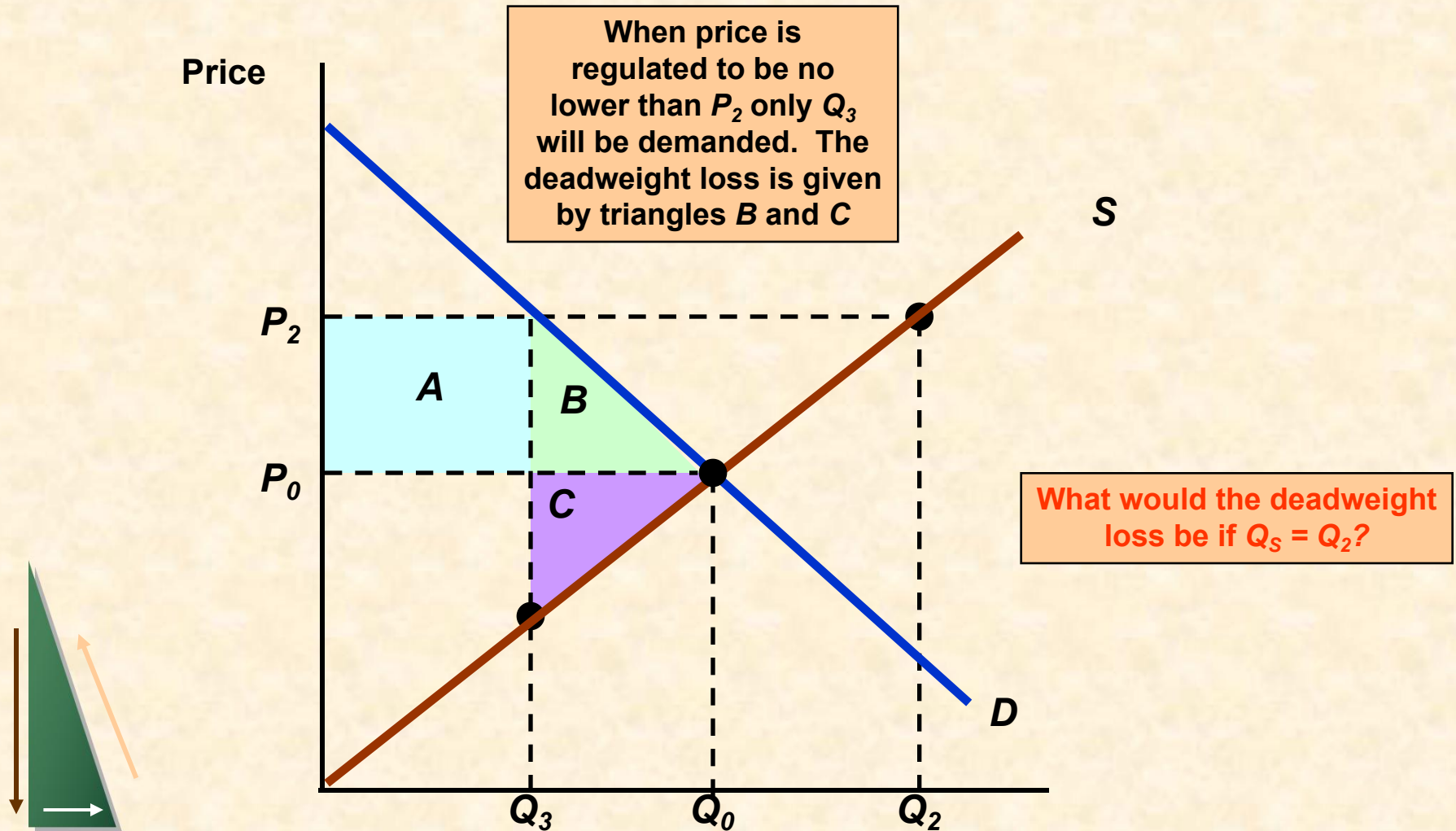
Welfare Loss When Price Is Held Below Market-Clearing Level

Price

S

When price is regulated to be no higher than P_1, the deadweight loss given by triangles *B* and *C* results.

P_0

B

A

C

P_1

D

Q_1 Q_0

Welfare Loss When Price Is Held Above Market-Clearing Level

Price

When price is regulated to be no lower than P_2 only Q_3 will be demanded. The deadweight loss is given by triangles B and C

S

P_2

A

B

P_0

C

What would the deadweight loss be if $Q_S = Q_2$?

D

Q_3 Q_0 Q_2
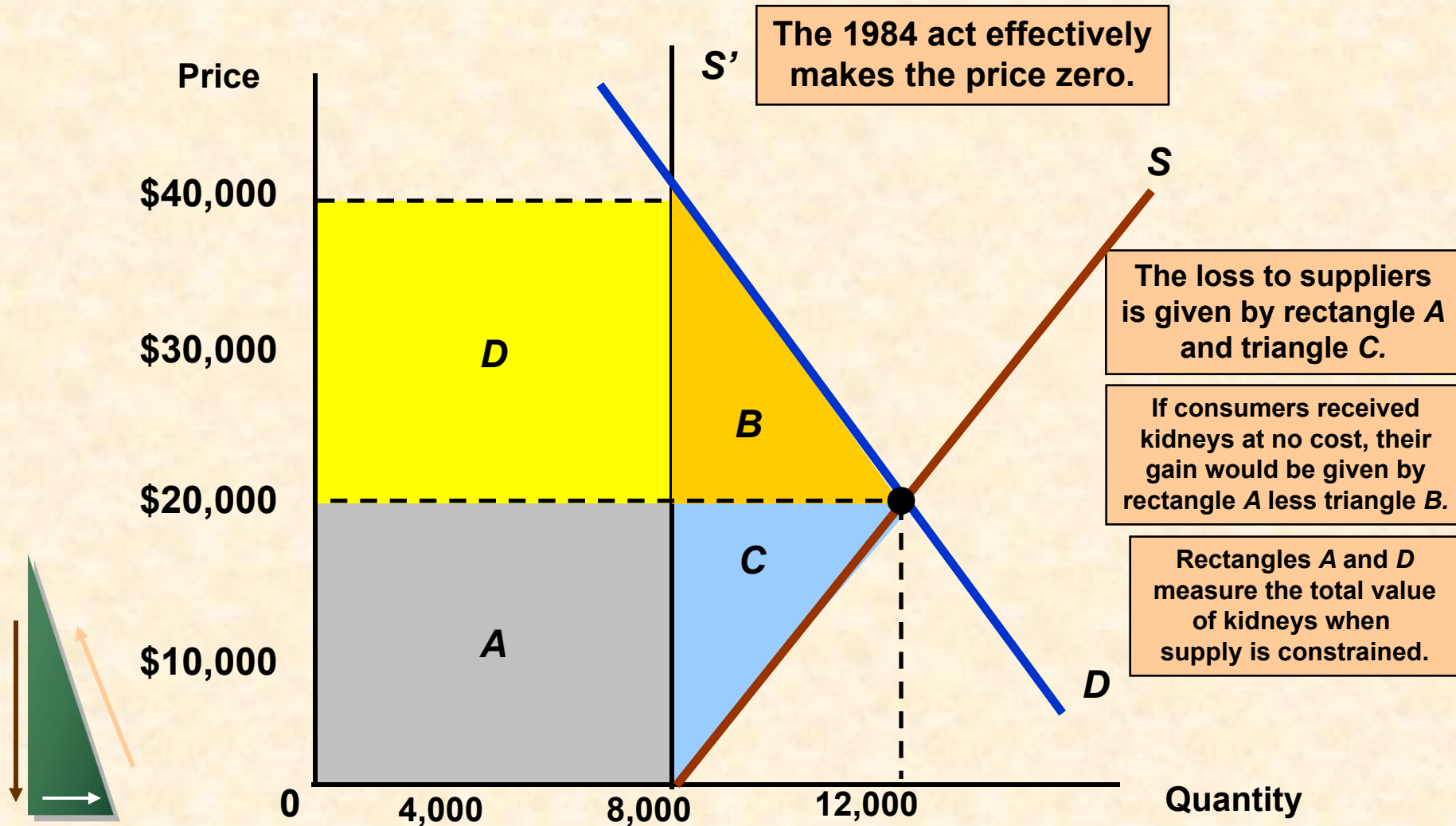
The Market for Human Kidneys

- The 1984 National Organ Transplantation Act prohibits the sale of organs for transplantation.

- Analyzing the Impact of the Act
  - Supply: $Q^S = 8,000 + 0.2P$
    - ◆ If $P = \$20,000$, $Q = 12,000$
  - Demand: $Q^D = 16,000 - 0.2P$

The Market for Kidneys, and Effects of the 1984 Organ Transplantation Act

The 1984 act effectively makes the price zero.

The loss to suppliers is given by rectangle *A* and triangle *C*.

If consumers received kidneys at no cost, their gain would be given by rectangle *A* less triangle *B*.

Rectangles *A* and *D* measure the total value of kidneys when supply is constrained.

www.kaoyancas.net

The Market for Human Kidneys

- The act limits the quantity supplied (donations) to 8,000.

- Loss to supplier surplus:

  - *A* + *C* =

    (8,000)($20,000) + (1/2)(4,000)($20,000) = $200/m.

The Market for Human Kidneys

- **Gain to recipients:**
  - *A - B* =

    (8,000)($20,000) - (1/2)(4,000)($20,000) = $120/m.

- **Deadweight loss:**
  - B + C or

    $200 million - $120 million = $80 million

The Market for Human Kidneys

- **Other Inefficiency Cost**

  1) Allocation is not necessarily to those who value the kidney's the most.

  2) Price may increase to $40,000, the equilibrium price, with hospitals getting the price.

The Market for Human Kidneys

- Arguments in favor of prohibiting the sale of organs:

  1) Imperfect information about donor's health and screening

The Market for Human Kidneys

- Arguments in favor of prohibiting the sale of organs:

