
Chapter 2

Demand and Supply Analysis

Outline

1. Competitive Markets
 - Definition
 - Assumptions of the model
2. The Market Demand Curve
3. The Market Supply Curve
4. Competitive Market Equilibrium
5. Elasticity

Monthly Crude Oil Prices in US dollars



Oil Market

Why do oil price fluctuate?

1. Fall in Demand

- Weak economic activity
- Increased efficiency
- Substitute toward other fuels

2. Geopolitical Reasons

- Middle East trying to flood market to keep prices low to make it hard for substitutes
- Wars in middle east

3. Increase Production in America

- Decreased oil imports to become more “energy independent”

Competitive Markets

Definition: Markets where sellers and buyers are small and numerous, so they take the market price as given when they decide how much to buy and sell.

Competitive Market Assumptions

- 1. Fragmented market:** many buyers and sellers
 - Implies buyers and sellers are price takers
- 2. Undifferentiated Products:** consumers perceive the product to be identical so don't care who they buy it from
- 3. Perfect Information about price:** consumers know the price of all sellers
- 4. Equal Access to Resources:** everyone has access to the same technology and inputs.
 - Free entry into the market, so if profitable for new firms to enter into the market they will

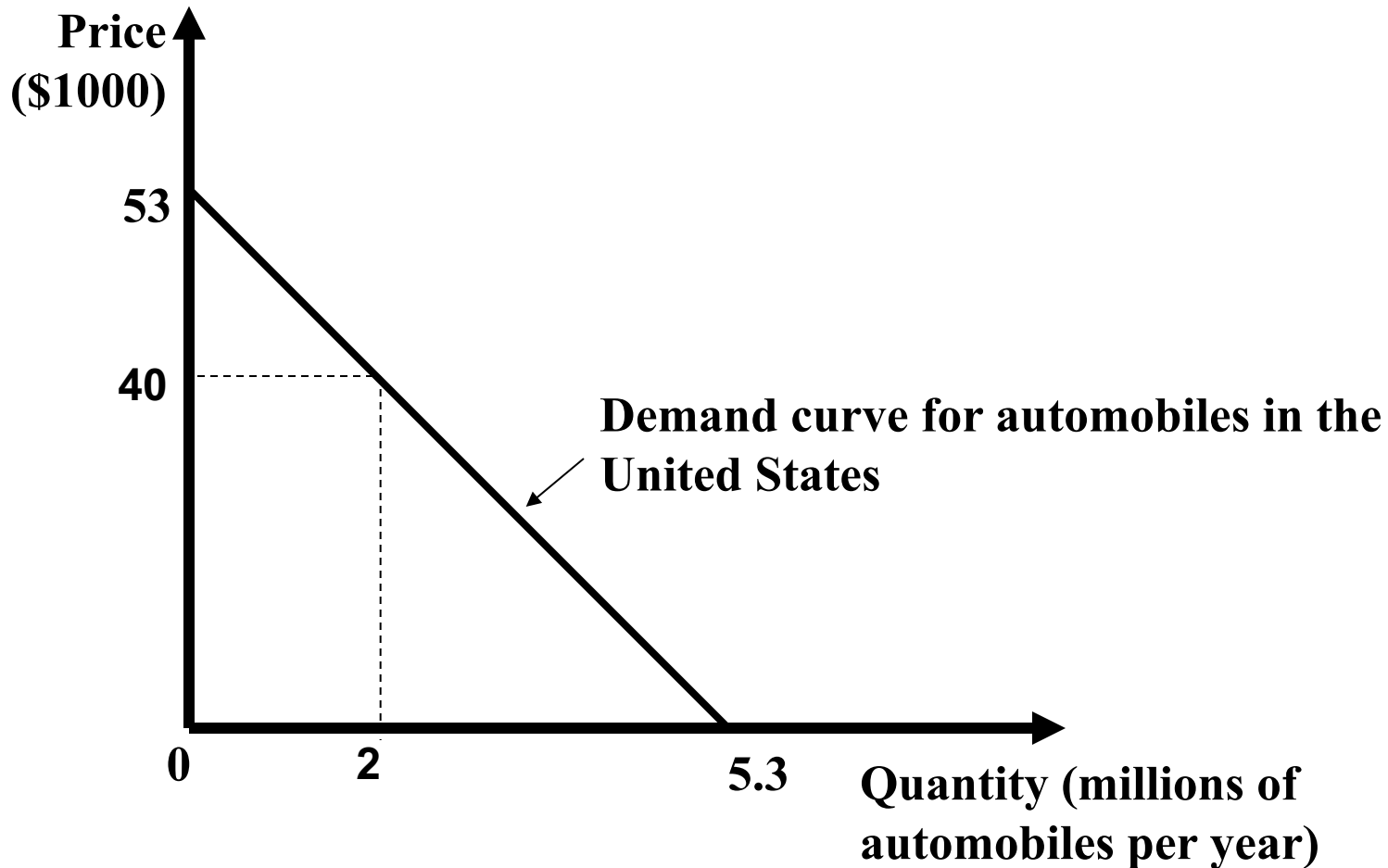
Market Demand

- Market Demand function: Tells us how the quantity of a good demanded by the sum of all consumers in the market depends on various factors.
 - $Q^d = Q(p, p_o, I, \dots)$
- The Demand Curve: Plots the aggregate quantity of a good that consumers are willing to buy at different prices, *holding constant other demand drivers such as prices of other goods, consumer income, quality.*
 - $Q^d = Q(p)$
