

Key issues

- demand
- supply
- market equilibrium
- shocking the equilibrium
- effects of government interventions
- when to use supply and demand model

Supply and demand model

- most widely-used economic model
- testable (like all good theories)
- describes how consumers and suppliers interact in a market to determine quantity of a good sold and its price

To use supply and demand model

- you need to determine
 - buyers' behavior
 - sellers' behavior
 - how they interact
- know whether the model is:
applicable to the market under examination

Quantity demanded

is the amount of a good or service that consumers *want* to buy at a given price, holding constant other factors that affect demand

What determines demand?

- tastes
- price of this good
- prices of other goods
- income
- information (cholesterol)
- government actions
- other factors: nicotine, ...

Demand curve

- shows *quantity demanded*—largest quantity that consumers are willing to buy—at each price, holding constant other factors that affect purchases
- note: *quantity demanded* of a good or service can exceed *quantity sold* (or vice versa)
- strange demand curve convention: price is on the vertical axis

Demand Curve for Canadian Pork



Effect of price changes

- *movement along the demand curve*
- *demand curve* is a concise summary of the answer to the question:
what happens to the quantity demanded as the price changes, holding all other factors constant?

Law of demand

- demand curves slope down
- \Rightarrow a drop in price results in an increase in quantity demanded (holding other factors constant)
- one of the most important empirical findings in economics

Demand effects of other factors

- change in any factor other than the price of the good causes a *shift of the demand curve* (not a *movement along the demand curve*)
- this shift of the demand curve is a trick to avoid drawing 3D diagrams

Effect on pork demand of a rise in price of beef

- beef is a substitute for pork
- at a given price of pork, a rise in the price of beef causes some people to switch from beef to pork