  2) Unfair to allocate according to the ability to pay

     - Holding price below equilibrium will create shortages

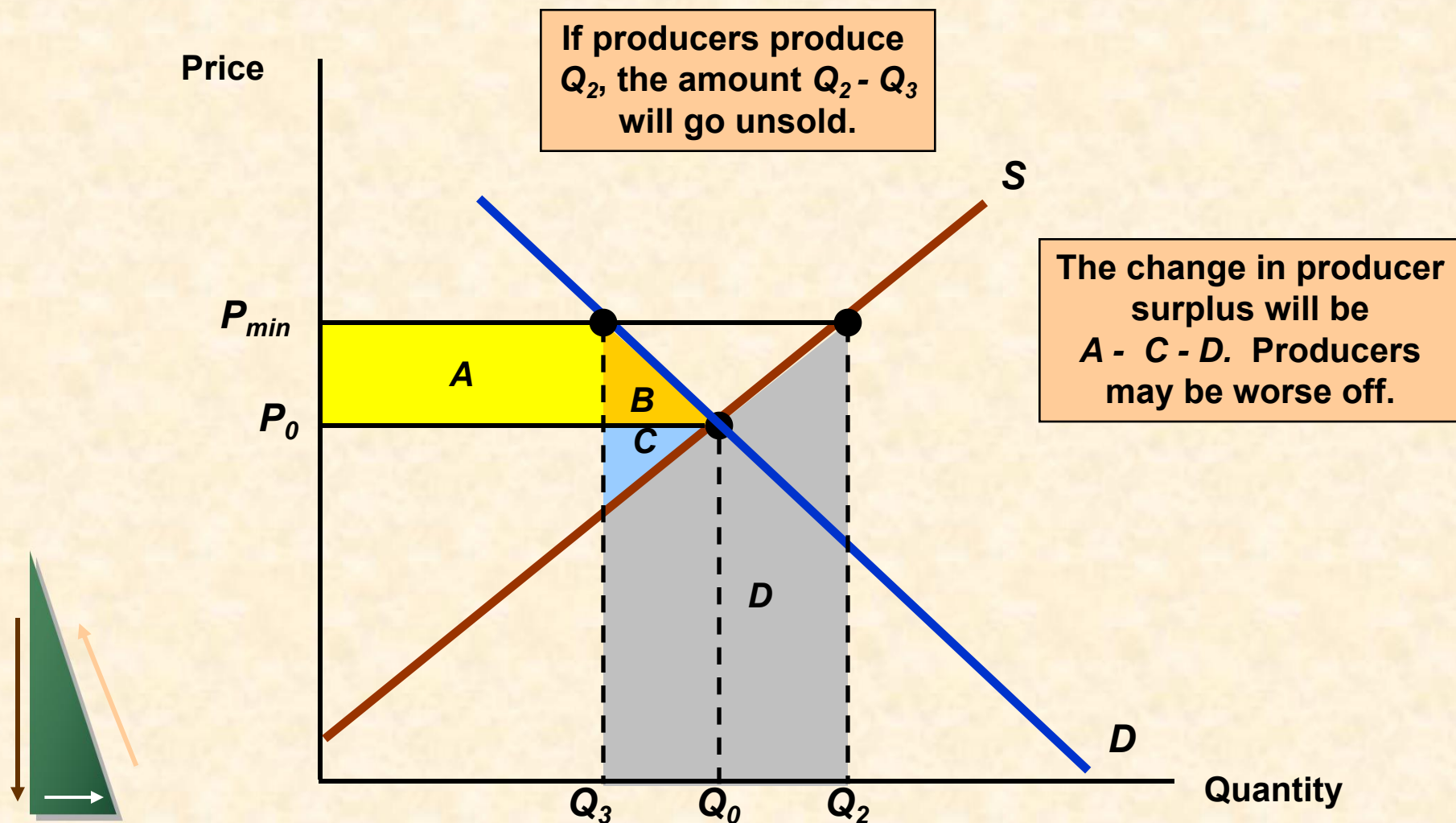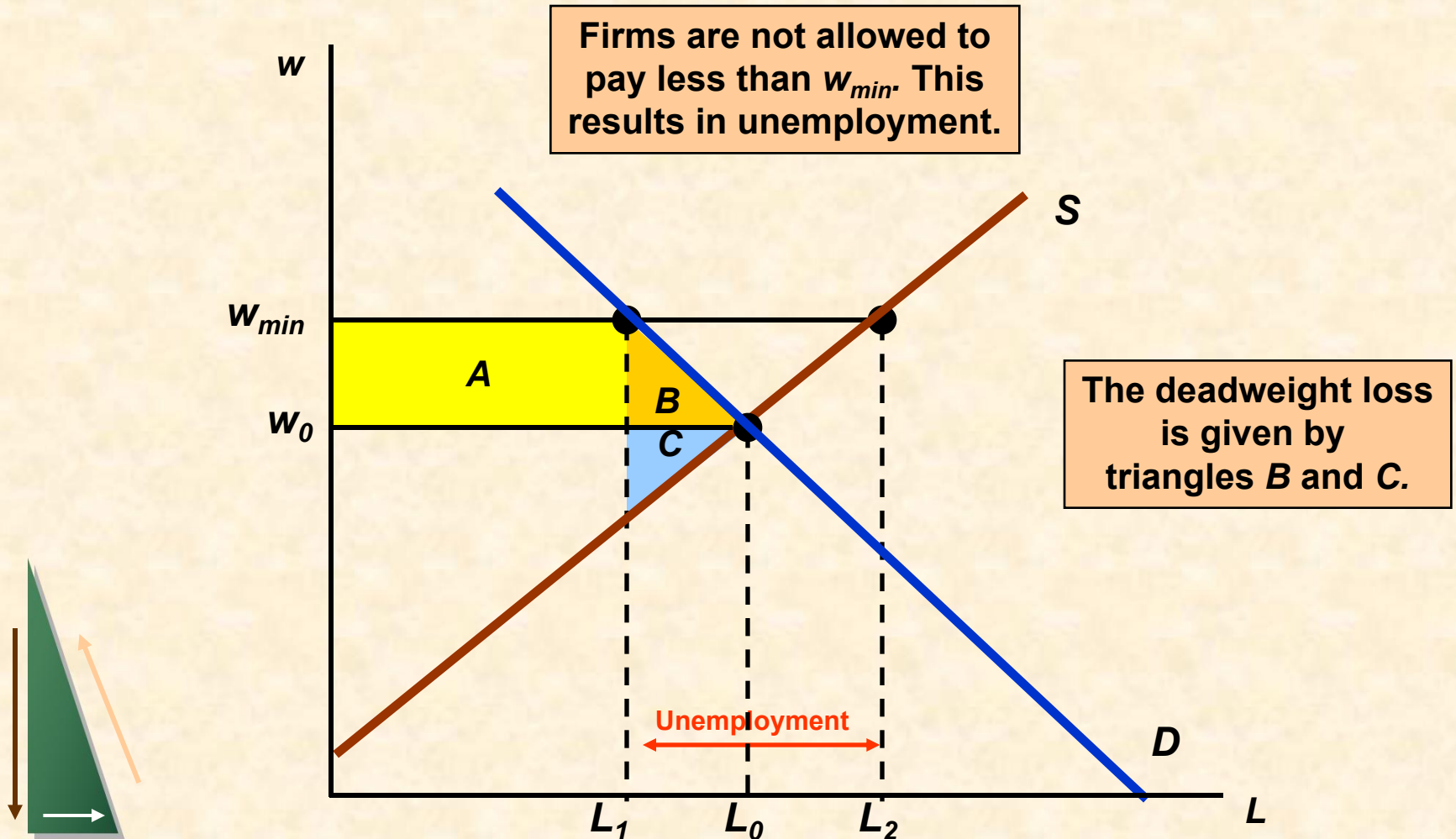   - Organs versus artificial substitutes

Minimum Prices

- Periodically government policy seeks to raise prices above market-clearing levels.

- We will investigate this by looking at a price floor and the minimum wage.

Price Minimum

Price

If producers produce Q_2, the amount $Q_2 - Q_3$ will go unsold.

S

P_{min}

P_0

A

B

C

D

The change in producer surplus will be $A - C - D$. Producers may be worse off.

D

Quantity

Q_3 Q_0 Q_2

The Minimum Wage

Firms are not allowed to pay less than w_{min}. This results in unemployment.

The deadweight loss is given by triangles *B* and *C*.

w

w_{min}

w_0

A

B

C

S

D

Unemployment

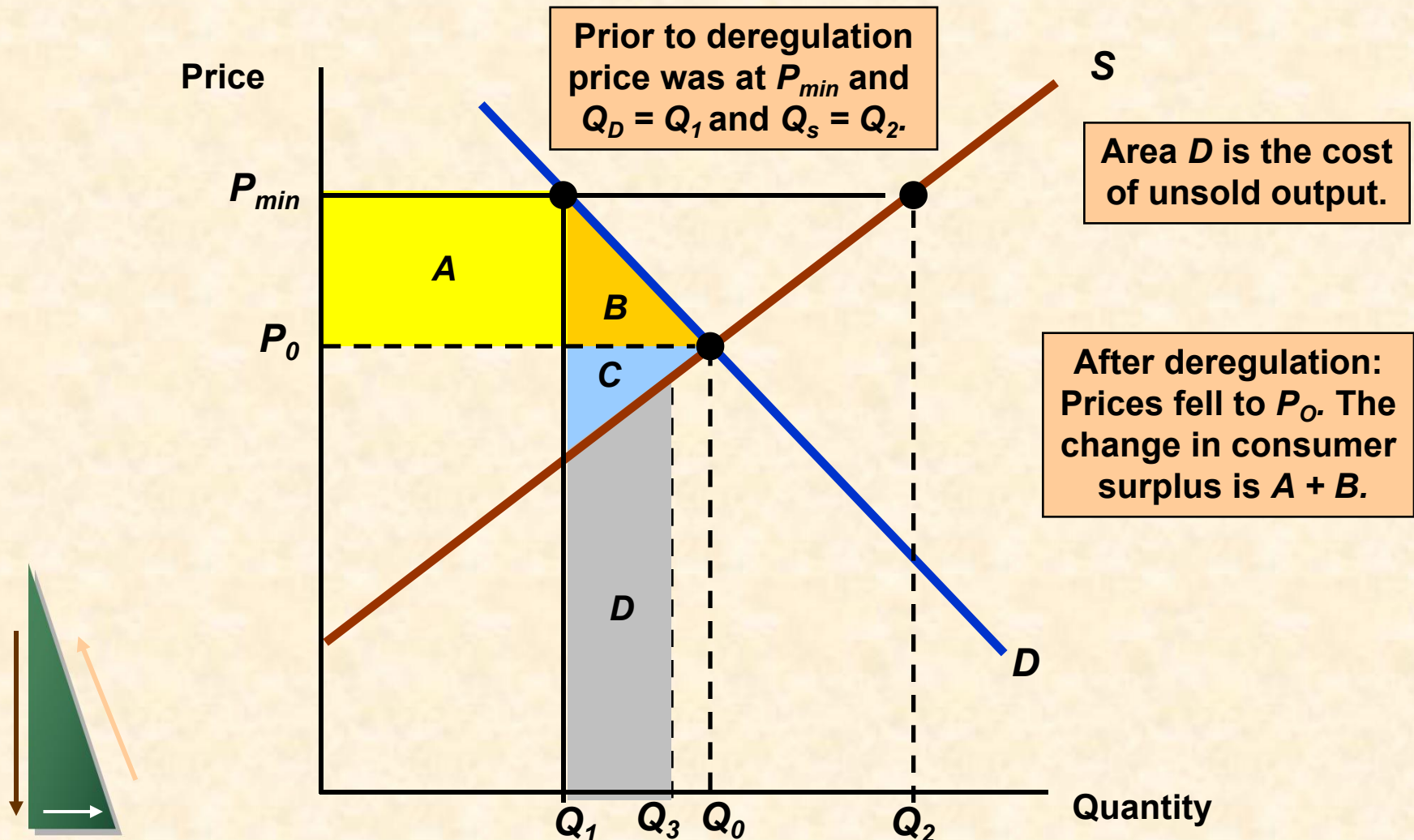L_1 L_0 L_2 L

Airline Regulation

- During 1976-1981 the airline industry in the U.S. changed dramatically.

- Deregulation lead to major changes in the industry.

- Some airlines merged or went out of business as new airlines entered the industry.

Effect of Airline Regulation by the Civil Aeronautics Board

Price

S

Prior to deregulation price was at P_{min} and $Q_D = Q_1$ and $Q_s = Q_2$.

Area *D* is the cost of unsold output.

P_{min}

A

B

P_0

C

After deregulation: Prices fell to P_O. The change in consumer surplus is *A + B*.

D

D

Quantity

Q_1 Q_3 Q_0 Q_2

Airline Industry Data

	1975	1980	1985	1990	1995	1996
Number of carriers	33	72	86	60	86	96
Passenger load factor(%)	54	59	61	62	67	69
Passenger-mile rate (constant 1995 dollars)	.218	.210	.166	.150	.129	.126
Real cost index (1995=100)	101	122	111	107	100	99
Real cost index corrected for fuel cost increases	94	98	98	100	100	98

Airline Industry Data

- Airline industry data show:

    1) Long-run adjustment as the number of carriers increased and prices decreased

    2) Higher load factors indicating more efficiency

Airline Industry Data

- Airline industry data show:

  3) Falling rates

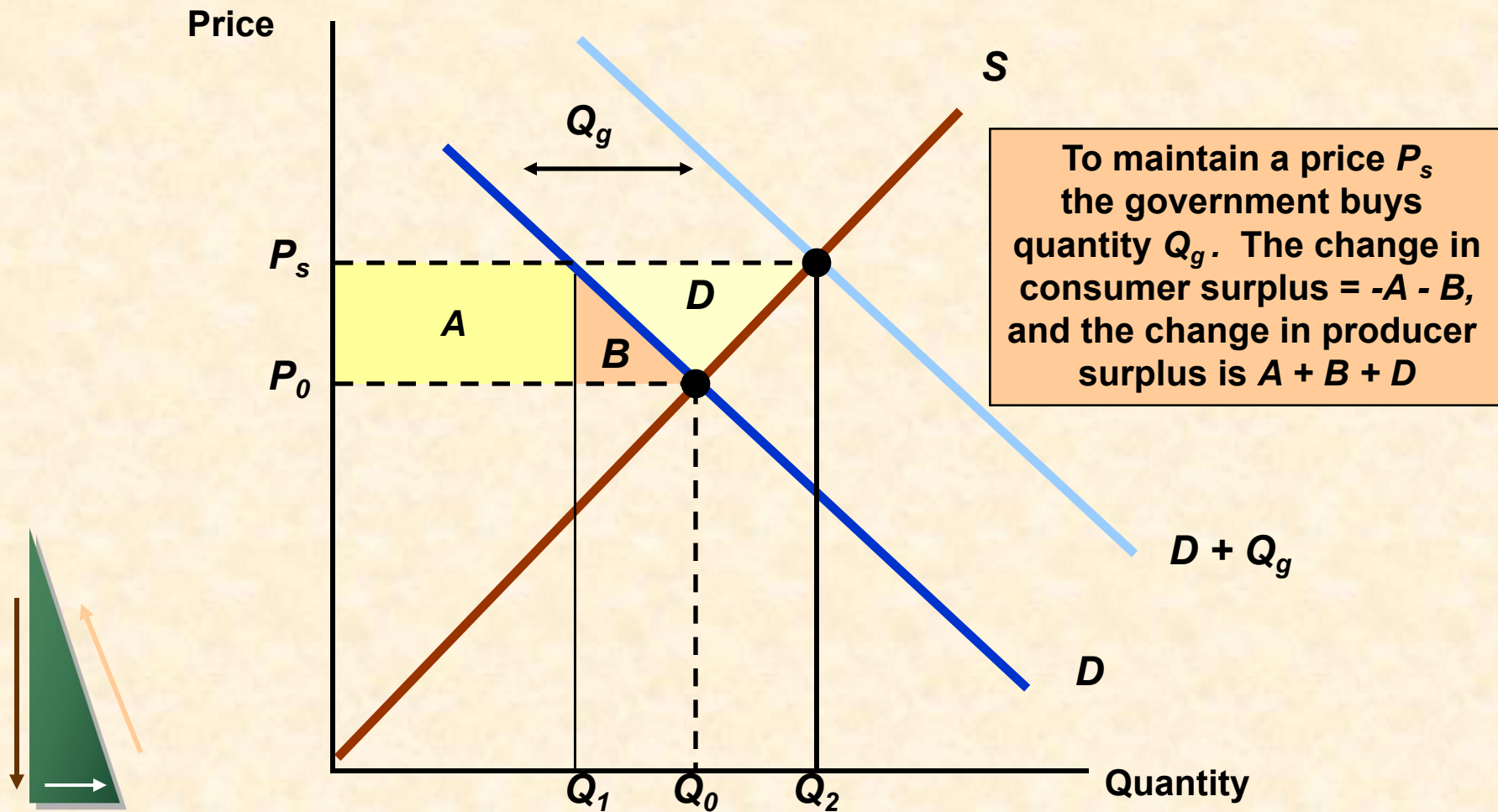 4) Real cost increased slightly (adjusted fuel cost)