- Example – Market Demand for Automobiles in the United States

$$Q^d = 5.3 - 0.1P$$

Market Demand – Example

Demand for New Automobiles in the US



Market Demand

Note

- On a graph:
 - P, price, is ALWAYS on vertical axis and Q on horizontal axis.
- When writing out a demand function:
 - we write demand as Q as a function of P... If P is written as function of Q, it is called the inverse demand.
 - Demand Function: $Q^d = 100 - 2P$
 - Inverse Demand Function: $P = 50 - Q^d/2$

Market Demand

Law of Demand

- **Law of Demand** states that the quantity of a good demanded decreases when the price of this good increases.
 - Empirical regularity
- **The demand curve *shifts*** when factors other than own price change...
 - If the change increases the willingness of consumers to acquire the good, the demand curve shifts **right**
 - If the change decreases the willingness of consumers to acquire the good, the demand curve shifts **left**

Market Demand

Some Demand Shifters – What are some?

- Price of related goods (Substitutes / Complements)
- Income
- Number of buyers
- Tastes
- Expectations

Market Demand

Rule

- A movement **along** the demand curve for a good can only be triggered by a change in the price of that good.
 - We assume everything else but price is held fixed
- Any change in another factor that affects the consumers' willingness to pay for the good results in a **shift** in the demand curve for the good

Market Supply

Market Supply Function: Tells us how the quantity of a good supplied by the sum of all producers in the market depends on various factors.

$$Q^s = Q(p, p_o, w, r \dots)$$

P_o = price of other goods,

w = wage rate, r = rental rate

Market Supply Curve: Plots the aggregate quantity of a good that will be offered for sale at different prices.