A Shift of the Pork Demand Curve

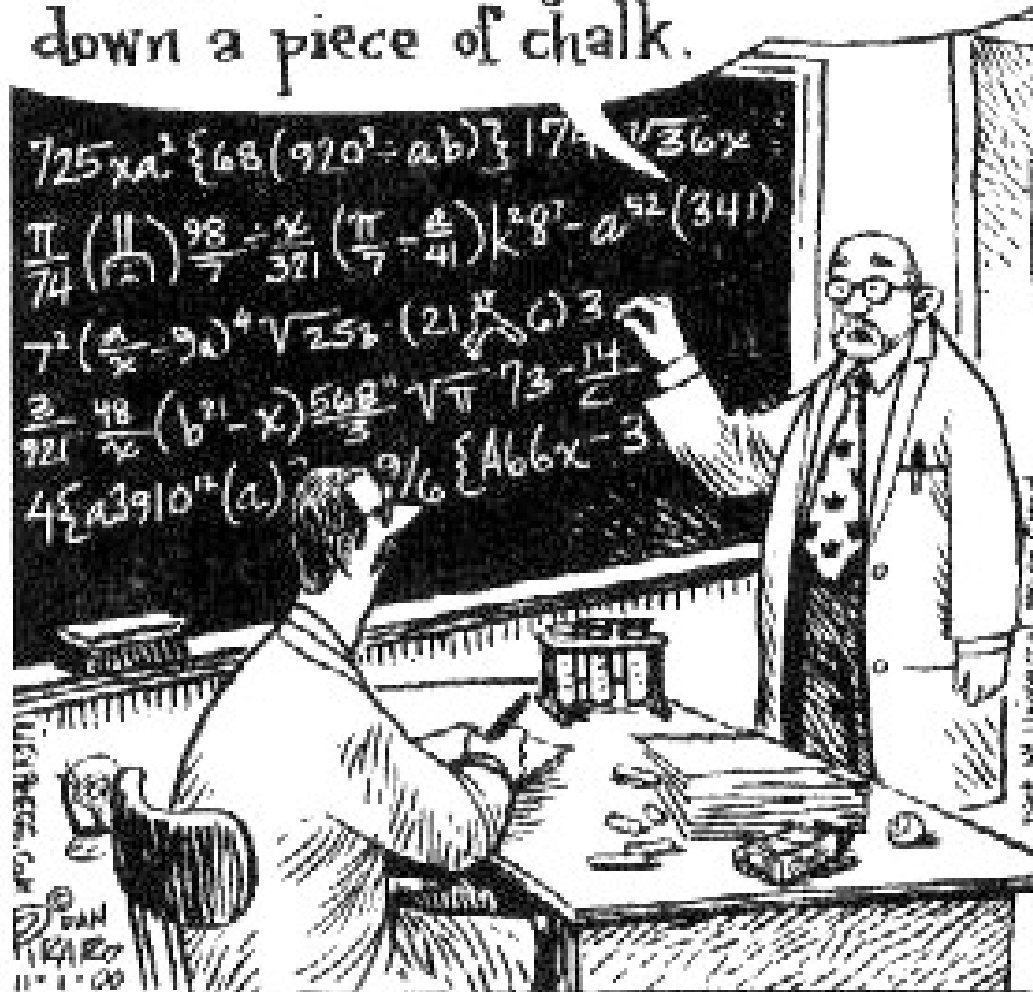


Summary

- *change in the price of a good causes a movement along a demand curve*
- *change in any other factor besides the price causes a shift of the demand curve*

BIZARRO *Piraro*

...and so, from this experiment, we can see that it takes an average of 374 random symbols to wear down a piece of chalk.



Variable definitions

- Q = quantity of pork demanded (million kg per year)
- P = price of pork (\$ per kg)
- P_b = price of beef (\$ per kg)
- P_c = price of poultry (\$ per kg)
- I = income of consumers (thousand \$)

Demand function

- general function

$$Q = D(P, P_b, P_c, I)$$

- specific (linear) pork demand function

$$Q = 171 - 20P + 20P_b + 3P_c + 2I$$

Summing demand curves

- total demand is sum of demand for all consumers
- suppose there are 2 consumers with demand curves:

$$Q_1 = D^1(P)$$

$$Q_2 = D^2(P)$$

- total quantity demanded = horizontal sum of quantity each consumer demands at each given price:

$$Q = Q_1 + Q_2 = D^1(P) + D^2(P)$$

Aggregating the Demand for Cling Peaches



Quantity supplied

is the amount of a good or service that firms *want* to sell at a given price, holding constant other factors that affect supply

Supply is a function of

- price
- costs of production
- government rules and regulations
- technology

Supply curve

- increase in price of pork causes a *movement along the supply curve* (holding fixed other variables that affect supply)
- supply curve is a concise summary of answer to the question:
what happens to the quantity supplied as the price changes holding all other factors constant?

Supply Curve of Canadian Pork



Effect of price on supply

- supply curve for pork is upward sloping
- thus, increase in the price of pork \Rightarrow movement along the supply curve, resulting in larger quantity of pork supplied

There is no "Law of Supply"

market supply curve may be upward sloping, vertical, horizontal, or downward sloping

Supply effects of other variables

shift in a variable other than price of pork
causes the entire *supply curve to shift*

A Shift of Pork Supply Curve



Summary

- change in price of pork causes a *movement along the supply curve*
- when costs, government rules, or other variables that affect supply change, the *supply curve shifts*

General supply function

Summing supply curves

total supply curve

- horizontal summation of individual supply curves
- shows total quantity produced by all suppliers at each possible price

Total Supply: The Sum of Domestic and Foreign Supply



Solved problem



- What is the effect of a ban on foreign imports of rice into Japan on the supply curve of rice to the Japanese market?
- (suppose that domestic and foreign supply curves of rice in Japan are linear, upward sloping curves with the same intercept and different slopes)

Restatement of problem

- in most of our problems we are asked to determine how a *change* in a variable or policy *affects* one or more variables
- what *changes*: foreign rice may no longer be imported
- which *affects* foreign supply and total Japanese supply curve