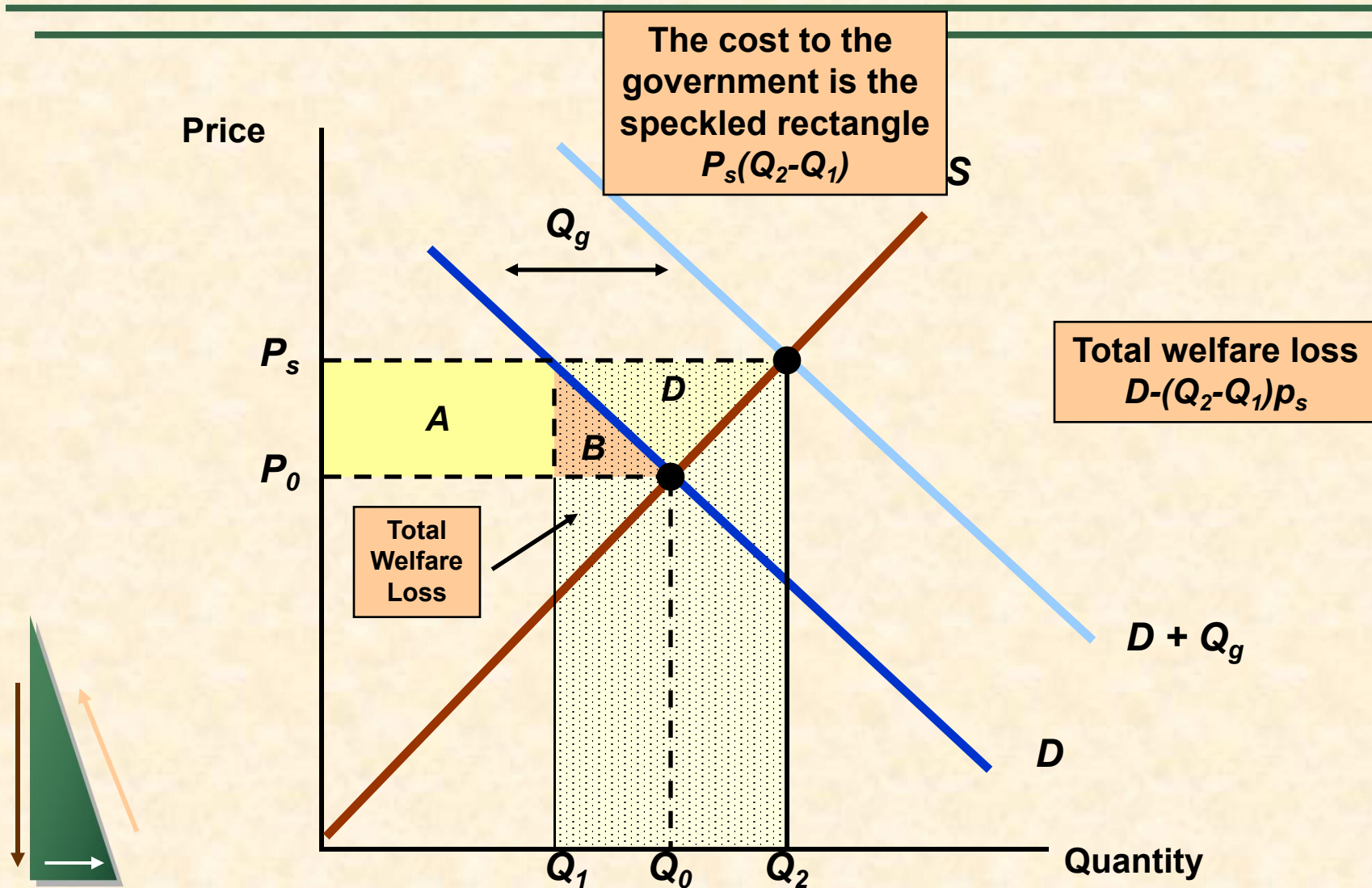 5) Large welfare gain

Price Supports and Production Quotas

- Much of agricultural policy is based on a system of price supports.

  - This is support price is set above the equilibrium price and the government buys the surplus.

- This is often combined with incentives to reduce or restrict production

Price Supports

Price

Q_g

S

P_s

D

A

B

P_0

To maintain a price P_s the government buys quantity Q_g. The change in consumer surplus = $-A - B$, and the change in producer surplus is $A + B + D$

$D + Q_g$

D

Q_1 Q_0 Q_2 Quantity

Price Supports

The cost to the government is the speckled rectangle $P_s(Q_2-Q_1)$

Price

Q_g

S

P_s

A

D

B

P_0

Total Welfare Loss

Total welfare loss $D-(Q_2-Q_1)p_s$

$D + Q_g$

D

Q_1 Q_0 Q_2

Quantity

Price Supports

- ■ Question:

    - ● Is there a more efficient way to increase farmer's income by *A + B + D?*

Price Supports and Production Quotas

- Production Quotas

  - The government can also cause the price of a good to rise by *reducing supply.*
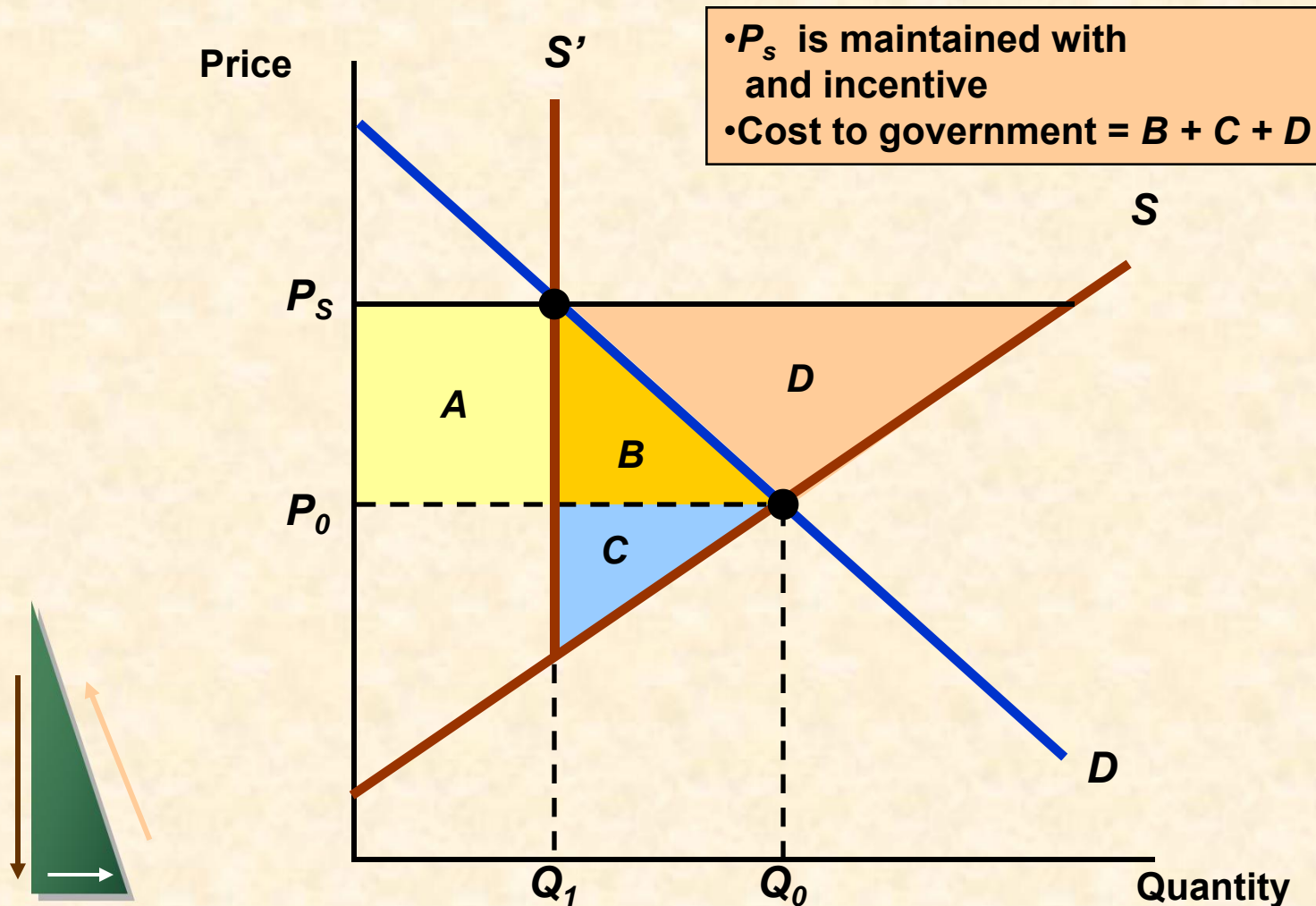
Price Supports and Production Quotas

- What is the impact of:

  1) Controlling entry into the taxicab market?

  2) Controlling the number of liquor licenses?

Supply Restrictions

Price

S'

S

- Supply restricted to Q_1
- Supply shifts to S' @ Q_1

P_S

A

D

B

P_0

C

- CS reduced by $A + B$
- Change in PS = $A - C$
- Deadweight loss = BC

D

Q_1 Q_0

Quantity

Supply Restrictions

- P_s is maintained with and incentive
- Cost to government = $B + C + D$

Price

S'

