

## Chapter 3

### Applying the Supply-and-Demand Model

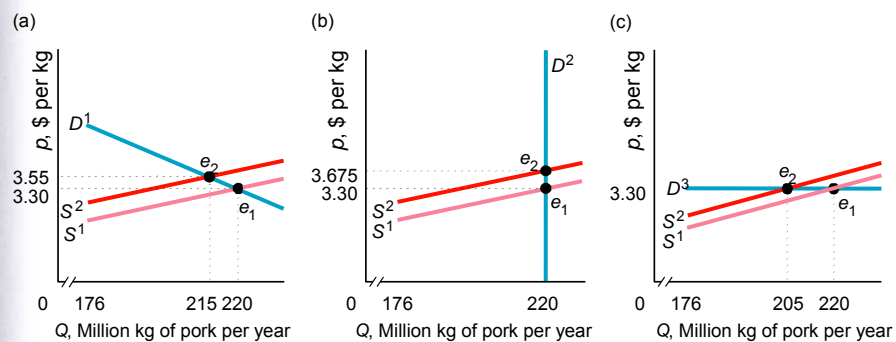
#### Applying supply and demand model

1. shapes matter
2. sensitivity of quantity demanded to price
3. sensitivity of quantity supplied to price
4. sensitivity is different in long run than in the short run
5. effects of a sales tax

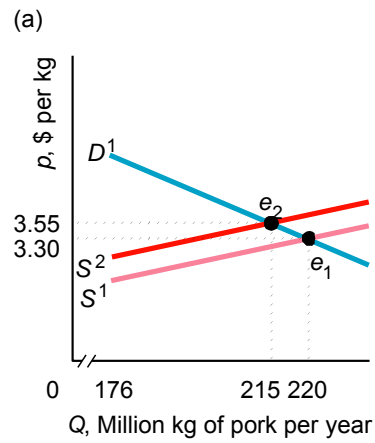
## What-if questions

- how do equilibrium price and quantity change when an underlying factor changes?
- use graphs to predict *qualitative* effects of changes: The direction of change
- need to know shape of demand and supply curves to determine *quantitative* change: amount equilibrium quantity and price change

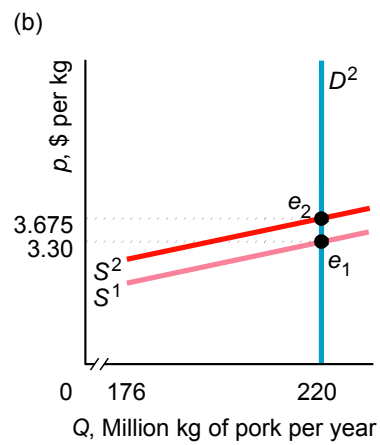
**Figure 3.1** How the Effect of a Supply Shock Depends on the Shape of the Demand Curve



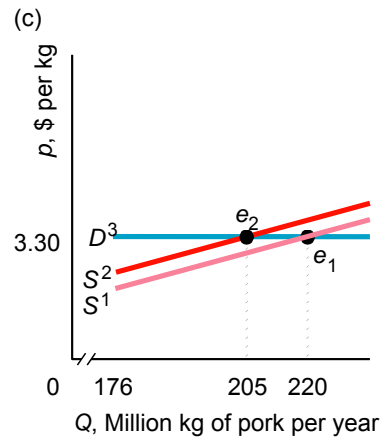
**Figure 3.1a** How the Effect of a Supply Shock Depends on the Shape of the Demand Curve



**Figure 3.1b** How the Effect of a Supply Shock Depends on the Shape of the Demand Curve



**Figure 3.1c** How the Effect of a Supply Shock Depends on the Shape of the Demand Curve



## Elasticity of demand

- summarize sensitivity of the quantity demanded to price in a single statistic: *price elasticity of demand*:

$$\varepsilon = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}} = \frac{\Delta Q/Q}{\Delta p/p}$$

$$\varepsilon = \frac{\Delta Q/Q}{\Delta p/p} = \frac{\Delta Q}{\Delta p} \frac{p}{Q}$$

## Linear demand curve

- linear demand:  $Q = a - bp$
- elasticity of demand:

$$\varepsilon = \frac{\Delta Q}{\Delta p} \frac{p}{Q} = -b \frac{p}{Q}$$

- pork demand curve:  $Q = 286 - 20p$

$$\varepsilon = \frac{\Delta Q}{\Delta p} \frac{p}{Q} = -b \frac{p}{Q} = -20 \frac{3.30}{220} = -0.3$$