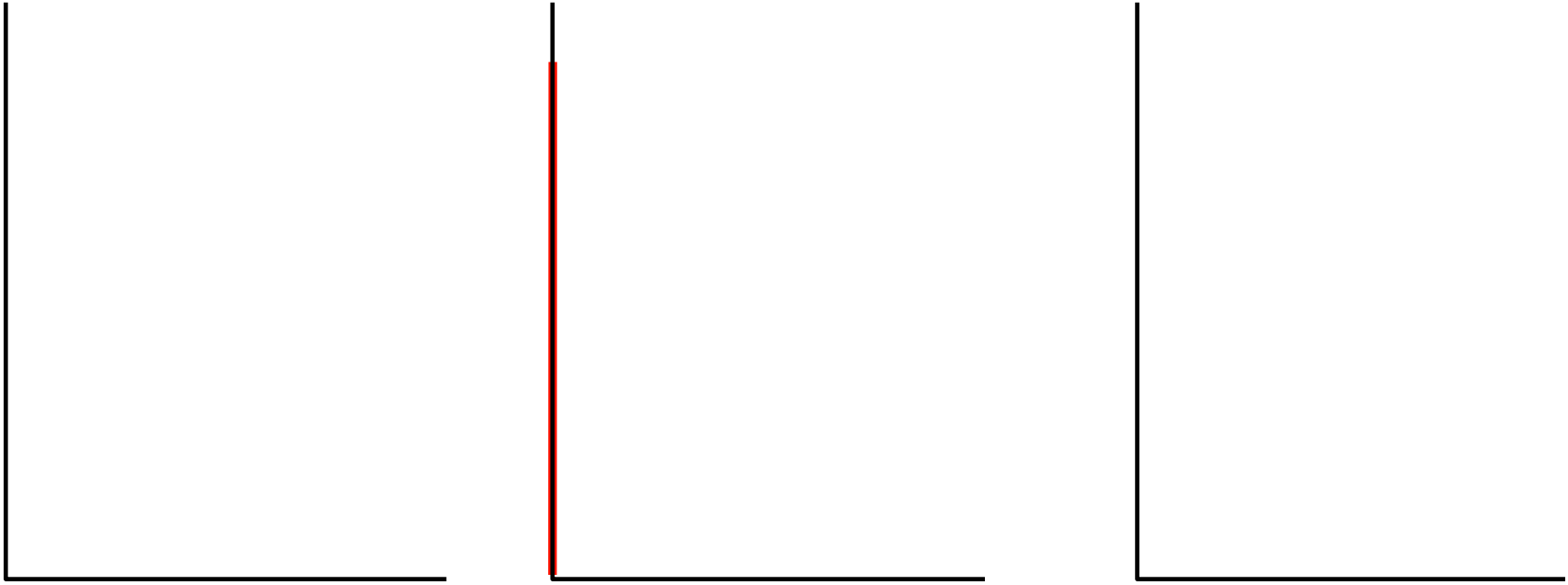
Answer

1. *show what the ban does to the foreign supply*: ban prevents imports \Rightarrow new foreign supply curve, S^f , lies on the vertical axis
2. *compare the new and original foreign supply curves*: at prices above the price where foreign supplier originally supplied quantity, the new foreign supply curve lies to left of original one

Answer (continued)

- 3. show what happens to new total supply:* new total supply curve is the horizontal sum of the Japanese supply curve, S^d , and foreign supply curve, S^f . Thus, new total supply curve is identical to domestic supply curve
- 4. compare new and original total supply curves:* at any price above the price where any quantity was originally supplied by foreign suppliers, the new total supply curve lies to the left of the original one

Total Supply: The Sum of Domestic and Foreign Supply



Supply and demand: Market equilibrium

- supply and demand curves determine market price and quantity
- unless price is set so that consumers want to buy exactly as much as suppliers want to sell, some party will be frustrated
- when neither buyers nor sellers are disappointed, market is in *equilibrium*: no one wants to change his or her behavior

Equilibrium

- *equilibrium price*: price where
 - consumers can buy as much as they want
 - sellers can sell as much as they want
- *equilibrium quantity*: quantity bought and sold at the equilibrium price

Pork Market Equilibrium

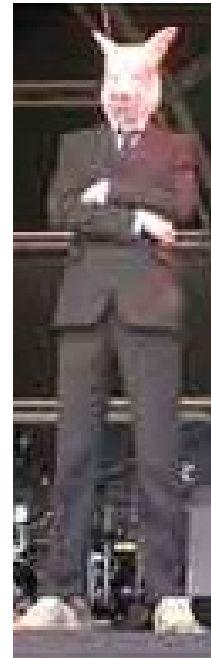


Determine equilibrium price

Determine equilibrium quantity

Invisible hand

at nonequilibrium price, consumers or firms
change their behavior (market forces)
driving price to equilibrium