S

P_S

D

A

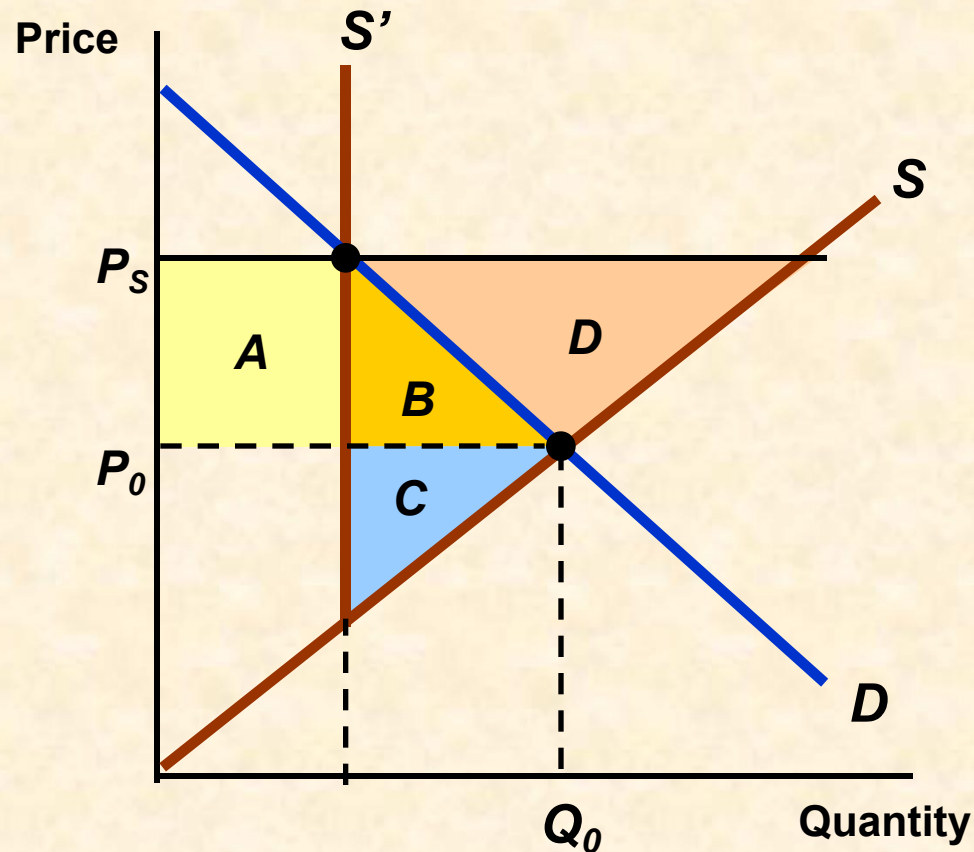B

P_0

C

D

Q_1

Q_0

Quantity
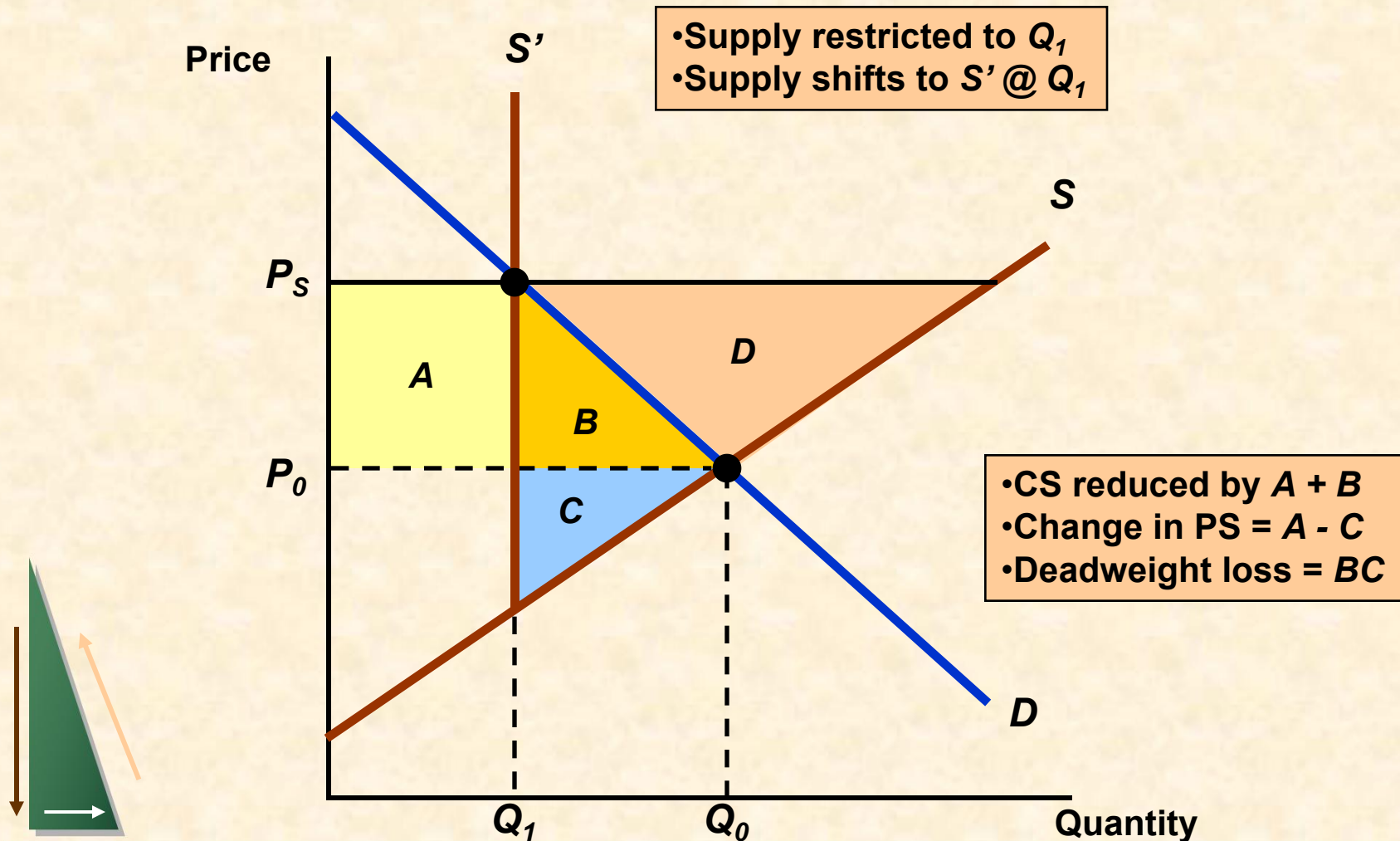
Supply Restrictions

- $\Delta PS = A - C + B + C + D = A + B + D.$

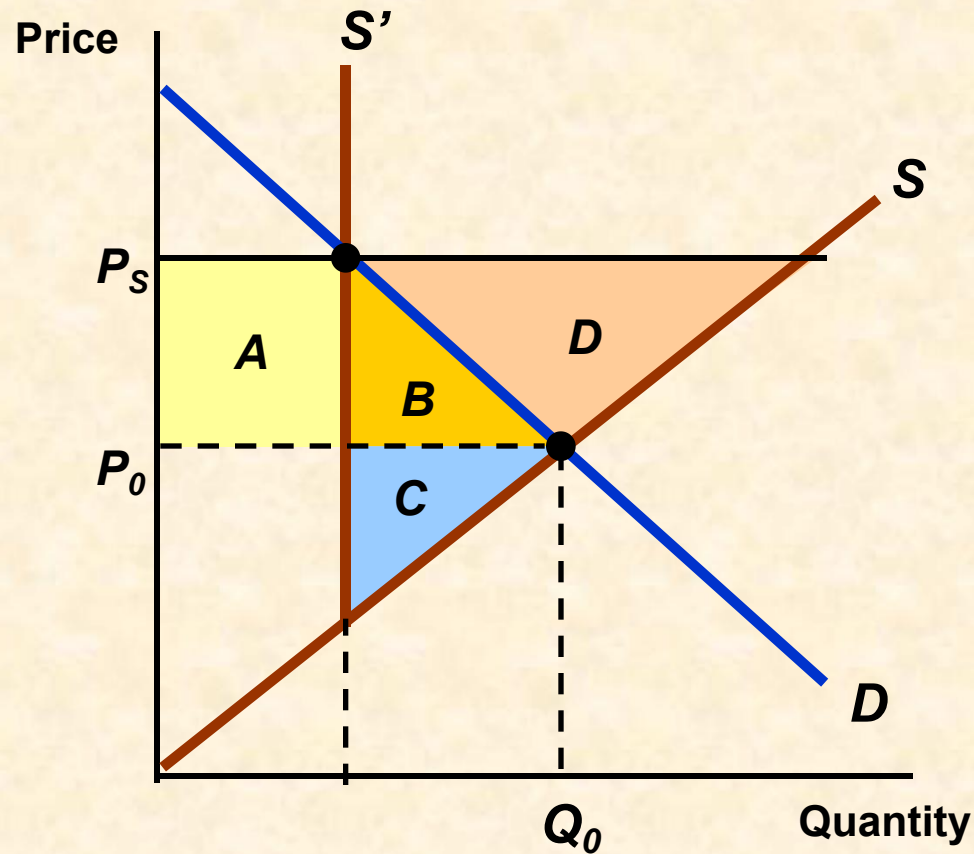- The change in consumer and producer surplus is the same as with price supports.

- $\Delta welfare = -A - B + A + B + D - B - C - D = -B - C.$

Price

S'

S

P_S

A

D

B

P_0

C

D

Q_0

Quantity

Supply Restrictions

■ Questions:

- How could the government reduce the cost and still subsidize the farmer?

- Which is more costly: supports or acreage limitations?

Supporting the Price of Wheat

- 1981

  - Supply: $Q_s = 1,800 + 240P$

  - Demand: $Q_D = 3,550 - 266P$

  - Equilibrium price and quantity was $3.46 and 2,630 million bushels

Supporting the Price of Wheat

- 1981

  - Price support was set at $3.70

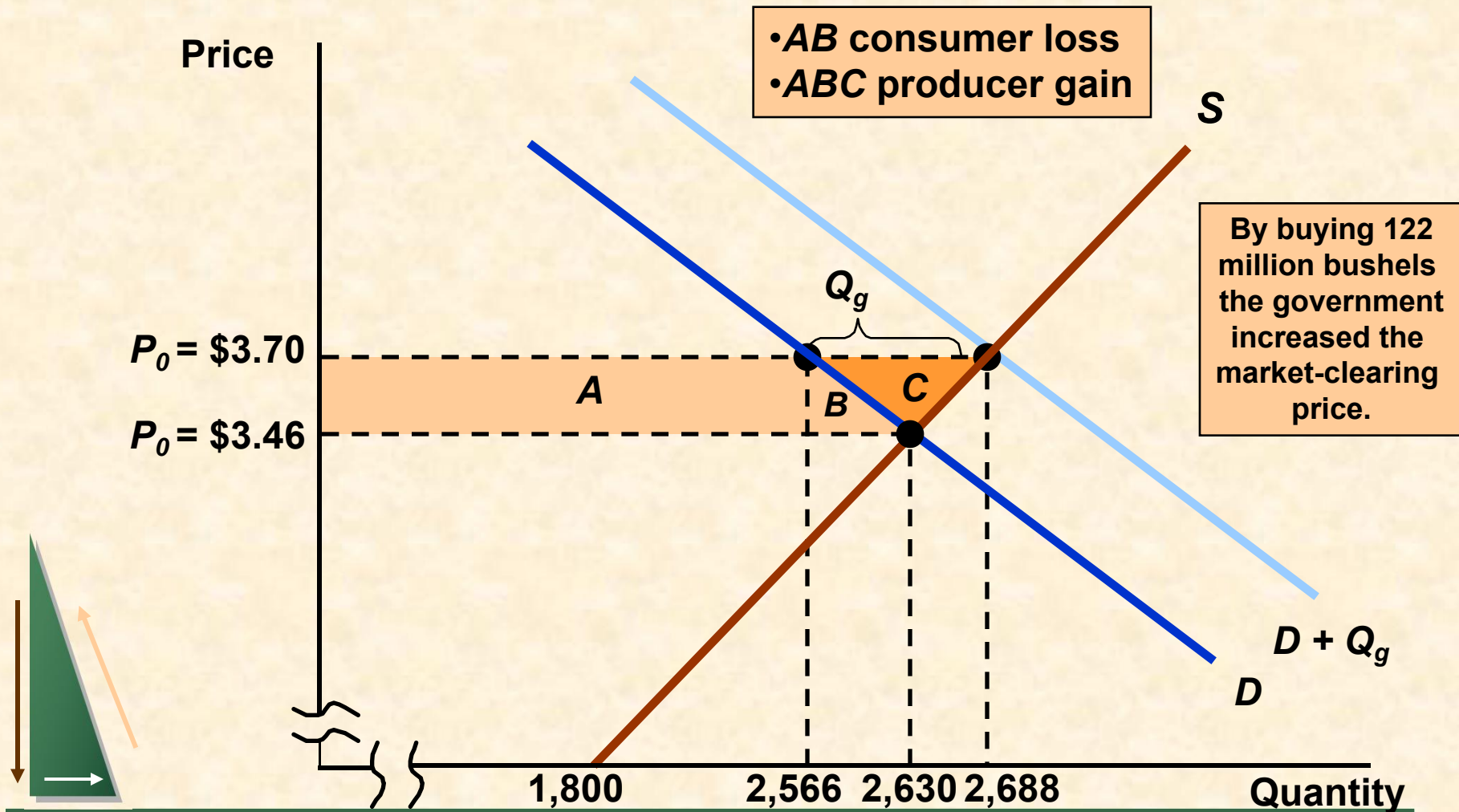 - $Q_{D+} Q_G = Q_{DT} = 3{,}440 - 266P + Q_G$

  - $Q_S = Q_D$

    $1{,}800 + 240P = 3{,}550 - 266P + Q_G$

    $Q_G = 506P - 1{,}750$

    $Q_G = (506)(3.70) - 175 = 122$ million bushels

The Wheat Market in 1981

Price

•*AB* consumer loss
•*ABC* producer gain

S

By buying 122 million bushels the government increased the market-clearing price.

Q_g

P_0 = $3.70

A   *B*   *C*

P_0 = $3.46

D + Q_g

D

1,800   2,566 2,630 2,688

Quantity

Supporting the Price of Wheat

- 1981
  - The change in consumer surplus = *(-A -B)*

    A = (3.70 - 3.46)(2,566) = $616 million

    B = (1/2)(3.70-3.46)(2,630-2,566) = $8 million

    - Change in consumer surplus: -$624 million.

Supporting the Price of Wheat

- ■ 1981
  - ● Cost to the government:

    $3.70 x 122 million bushels = $452 million
  - ● Total cost = $624 + 452 = $1,076 million
  - ● Total gain = *A* + *B* + *C* = $638 million
  - ● Government also paid 30 cents/bushel = $806 million

Chapter 9   **Slide 52**

Supporting the Price of Wheat

- ■ In 1985, export demand fell and the market clearing price of wheat fell to $1.80/bushel.