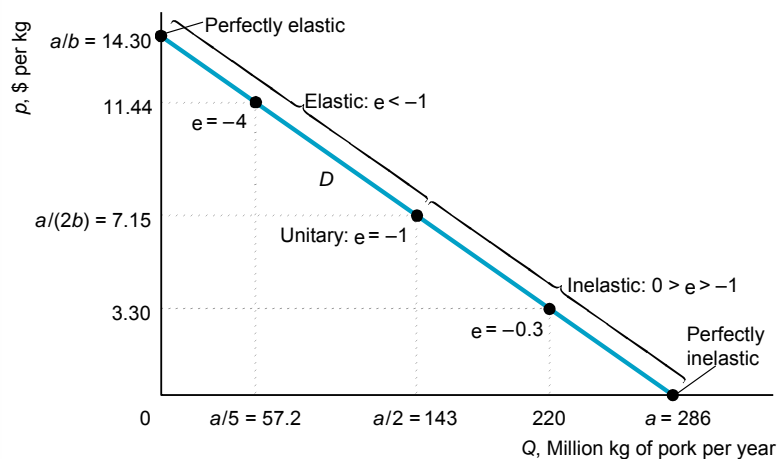
## Interpretation of pork demand elasticity

- 1% increase in price of pork leads to an  $\varepsilon\%$  = -0.3% change in the quantity demanded
- quantity falls less than in proportion to price
- negative price elasticity, -0.3, is consistent with Law of Demand

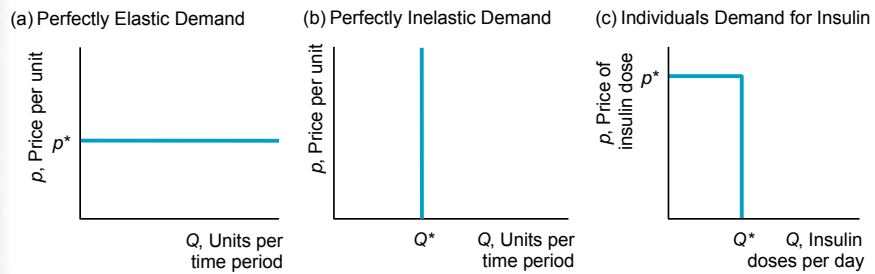
## Types of elasticities

- *elastic*: the quantity demanded changes more than in proportion to a change in price
- *inelastic*: the quantity demanded changes less than in proportion to a change in price
- *elasticity of demand varies along most linear demand curves*

**Figure 3.2** Elasticity Along the Pork Demand Curve

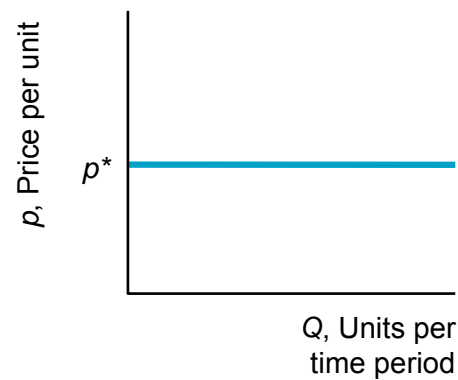


### Figure 3.3 Vertical and Horizontal Demand Curves



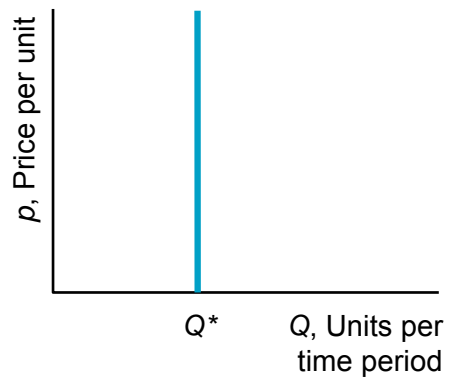
### Figure 3.3a Vertical and Horizontal Demand Curves

(a) Perfectly Elastic Demand



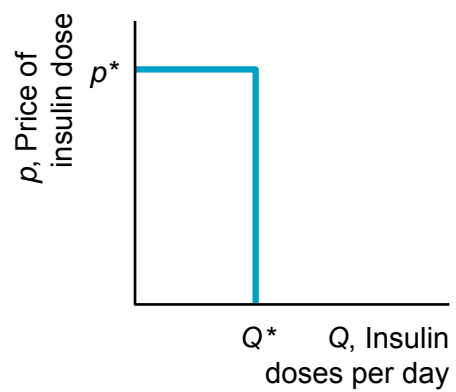
### Figure 3.3b Vertical and Horizontal Demand Curves

(b) Perfectly Inelastic Demand



### Figure 3.3c Vertical and Horizontal Demand Curves

(c) Individual's Demand for Insulin





## An Application: Electric power

Why did wholesale electric power rates suddenly shoot up?