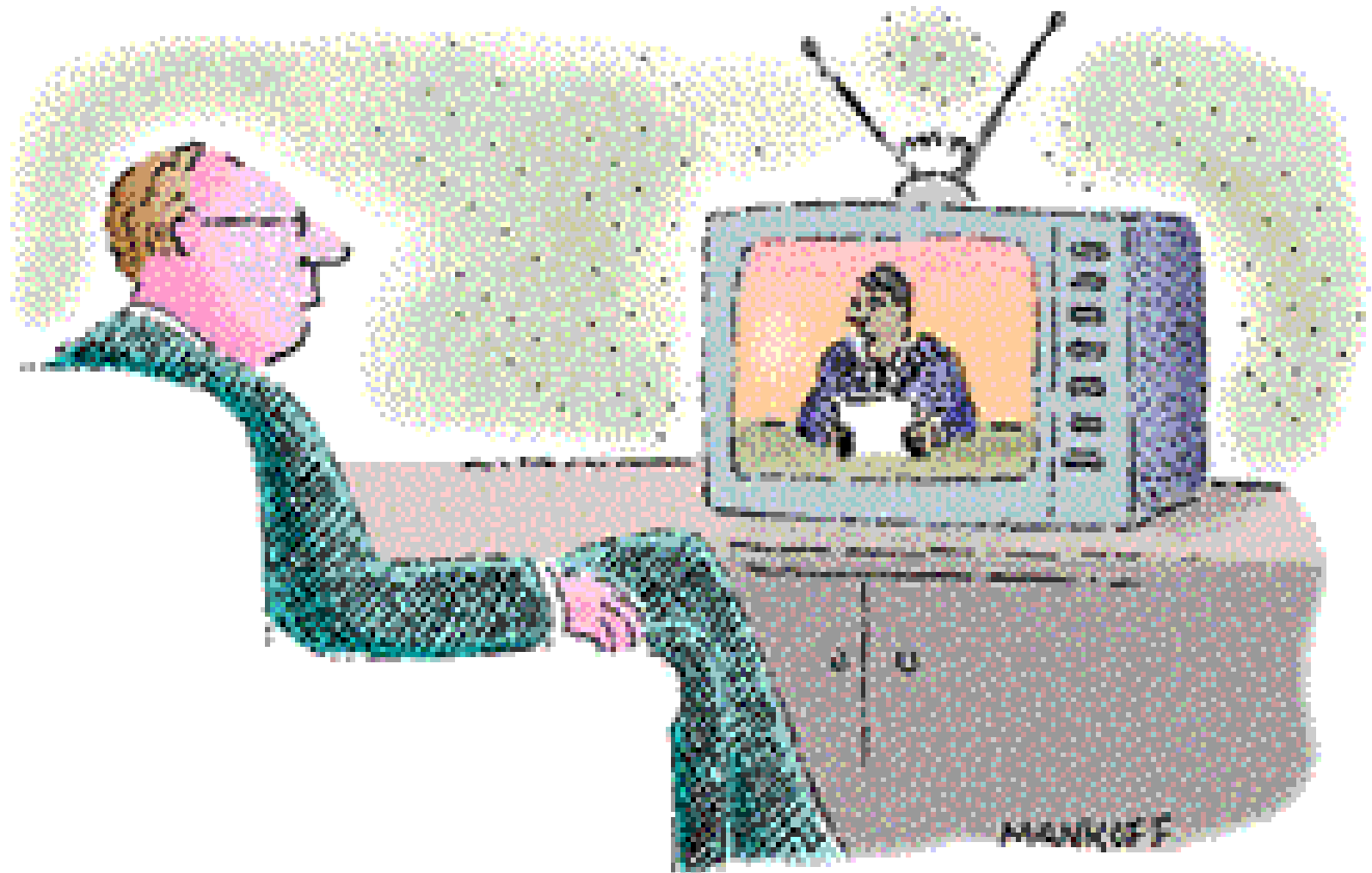




CORPORATE LEADERS GATHER IN A FIELD OUTSIDE DARIEN, CONNECTICUT, WHERE ONE OF THEM CLAIMS TO HAVE SEEN THE INVISIBLE HAND OF THE MARKETPLACE.

Market forces drive market to equilibrium

- at prices $<$ equilibrium level: *excess demand* (amount by which quantity demanded exceeds quantity supplied at the specified price)
- at price $>$ equilibrium level: *excess supply*
- equilibrium price is market clearing price: no excess demand or excess supply



"On Wall Street today, the stock market was down. Analysts say this was because more people wanted to sell stocks than buy them."