Supporting the Price of Wheat

- 1985 Supply: $Q_S = 1,800 + 240P$

- 1986 Demand: $Q_D = 2580 - 194P$
  - $Q_S = Q_D$ at \$1.80 and 2,232 million bushels
  - $P_S = \$3.20$
    - To maintain \$3.20/bushel a production quota of 2,425 bushels was imposed

Supporting the Price of Wheat

- ■ 1985
  - ● Government Purchase:
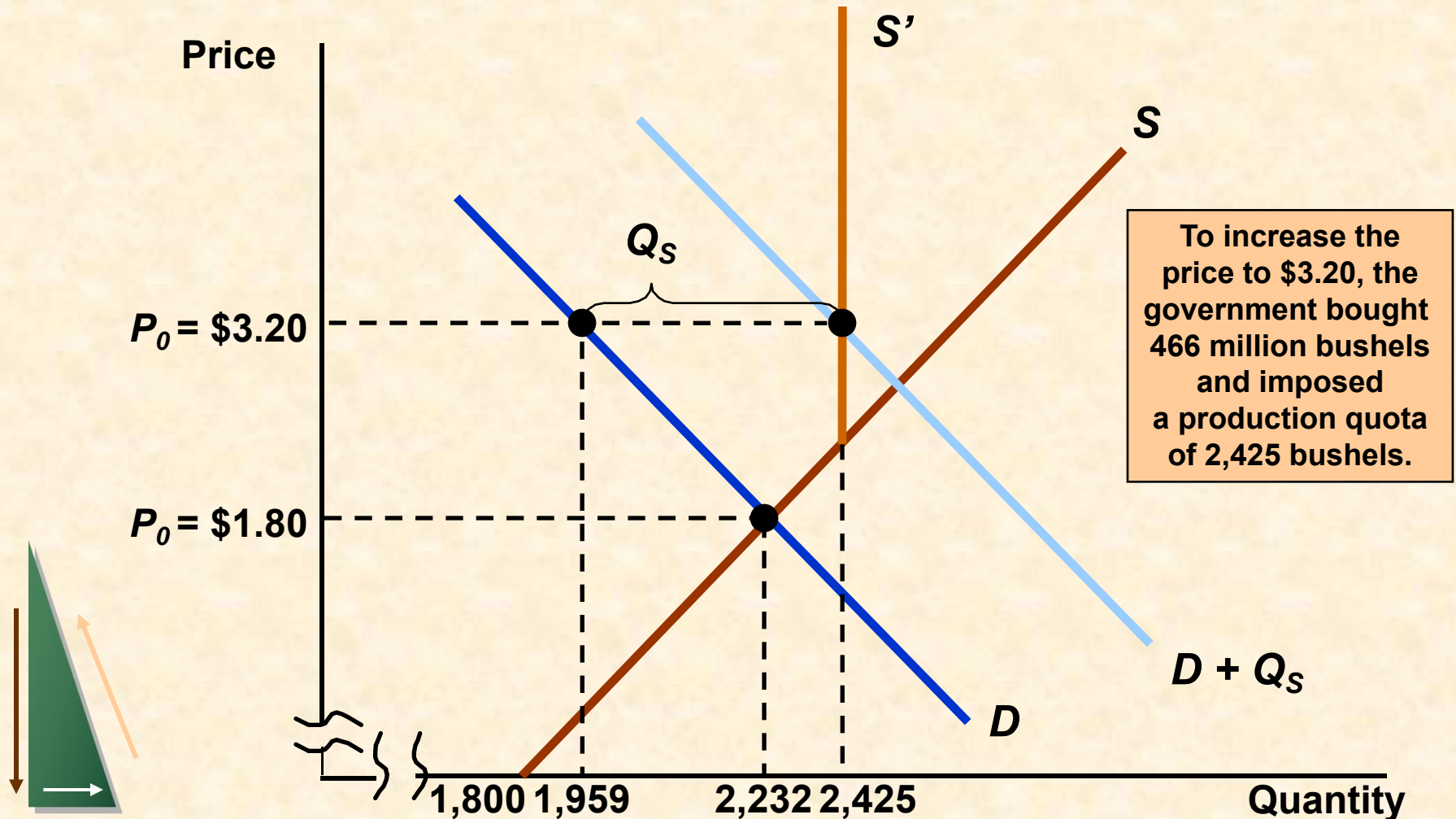
    $2{,}425 = 2{,}580 - 194P + Q_G$

    - ◆ $Q_G = -155 + 194P$

    - ◆ $P = \$3.20$ -- the support price

    - ◆ $Q_G = -155 + 194(\$3.20) = 466$ million bushels

The Wheat Market in 1985

Supporting the Price of Wheat

- **1985**

  - Government Purchase:

    - Government cost = $3.20 x 466 = $1,491million

    - 80 cent subsidy = .80 x 2,425 = $1,940 million

    - Total cost = $3.5 billion

Supporting the Price of Wheat

- Question:

  - What is the change in consumer and producer surplus?

Supporting the Price of Wheat

- **1996 Freedom to Farm**

  - Reduces price supports and quotas until 2003 when they go back into effect under the 1996 law.

Chapter 9 **Slide 59**

Supporting the Price of Wheat

- **1998 Wheat Market**
  - P = $2.65
  - Q_D = 3244 - 283P
  - Q_S = 1944 + 207P
  - Q = 2493
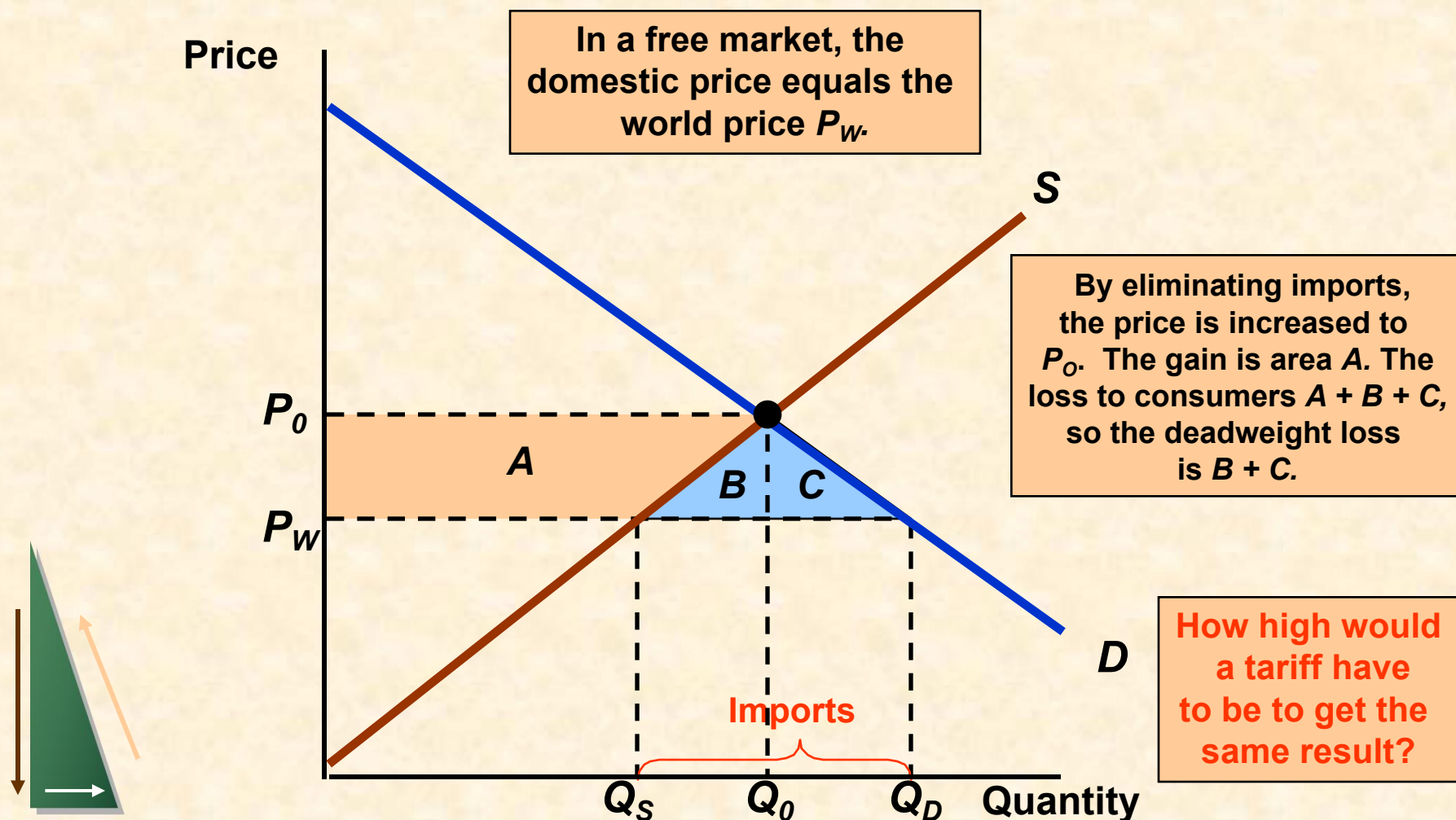 - Government subsidy of .66/bushel or $1.6 billion

Import Quotas and Tariffs

■ Many countries use import quotas and tariffs to keep the domestic price of a product above world levels

Import Tariff or Quota That Eliminates Imports

Price

In a free market, the domestic price equals the world price P_W.

S

By eliminating imports, the price is increased to P_O. The gain is area A. The loss to consumers $A + B + C$, so the deadweight loss is $B + C$.

P_0

A

B C

P_W

D

How high would a tariff have to be to get the same result?

Imports

Q_S Q_0 Q_D **Quantity**
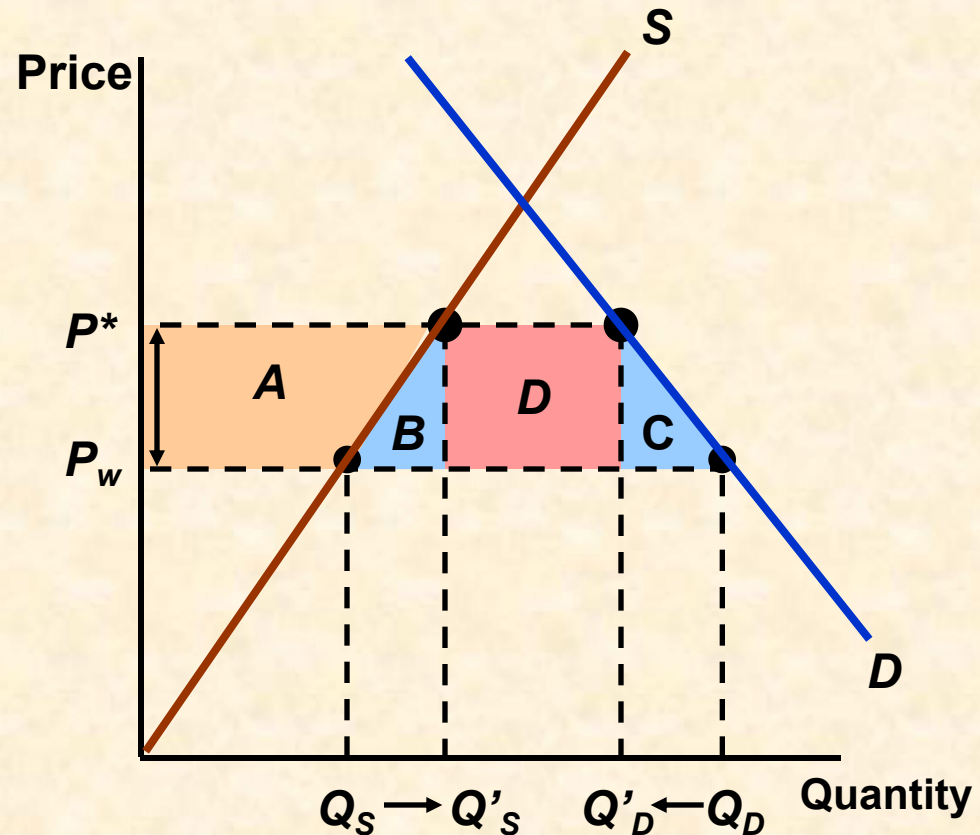
Import Tariff or Quota (general case)

- The increase in price can be achieved by a quota or a tariff.

- Area *A* is again the gain to domestic producers.