## One answer to the electricity problem

- “demand increased 5% more than expected”
- limited capacity  $\Rightarrow$  short-run supply nearly vertical

## Pork income elasticity of demand

pork demand function is

$$Q = 171 - 20p + 20p_b + 3p_c + 2Y$$

so pork income elasticity is

$$\xi = \frac{\Delta Q}{\Delta Y} \frac{Y}{Q} = 2 \frac{Y}{Q}$$

at  $Q = 220$  and  $Y = 12.5$

$$\xi = 2 \times 12.5 / 220 = 0.114$$

## Cross-price elasticity of demand

- how quantity of one good changes as price of another good increases

$$\begin{aligned} & \frac{\% \text{change in quantity demanded}}{\% \text{change in price of another good}} \\ &= \frac{\Delta Q / Q}{\Delta p_o / p_o} = \frac{\Delta Q}{\Delta p_o} \frac{p_o}{Q} \end{aligned}$$

## Negative cross-price elasticity

- When the cross price elasticity is negative between two goods, the goods are ***complements***.
- as the other good's price increases, people buy less of this good
- demand curve shifts to the left
- examples
  - as price of cream rises, people consume less coffee (cross-price elasticity is negative)
  - Ford wants to know how much a change in the price of a Camry affects the demand for a Taurus

## Positive cross-price elasticity

- When the cross price elasticity is positive between two goods, the goods are ***substitutes***.
- as the price of the other good increases, people buy more of this good
- demand curve shifts to the right
- example: cross-price elasticity of pork with respect to the price of beef is positive

## Pork-beef example

- pork demand function is

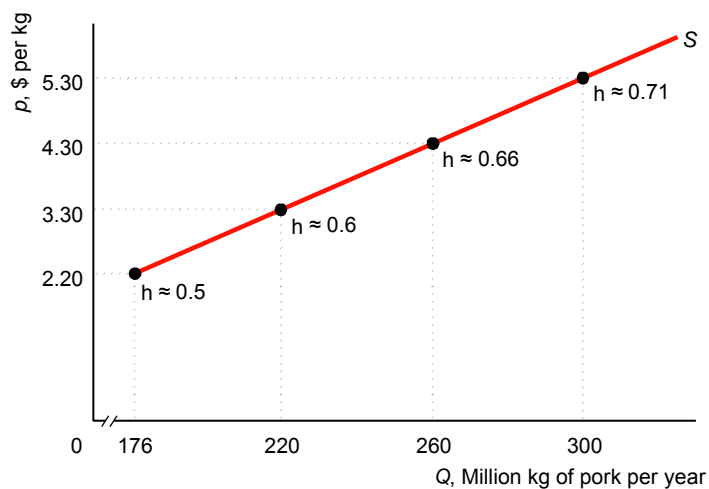
$$Q = 171 - 20p + 20p_b + 3p_c + 2Y$$

- so cross-price elasticity of demand for pork and the price of beef is

$$\frac{\Delta Q}{\Delta p_o} \frac{p_o}{Q} = 20 \frac{p_b}{Q}$$

- at  $Q = 220$  and  $p_b = \$4$  per kg, cross-price elasticity is  $20 \times 4/220 = 0.364$

**Figure 3.4** Elasticity Along the Pork Supply Curve



## Burden of Tax: Predictions based on elasticities

knowing only the elasticities of demand and supply, we can make accurate predictions about the effects of a new tax and determine how much of the tax falls on consumers

## Two types of sales taxes

- *ad valorem* tax (*the* sales tax): for every dollar the consumer spends, the government keeps a fraction,  $\alpha$
- *specific (unit)* tax: a specified amount,  $\tau$ , is collected per unit of output

## 4 Questions about sales taxes

- what effect does a specific sales tax have on equilibrium prices and quantity?
- are sales taxes assessed on producers "passed along" to consumers? (do consumers pay entire tax?)
- do equilibrium price and quantity depend on whether the consumers or producers are taxed?
- do both types of sales taxes have the same effect on equilibrium?