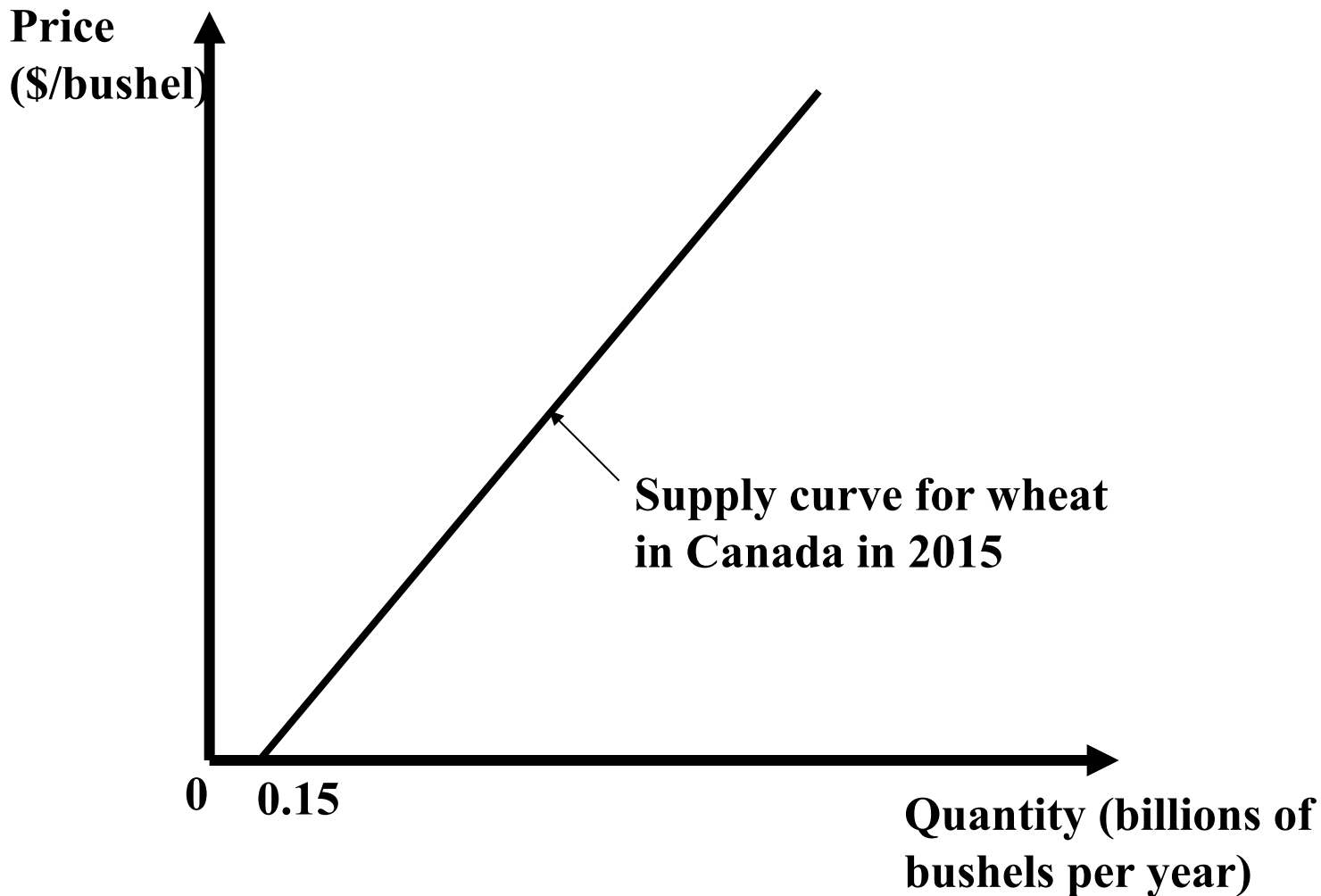
$$Q^s = Q(p)$$

Example – Market Supply for wheat in Canada

$$Q^s = 0.15 + P$$

Market Supply

E.g. Supply Curve for Wheat in Canada



Market Supply

- The **Law of Supply** states that the quantity of a good offered increases when the price of this good increases.
 - Empirical regularity
- The supply curve **shifts** when factors other than own price change...
 - If the change increases the willingness of producers to offer the good at the same price, the supply curve shifts **right**
 - If the change decreases the willingness of producers to offer the good at the same price, the supply curve shifts **left**

Market Supply

Supply Shifters

- Price of related products
- Input prices
- Number of sellers
- Technology
- Expectations

Market Supply

Rule

- A move **along** the supply curve for a good can only be triggered by a change in the price of that good.
- Any change in another factor that affects the producers' willingness to sell the good results in a **shift** in the supply curve for the good.

Market Supply

E.g. Canadian Wheat

Supply Curve: $Q^S = p + .05r$

- Q^S = quantity of wheat (billions of bushels)
- p = price of wheat (dollars per bushel)
- r = average rainfall in western Canada, May – August (inches per month)

Questions:

1. What is the quantity of wheat supplied at price of \$2 and rainfall of 3 inches per month?
 - 2.15

Market Supply

E.g: Canadian Wheat

$$Q^S = p + .05r$$

2. How do you write the supply curve if rainfall is 3 inches per month?

$$Q^S = p + 0.5(3)$$

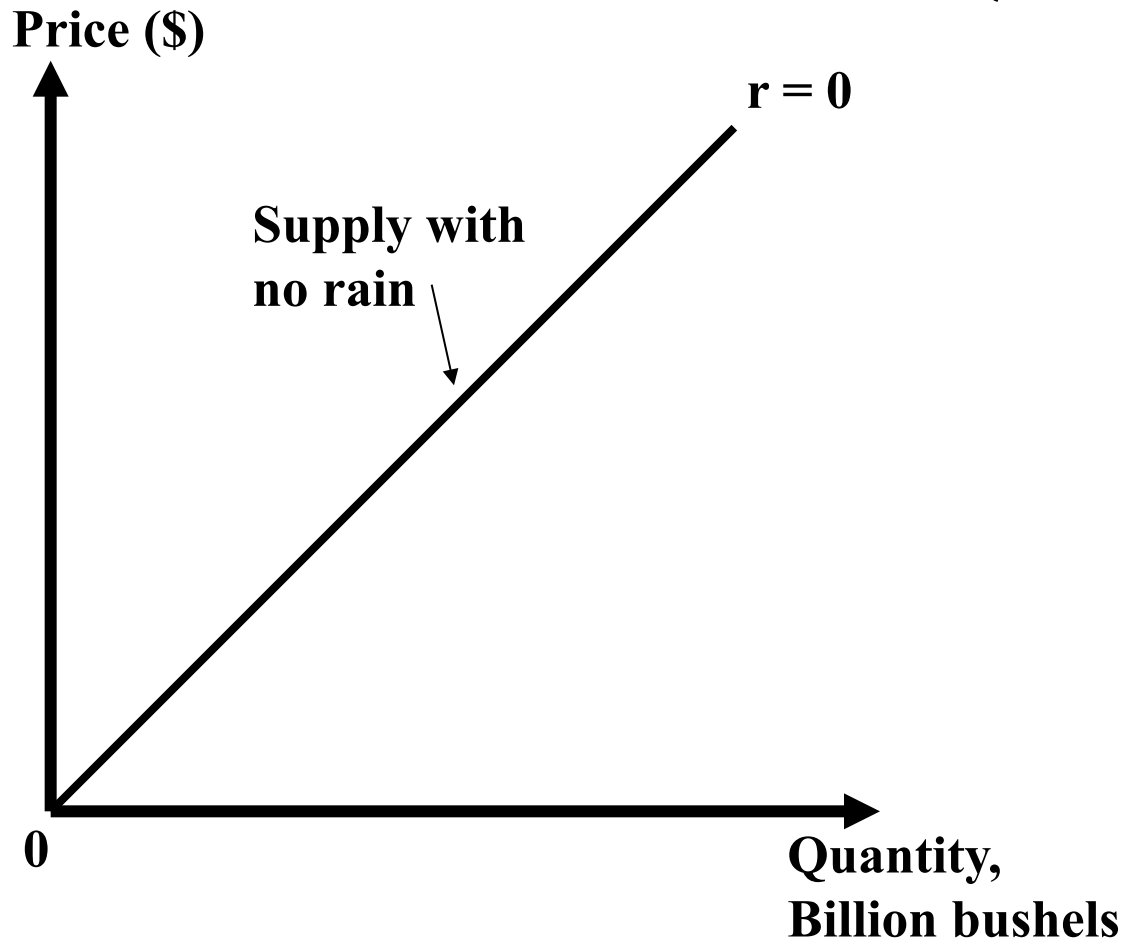
$$Q^S = p + 0.15$$

3. As rainfall increases how does it shift the supply curve? (e.g., $r = 4 \Rightarrow Q = p + 0.2$)
 - To the right

Market Supply

E.g: Canadian Wheat

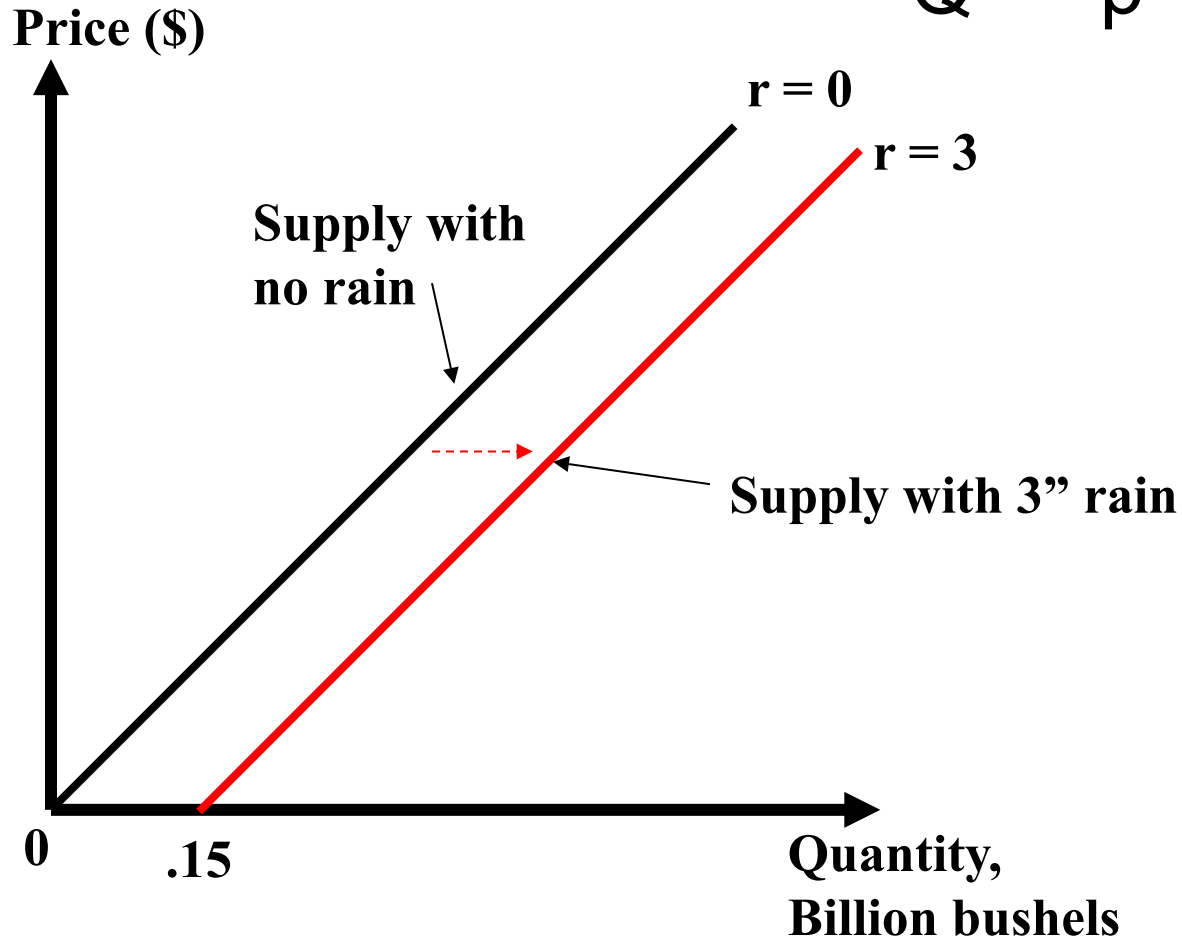
$$Q^S = p + .05r$$



Market Supply

E.g: Canadian Wheat

$$Q^S = p + .05r$$

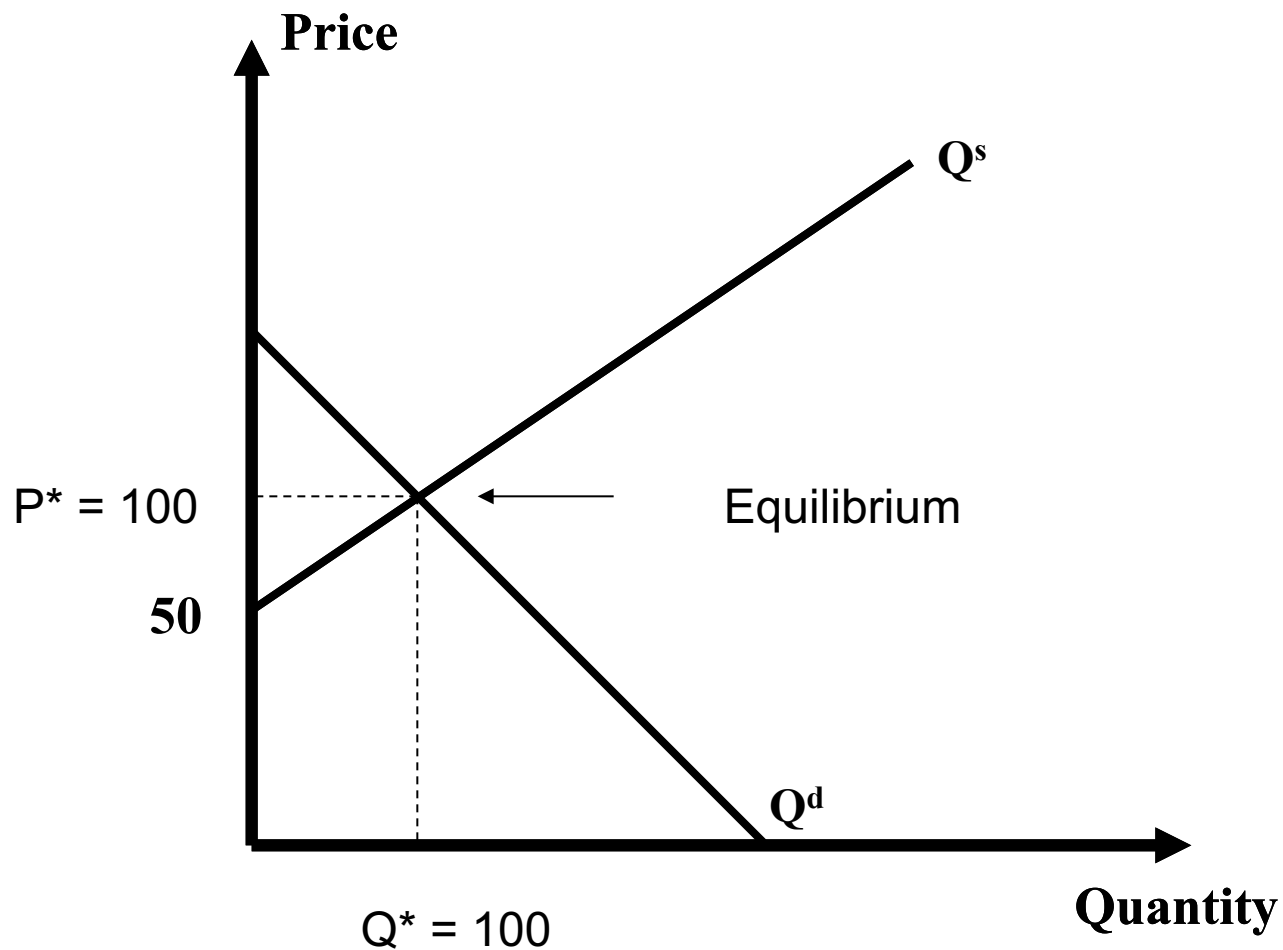