- The loss to consumers is *A + B + C + D.*
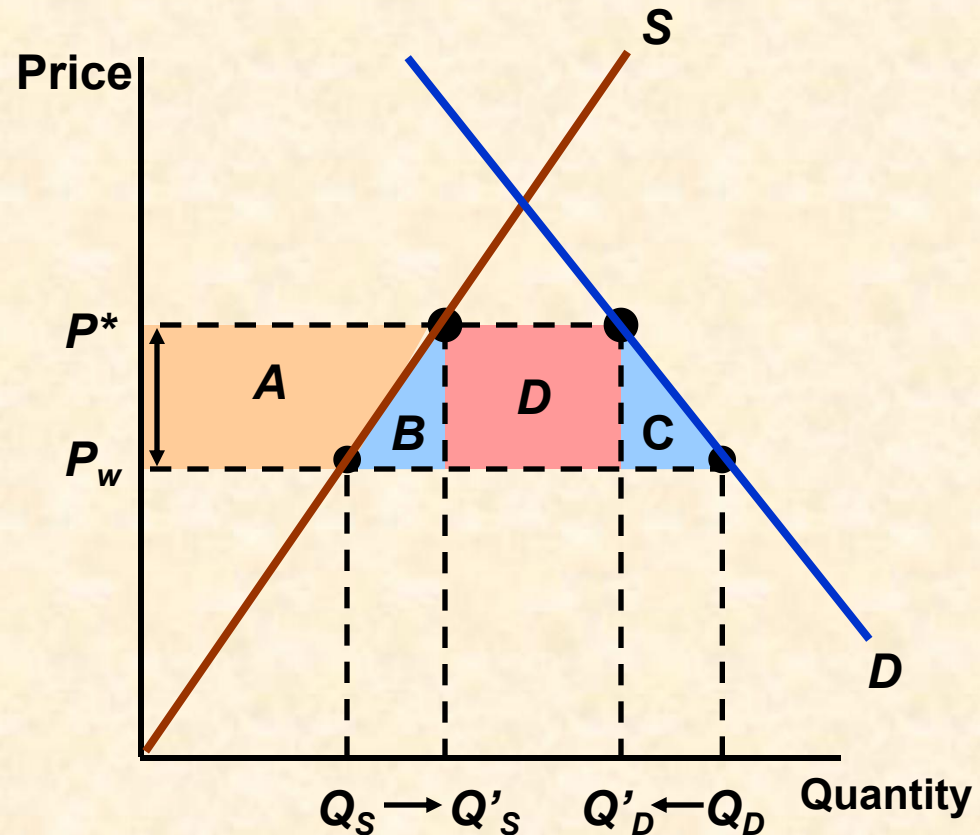
Import Tariff or Quota (general case)

- If a tariff is used the government gains *D,* so the net domestic product loss is *B + C.*

- If a quota is used instead, rectangle *D* becomes part of the profits of foreign producers, and the net domestic loss is *B + C + D.*
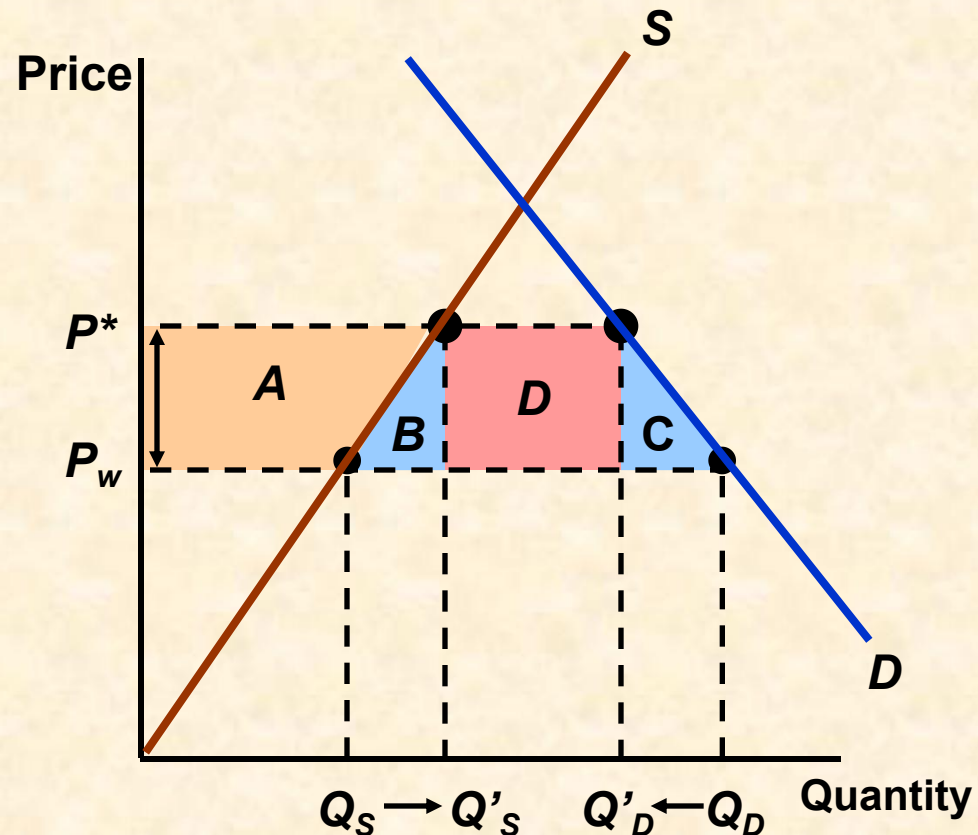
Import Tariff or Quota (general case)

- **Question:**
  - **Would the U.S. be better off or worse off with a quota instead of a tariff? (e.g. Japanese import restrictions in the 1980s)**

The Sugar Quota

- The world price of sugar has been as low as 4 cents per pound, while in the U.S. the price has been 20-25 cents per pound.

The Sugar Quota

- The Impact of a Restricted Market (1997)

  - U.S. production = 15.6 billion pounds

  - U.S. consumption = 21.1 billion pounds

  - U.S. price = 22 cents/pound
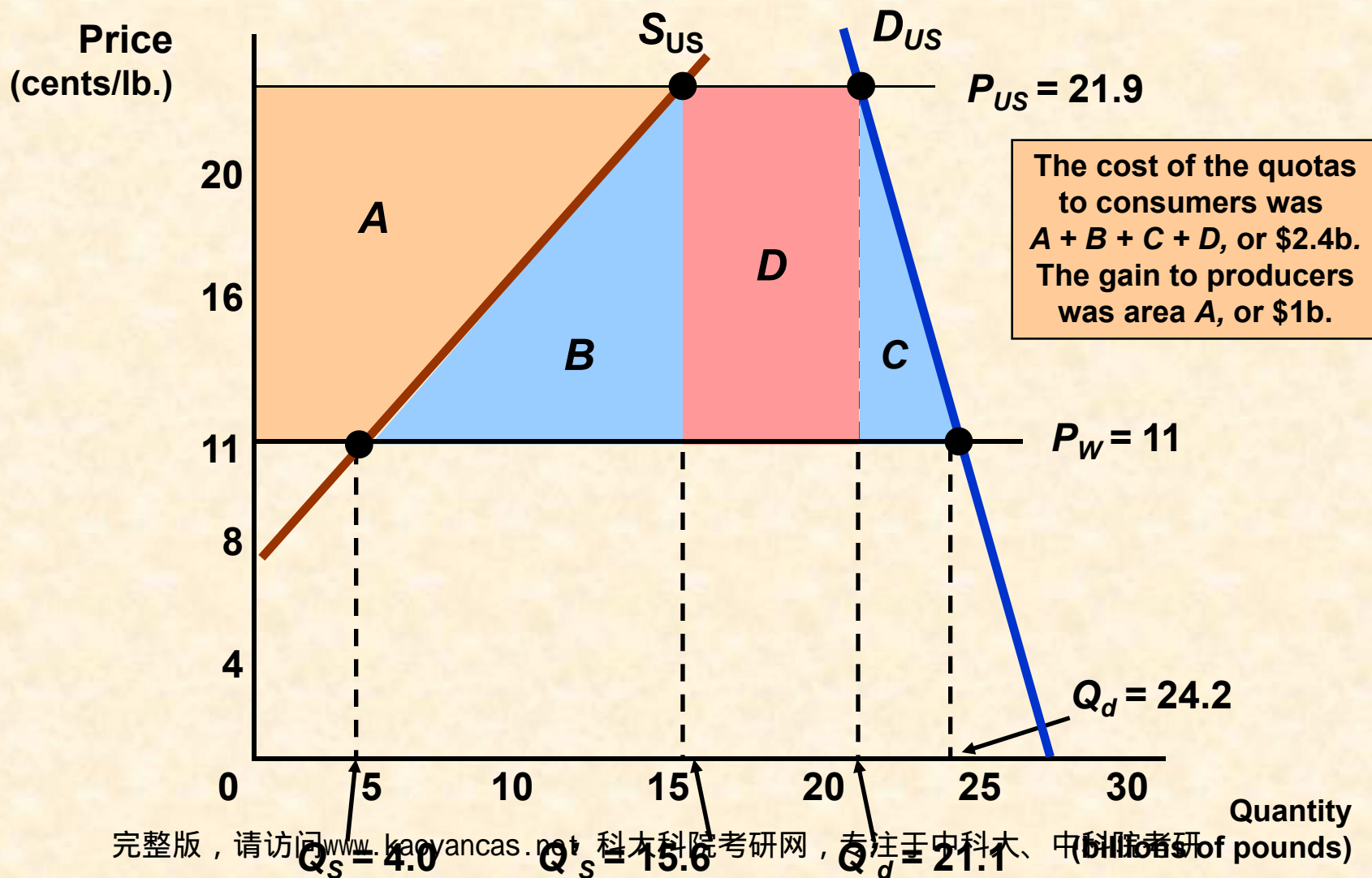
  - World price = 11 cents/pound

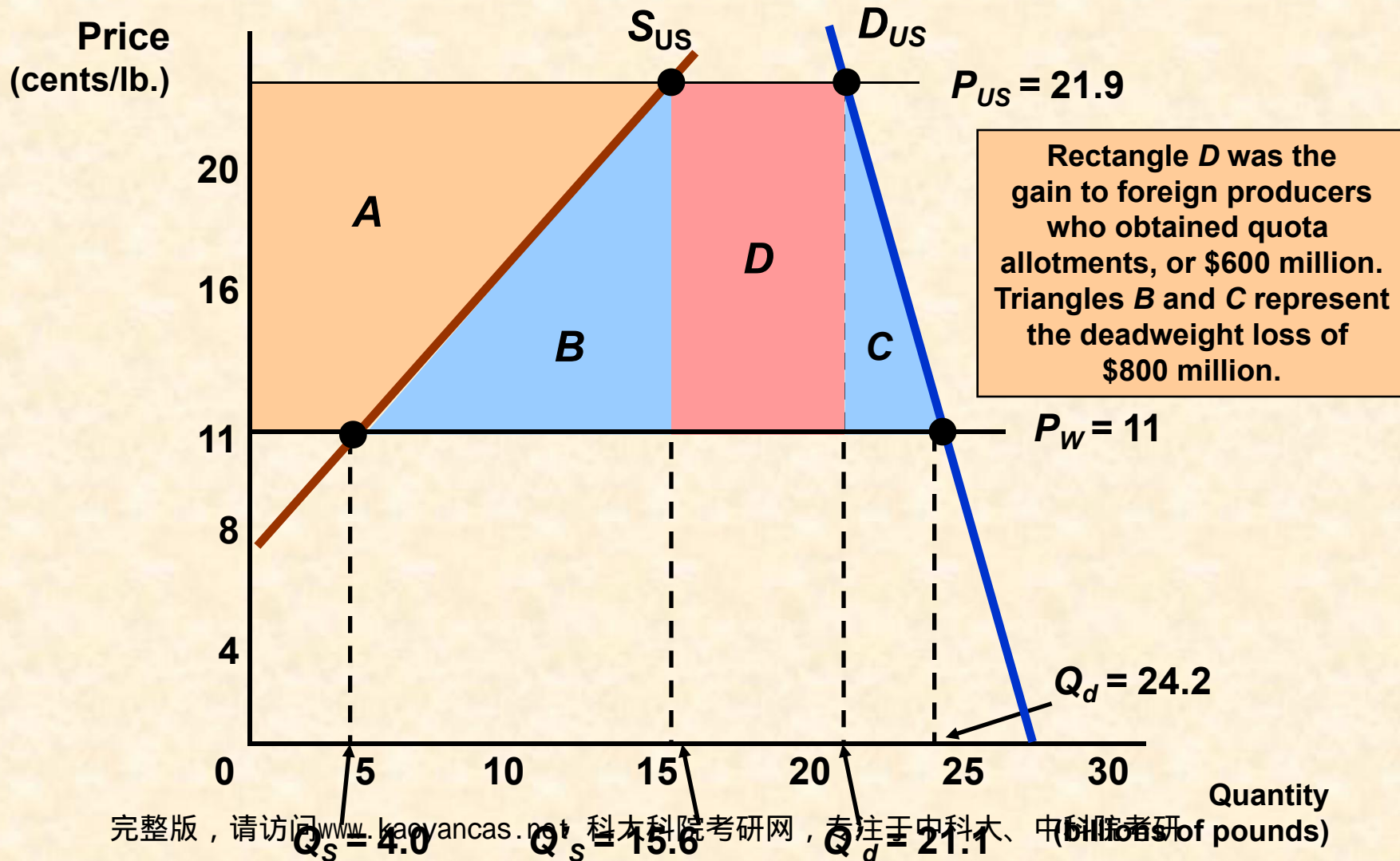# The Sugar Quota

- The Impact of a Restricted Market
  - U.S. E_S = 1.54
  - U.S. E_D = -0.3
  - U.S. supply: Q_S = -7.83+ 1.07P
  - U.S. demand: Q_D = 27.45 - 0.29P
  - P = .23 and Q = 13.7 billion pounds

Sugar Quota in 1997

Price (cents/lb.)

S_{US} D_{US}

P_{US} = 21.9

20

A

D

16

B   C

The cost of the quotas to consumers was A + B + C + D, or $2.4b. The gain to producers was area A, or $1b.