## Specific tax

- assume the specific tax is assessed on firms at the time of sale
- consumer pays  $p$
- government takes  $\tau$
- seller receives  $p - \tau$

## Tax on consumer

<i>Per unit tax</i>	<i>Total tax revenue</i>	<i>Firms' after-tax revenue</i>
ad valorem tax $\alpha p$	$T = \alpha pQ$	$(1 - \alpha)pQ$
specific tax $\tau$	$T = \tau Q$	$pQ - \tau Q$

## An Animated illustration

- In this animated slide, we see that in a competitive market a sales tax or an equivalent consumption tax have the same effect on the equilibrium.
- The effects on quantity, price and the incidence of tax that falls on consumers depend on the demand and supply elasticities.
- In competitive market, whether the tax is collected from consumers or producers has the same effects on quantity, price and the incidence of tax that falls on consumers and producers.

## Animated Graph 3.6

- After the illustration by the animated graph, I will explain each of them step by step.
- [Animated Example:](#)

## In-class problem

When a specific tax is imposed on pork, what happens to prices?

- A. prices consumers pay and firms receive both rise
- B. consumer's price up, firms' price unchanged
- C. consumers' price up, firms' price down

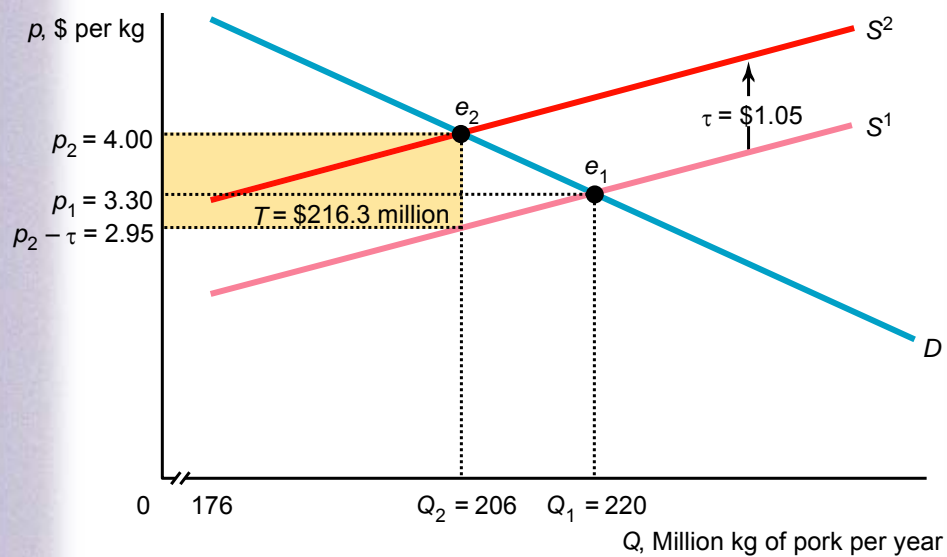


## Question 1

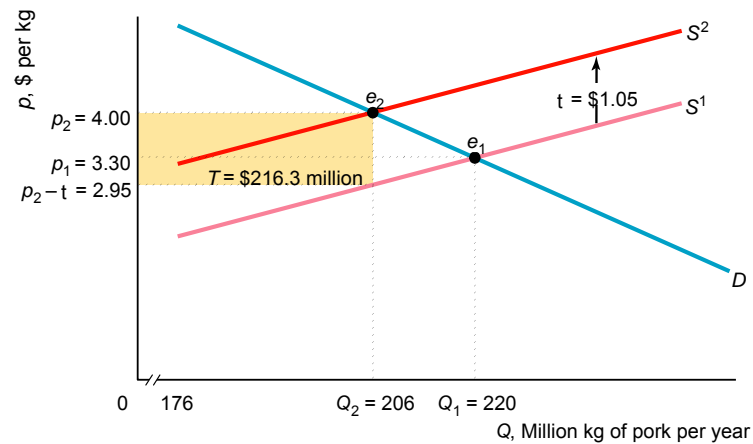
*what is the effect of a specific tax on the equilibrium?*

- *answer:* See Figure 3.5 where we shift up the after-tax supply curve
  - equilibrium price rises
  - equilibrium quantity falls
  - government collects tax revenues

**Figure 3.5** Effect of a \$1.05 Specific Tax on the Pork Market Collected from Producers



**Figure 3.5** Effect of a \$1.05 Specific Tax on the Pork Market Collected from Producers



### Summary on equivalence of two taxes

- We see that the outcomes are exactly same in either type of taxes.