Pork Market Equilibrium



Shocking the equilibrium

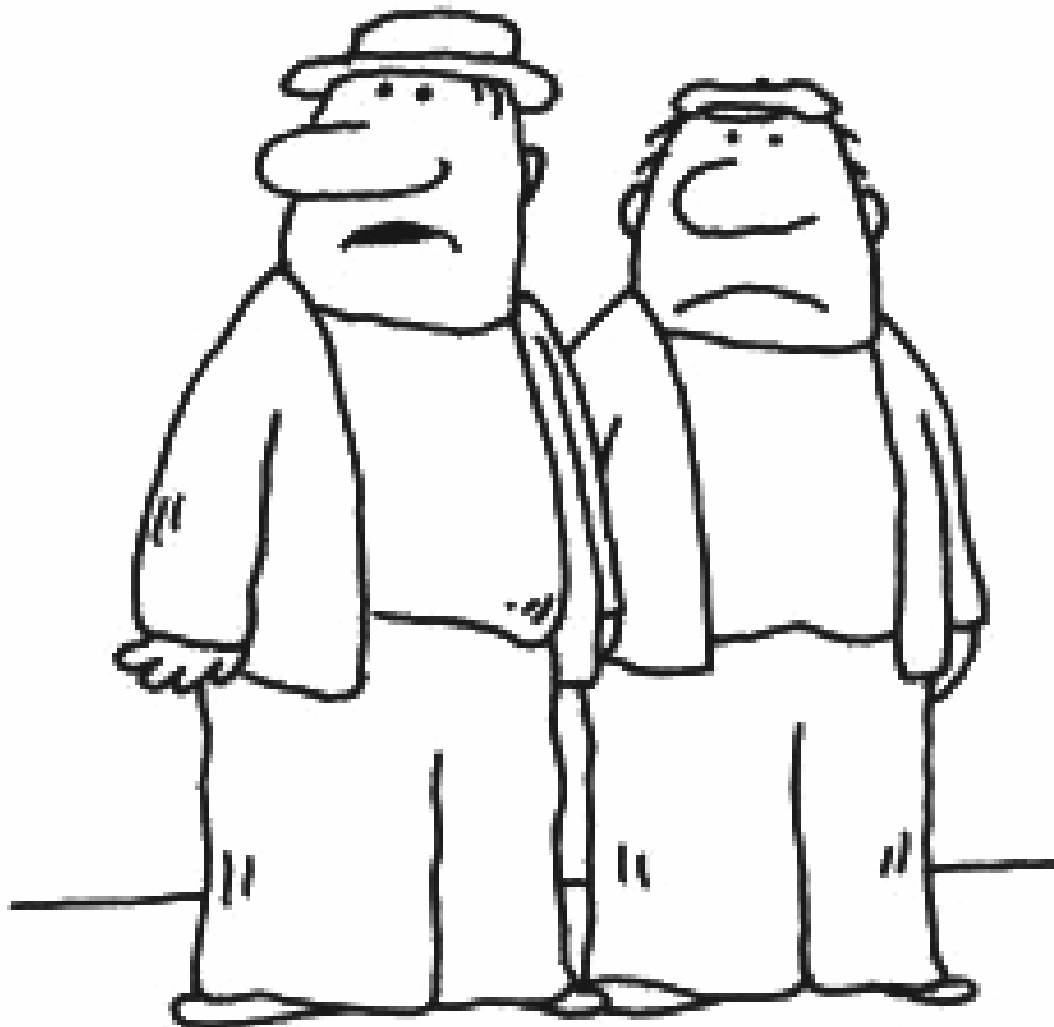
- once an equilibrium is achieved, it can persist indefinitely because no one applies pressure to change the price
- equilibrium changes only if
 - demand curve shifts
 - supply curve shifts
 - government intervenes

Effects of a Shift of the Pork Demand Curve



Government policies

- ceiling price
 - price controls
 - usury laws
 - rent control
- floor price: minimum wage
- quotas (restriction on supply)
- taxes and tariffs (tax on imports only)



C. Zervetti

"There, there it is again—the invisible hand of the marketplace giving us the finger."

Zimbabwe price controls

- October 2001 during a presidential campaign, Zimbabwe's government imposed price controls on many basic commodities
 - foods (about a third of citizens' daily consumption)
 - soap
 - cement
- controls led to shortages
- thriving *black* or *parallel market* developed
- black market prices 2 to 3 x controlled prices

In-class problem: price ceiling

Zimbabwe set a price ceiling (maximum price) on many goods. What effect does that have on these markets?