11   P_W = 11

8

4   Q_d = 24.2

0   5   10   15   20   25   30

Q_S = 4.0 Q'_S = 15.6 Q'_d = 21.1

Quantity (billions of pounds)
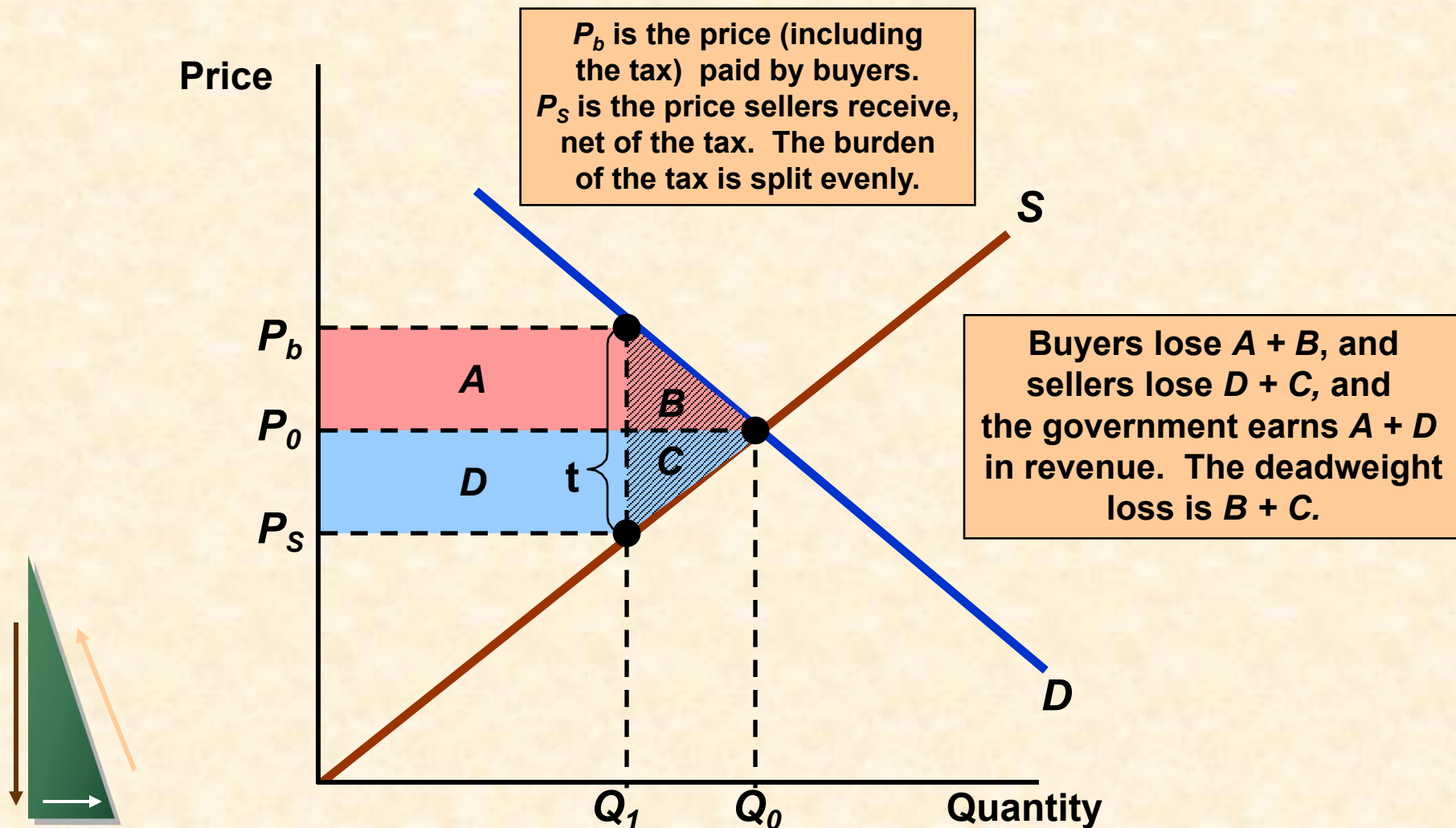
Sugar Quota in 1997

The Impact of a Tax or Subsidy

- The burden of a tax (or the benefit of a subsidy) falls partly on the consumer and partly on the producer.

- We will consider a *specific tax* which is a tax of a certain amount of money *per unit sold.*

Incidence of a Specific Tax

Price

P_b is the price (including the tax) paid by buyers. P_S is the price sellers receive, net of the tax. The burden of the tax is split evenly.

S

P_b

A

B

P_0

D t C

P_S

Buyers lose $A + B$, and sellers lose $D + C$, and the government earns $A + D$ in revenue. The deadweight loss is $B + C$.

D

Q_1 Q_0 **Quantity**

Incidence of a Specific Tax

- Four conditions that must be satisfied after the tax is in place:

  1) Quantity sold and P_b must be on the demand line: $Q^D = Q^D(P_b)$

  2) Quantity sold and P_S must be on the supply line: $Q^S = Q^S(P_S)$

Incidence of a Specific Tax

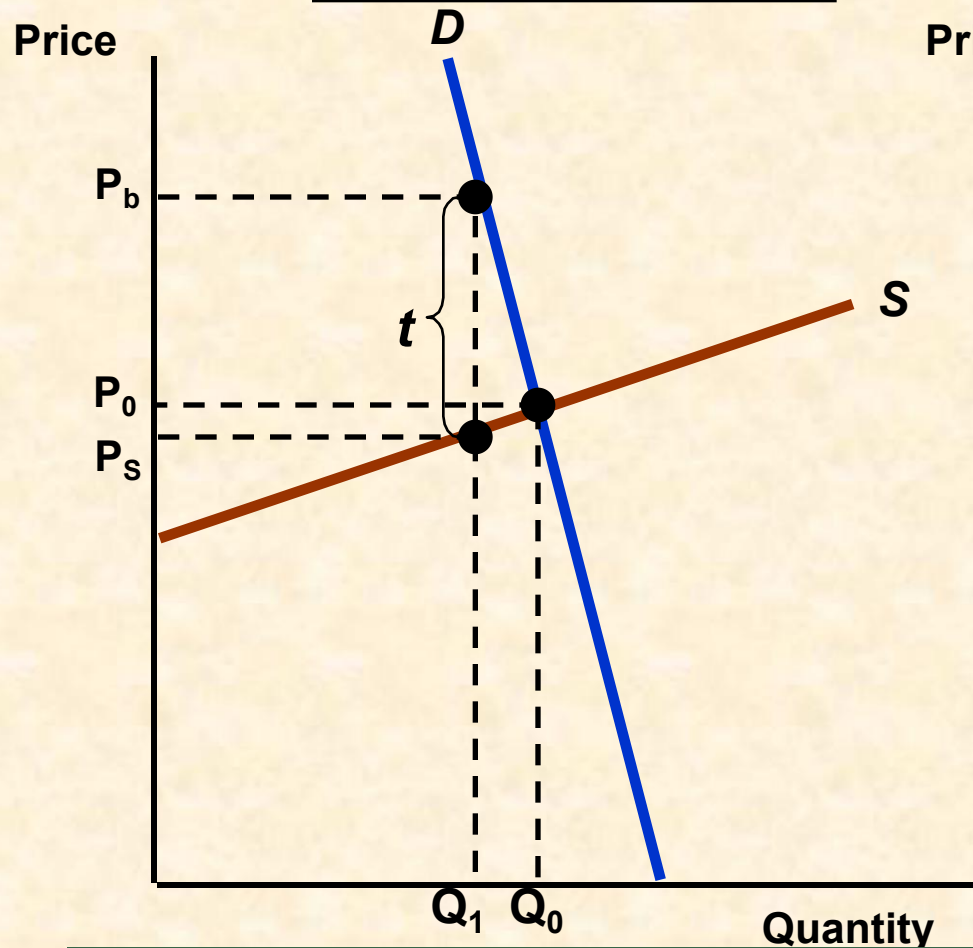- Four conditions that must be satisfied after the tax is in place:
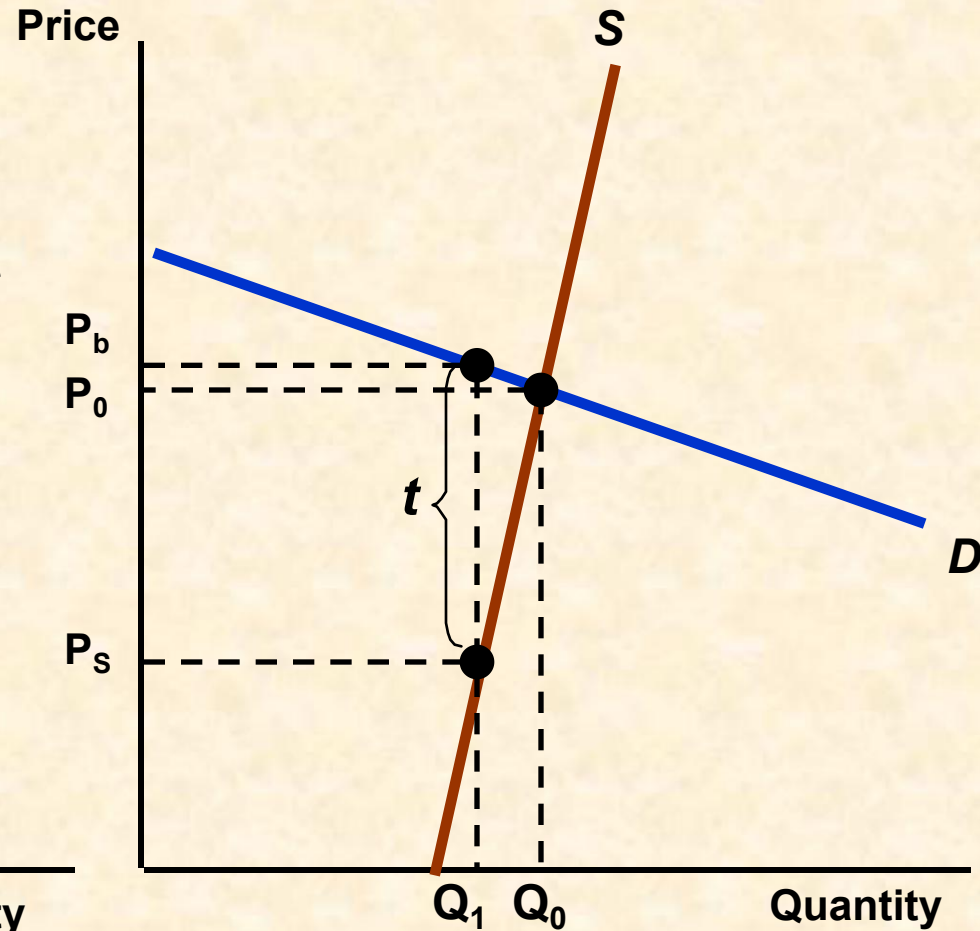
3) $Q^D = Q^S$

4) $P_b - P_S = tax$

Impact of a Tax Depends on Elasticities of Supply and Demand

The Impact of a Tax or Subsidy

- **Pass-through fraction**
  - $E_S/(E_S - E_d)$
  - For example, when demand is perfectly inelastic ($E_d = 0$), the pass-through fraction is 1, and all the tax is borne by the consumer.
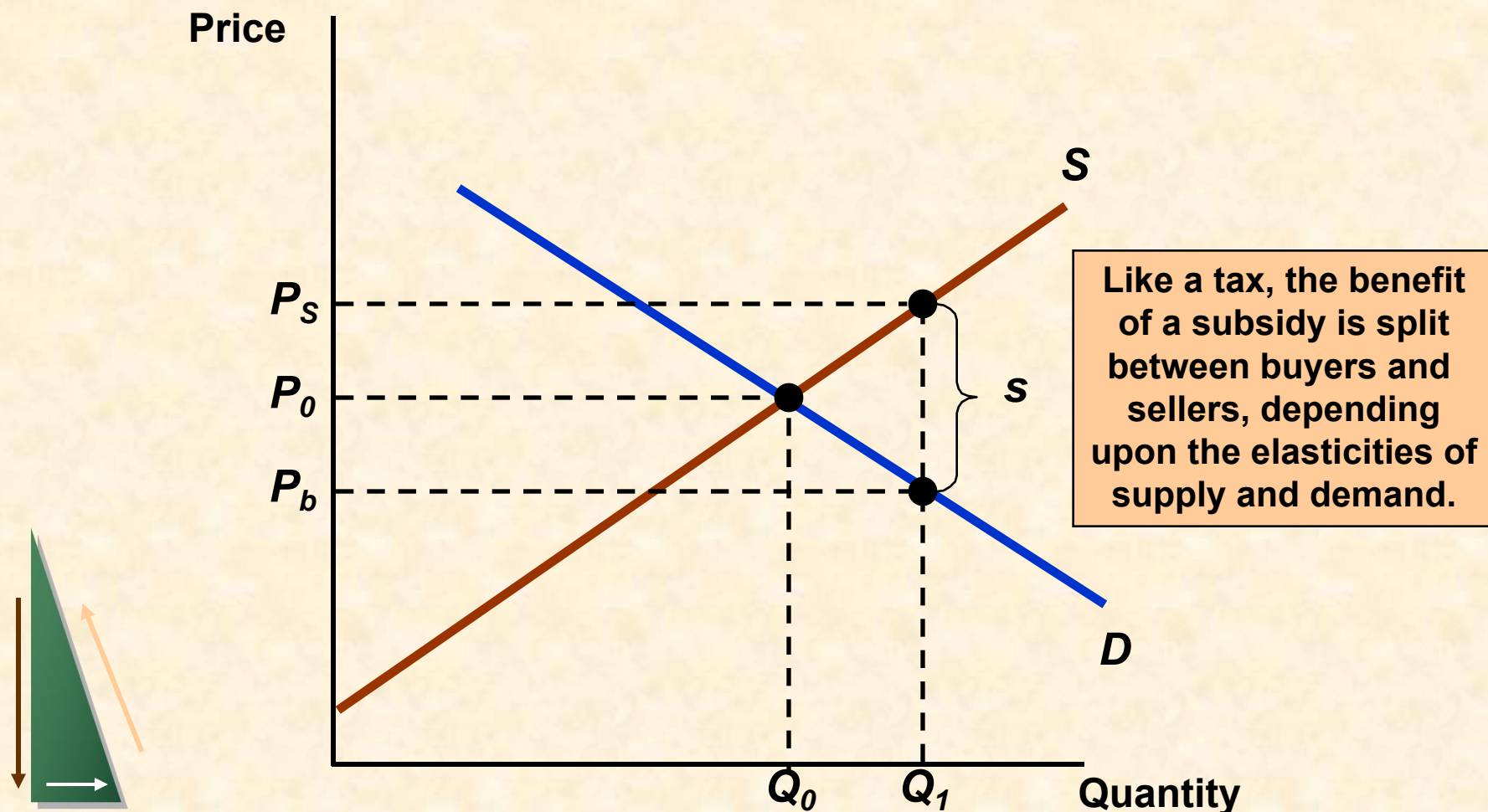
The Effects of a Tax or Subsidy

- A *subsidy* can be analyzed in much the same way as a tax.