## Equilibrium Effects of Specific Tax (Analytically), pp. 59-63.

- *Who is hurt by the tax?*
- *What is the incidence of the tax?*
- Incidence of a tax on consumers is share of tax that consumers pay

$$\frac{\Delta p}{\Delta \tau} = \frac{\eta}{\eta - \varepsilon}$$

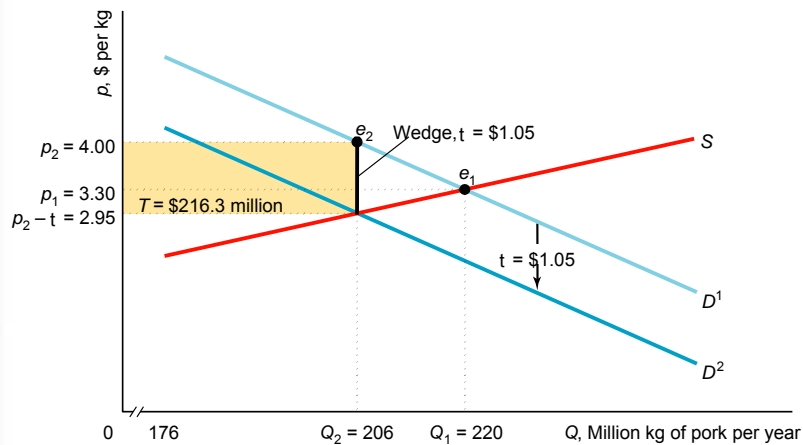
## Incidence of a tax on pork (from figure 3.6 and analytically using the above formula)

- Figure 3.6 (next slide) shows consumer incidence is  
 $\Delta p / \Delta \tau = \$0.70 / \$1.05 = 2/3$
- Using elasticities: In this example, demand elasticity  $\varepsilon = -0.3$ , supply elasticity,  $\eta = 0.6$ . The consumer incidence is then

$$\eta / (\eta - \varepsilon) = 0.6 / (0.6 - [-0.3]) = 2/3$$

Notice that more elastic the demand is say  $\varepsilon = -2.4$ , i.e., less steep the demand curve is, incidence is \$0.21 instead of \$0.71 earlier. i.e., lower is the incidence. (Using graphs next)

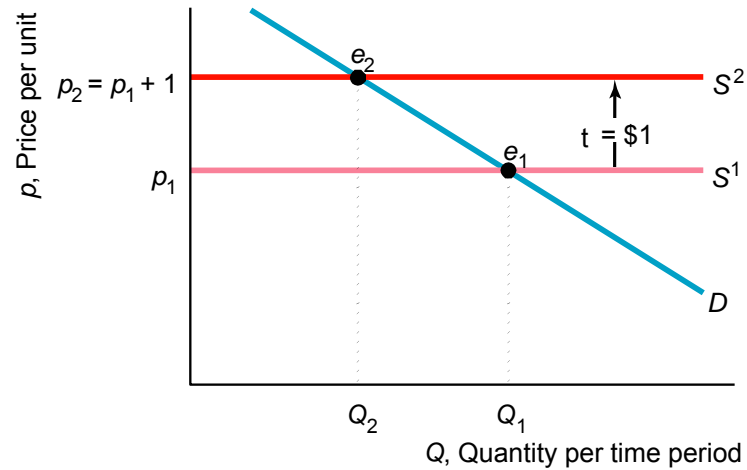
**Figure 3.6** Effect of a \$1.05 Specific Tax on Pork Collected from Consumers



### Solved Problem: 3.1

- If the supply curve is perfectly elastic and demand is linear and downward sloping, what is the effect of a \$1 specific tax collected from producers on equilibrium price and quantity, and what is the incidence on consumers? **Why?**

### Page 64 Solved Problem 3.1



### Solved Problem fig 3.2, p. 68

- If the supply curve for fresh fruit is perfectly inelastic and the demand curve is downward sloping straight line, what is the effect of an ad valorem tax on equilibrium price and quantity, and what is the incidence on consumers? **Why?**

## Page 68 Solved Problem 3.2