Answer: price falls and

- A. equilibrium quantity increases
- B. a shortage occurs
- C. equilibrium quantity falls

Answer

1. *show the initial equilibrium*: intersection of supply and demand curves determines equilibrium
2. *show price ceiling*: horizontal line
3. *show effect of restrictions*:
 - if ceiling is above original equilibrium price: no effect
 - if binding: price falls to ceiling, quantity suppliers to sell, Q_s , < quantity consumers want to buy, Q_d , so excess demand (shortage)

Price ceiling



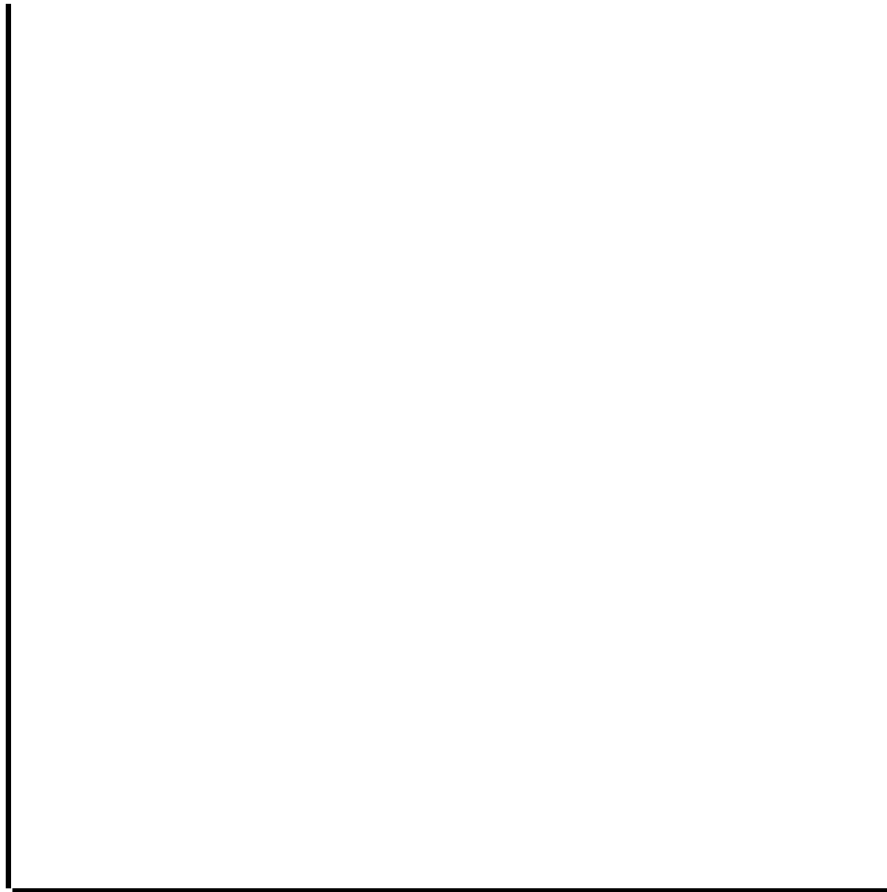
Supply need not equal demand

- price ceilings or price floors \Rightarrow quantity supplied does not necessarily equal quantity demanded
- *quantity supplied* = amount firms want to sell at a given price, holding constant other factors that affect supply
- *quantity demanded* = amount consumers want to buy at a given price, holding constant other factors

The Price of a College Education

- The real price of a college education rose 55 percent from 1970 to 2002
- Increases in costs of modern classrooms and wages increased costs of production
 - decrease in supply
- Due to a larger percentage of high school graduates attending college, demand increased

Market for a College Education



When to use supply and demand model

- many buyers and sellers
- firms sell identical goods
- firms are price takers
- no uncertainty: everyone has full information about price and quality of goods
- low transaction costs: buyers and sellers can trade easily

When supply and demand model is inappropriate

- only a few sellers (auto manufacturers)
- buyers and sellers are uncertain about the market equilibrium (concert music business)
- consumers know much less than sellers about quality or price (used cars)
- high transaction costs (art work)

Use supply and demand model in

- agricultural markets
- financial
- labor
- construction
- services
- wholesale
- retail