- It can be treated as a negative tax.

- The seller's price exceeds the buyer's price.

Subsidy

Price

S

P_S

P_0

P_b

s

Like a tax, the benefit of a subsidy is split between buyers and sellers, depending upon the elasticities of supply and demand.

D

Q_0 Q_1 Quantity

Subsidy

- With a subsidy (*s*), the selling price P_b is below the subsidized price P_S so that:
  - s = P_S - P_b

Subsidy

- The benefit of the subsidy depends upon E_d/E_S.

  - If the ratio is small, most of the benefit accrues to the consumer.

  - If the ratio is large, the producer benefits most.

A Tax on Gasoline

- Measuring the Impact of a 50 Cent Gasoline Tax
  - Intermediate-run E_P of demand = -0.5

    $Q^D = 150 - 50P$

  - E_P of supply = 0.4

    $Q^S = 60 + 40P$

  - $Q^S = Q^D$ at \$1 and 100 billion gallons per year (bg/yr)

A Tax on Gasoline

- **With a 50 cent tax**

  - $Q_D = 150 - 50P_b = 60 + 40P_S = Q_S$

  - $150 - 50(P_S + .50) = 60 + 40P_S$
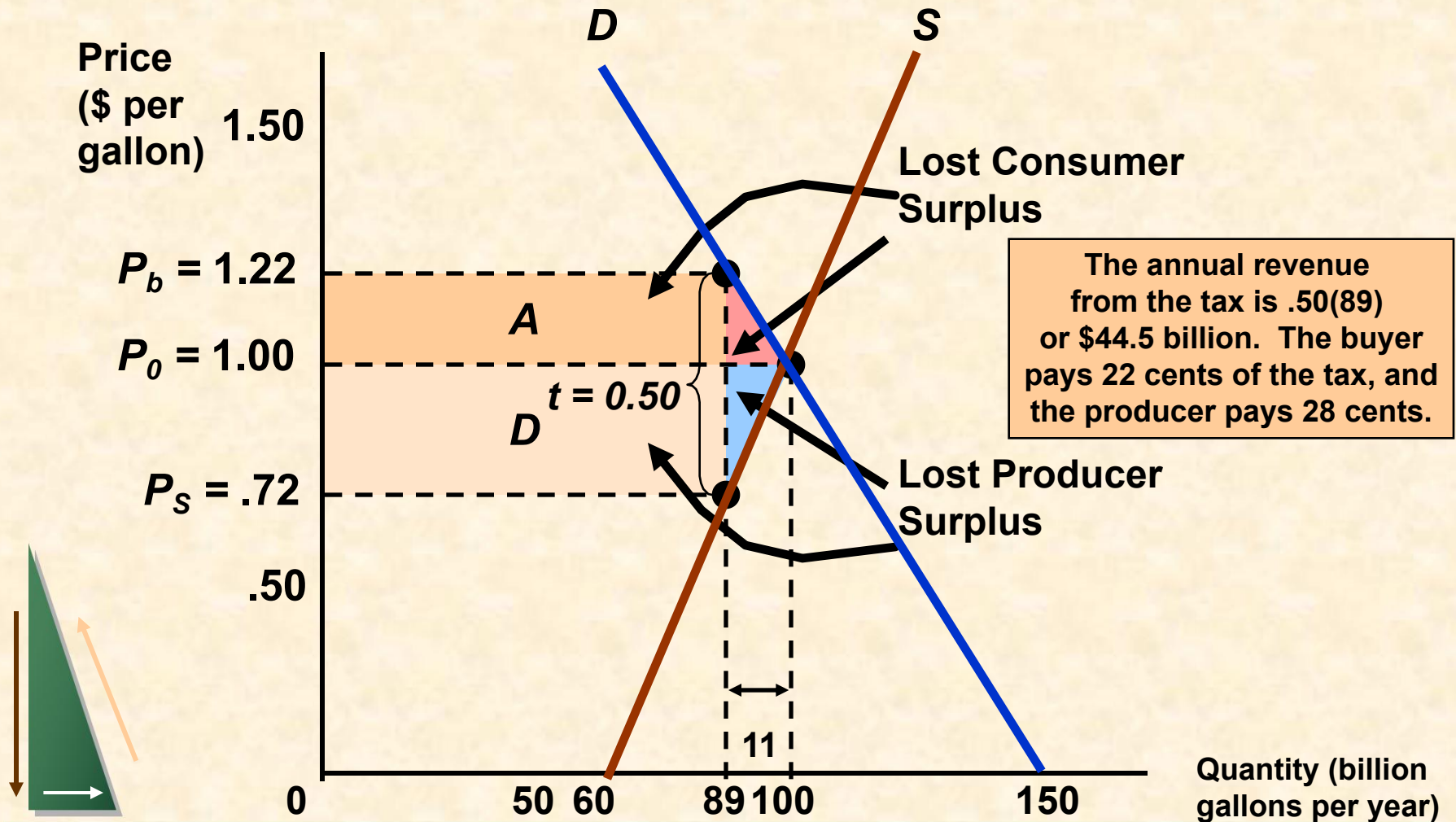
  - $P_S = .72$

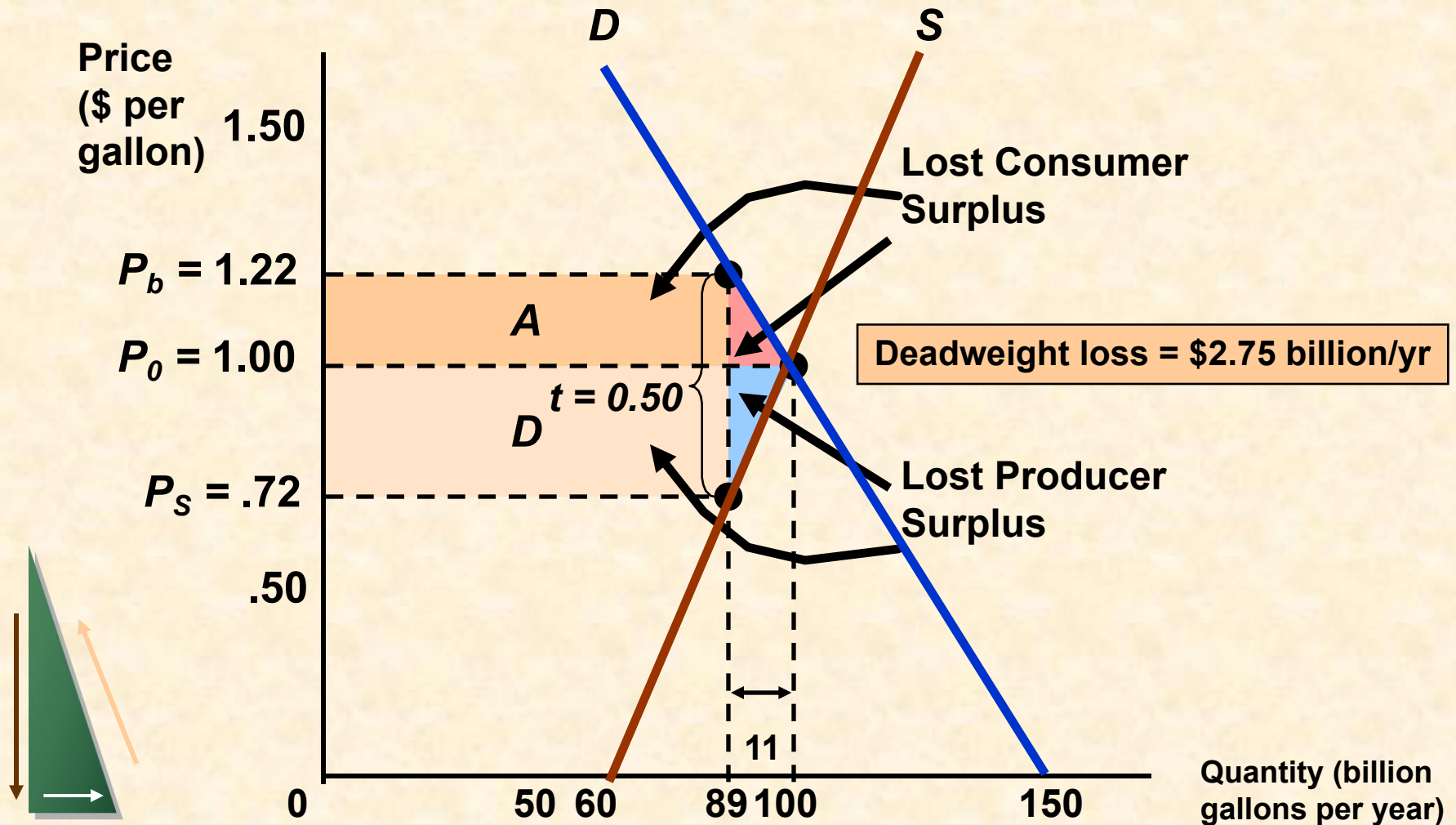 - $P_b = .5 + P_S$

  - $P_b = \$1.22$

A Tax on Gasoline

- With a 50 cent tax
  - $Q = 150 - (50)(1.22) = 89$ bg/yr
  - Q falls by 11%

Impact of a 50 Cent Gasoline Tax

Price ($ per gallon)

1.50

P_b = 1.22

P_0 = 1.00

P_S = .72

.50

D　　**S**

Lost Consumer Surplus

A

D

$t = 0.50$

Lost Producer Surplus

The annual revenue from the tax is .50(89) or $44.5 billion. The buyer pays 22 cents of the tax, and the producer pays 28 cents.

0　　**50 60**　　**89 100**　　**150**

11

Quantity (billion gallons per year)

Impact of a 50 Cent Gasoline Tax

Price ($ per gallon)

D   **S**

Lost Consumer Surplus

$P_b = 1.22$

A

$P_0 = 1.00$

Deadweight loss = $2.75 billion/yr

$t = 0.50$

D

$P_S = .72$

Lost Producer Surplus

1.50

.50

0   50 60   89 100   150

11

Quantity (billion gallons per year)

Summary

- Simple models of supply and demand can be used to analyze a wide variety of government policies.

- In each case, consumer and producer surplus are used to evaluate the gains and losses to consumers and producers.
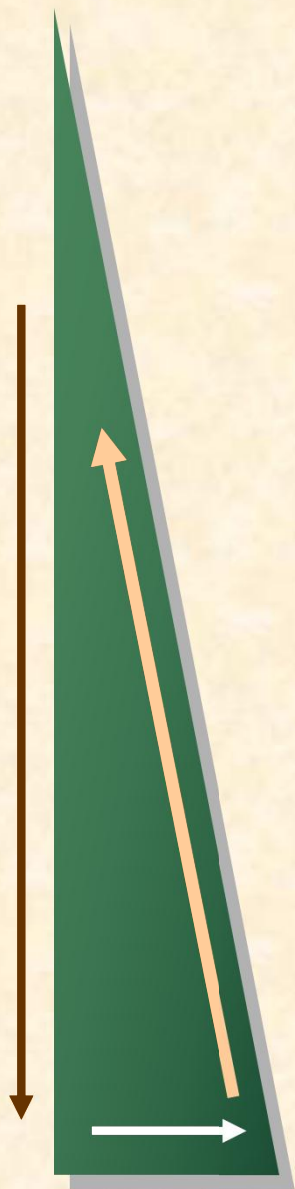
Summary

- When government imposes a tax or subsidy, price usually does not rise or fall by the full amount of the tax or subsidy.

- Government intervention generally leads to a deadweight loss.

Summary

- Government intervention in a competitive market is not always a bad thing.

End of Chapter 9

The Analysis of Competitive Markets