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

Elasticity of demand

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

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

$$E_P = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q P}{\Delta P Q}$$

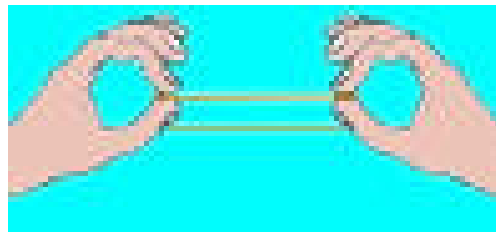
Linear demand curve

Interpretation of pork demand elasticity

- 1% increase in price of pork leads to an $E_p \% = -0.3\%$ 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*



Elasticity Along the Pork Demand Curve



Downward-sloping linear demand curve

- *perfectly elastic* (E_p is $-\infty$) where demand curve hits vertical axis
- *unitary elasticity* at midpoint:
 $p = a/(2b)$ and $Q = a/2$
therefore, $E_p = -bP/Q = -b(a/[2b])/(a/2) = -1$
- *perfectly inelastic* ($\varepsilon = 0$) where demand curve hits quantity axis
 $E_p = -bP/Q = -b0/Q = 0$

Estimated Elasticities

Product Category	Estimated E_p
Soft Drinks	-3.18
Toilet Paper	-2.42
Laundry Detergent	-1.58
Snack Crackers	-0.86
Toothpaste	-0.45
Breakfast Cereal	-0.20
Paper Towels	-0.05

Income elasticity of demand

$$E_I = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$$
$$= \frac{\Delta Q / Q}{\Delta Y / Y} = \frac{\Delta Q}{\Delta Y} \frac{Y}{Q}$$

Pork income elasticity of demand

Cross-price elasticity of demand

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

$$\frac{\text{\%change in quantity demanded}}{\text{\%change in price of another good}}$$

$$E_{Q, P_o} = \frac{\Delta Q / Q}{\Delta P_o / P_o} = \frac{\Delta Q}{\Delta P_o} \frac{P_o}{Q}$$

Negative cross-price elasticity

- 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)

Positive cross-price elasticity

- as the price of the other good increases, people buy more of this good
- demand curve shifts to the right
- example: demand for a Camry rises as the price of a Taurus increases



Cross price elasticities: $E_{X,Y} = [P_Y / D_X] [dD_X / dP_Y]$

- $E_{X,Y} > 0$ when “substitutes”
- $E_{X,Y} < 0$ when “compliments”

	Sentra	Escort	LS400	735i
Sentra	-6.528	0.454	0.000	0.000
Escort	0.078	-6.031	0.001	0.000
LS400	0.000	0.001	-3.085	0.032
735i	0.000	0.001	0.093	-3.515

Income elasticity: $E_I = [I/D][dD/dI]$

$E_I = <$ when "inferior"

$0 < E_I < 1$ when "necessity"

Elasticity	Coke	Pepsi
Price of elasticity of demand	-1.47	-1.55
Cross-price elasticity of demand	0.52	0.64
Income elasticity of demand	0.58	1.38

Price elasticity of supply

$$E_s = \frac{\% \text{change in quantity supplied}}{\% \text{change in price}}$$

$$= \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q P}{\Delta P Q}$$

What's the sign of the elasticity of supply?

- the elasticity of supply has the same sign as its slope, $\Delta P/\Delta Q$
- If supply curve slopes upward, $E_s > 0$
- If supply curve slopes downward, $E_s < 0$

Elastic vs. inelastic supply curve

- supply curve is elastic if $E_s > 1$
- supply curve is inelastic if $0 \leq E_s < 1$

Pork supply elasticity

Elasticity Varies Along Linear Pork Supply Curve



Long run versus short run

- SR and LR elasticities may differ substantially
- gasoline demand elasticities:
 - SR elasticity = -0.35
 - 5-year intermediate-run elasticity = -0.7
 - 10-year, LR elasticity = -0.8
- if a good can be easily stored, SR demand curve may be more elastic than LR curve



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, α
- *specific (unit)* tax: a specified amount, τ , is collected per unit of output

Tax on consumer

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

Specific tax

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

Sin taxes

- because output falls after tax, governments can use taxes to discourage "sin" activities
- federal specific taxes have been used for:
 - cigarettes
 - alcohol
 - playing cards (in an earlier day)



Question

- *Who is hurt by the tax?*
- *What is the incidence of the tax?*

Price impact of tax