Market Equilibrium

Definition: A **market equilibrium** is a price such that, at this price, the quantities demanded and supplied are the same.

Demand and supply curves intersect at equilibrium

Competitive Market Equilibrium



Market Equilibrium

Practice: Finding Equilibrium Price and Quantity for Cranberries

Set-Up:

$$Q^d = 500 - 4p$$

$$Q^s = -100 + 2p$$

- p = price of cranberries (dollars per barrel)
- Q = demand or supply in millions of barrels per year

Questions:

1. Find the equilibrium price of cranberries?

Clicker question

What is the P and Q in equilibrium if the market demand and supply is like below

$$Q^d = 500 - 4p$$

$$Q^s = -100 + 2p$$

- A. Q=100 and P=50
- B. Q=100 and P=100
- C. Q=50 and P=50
- D. Q=50 and P=100

Market Equilibrium

Practice: Finding Equilibrium Price and Quantity for Cranberries

- Step 1: Set supply equal to demand ($Q^d = Q^s$)

$$500 - 4p = -100 + 2p$$

- Step 2: Now solve for P:

$$600 = 6P^*$$

$$P^* = \$100$$

- Step 3: Plug P^* back into either Q^d **OR** Q^s

- Plugging into Q^d : $500 - 4(100) = 100$

- Plugging into Q^s : $-100 + 2(100) = 100$

- $Q^* = 100$

Market Equilibrium

Practice: Finding Equilibrium Price and Quantity for Cranberries

Now lets see how to graph supply and demand

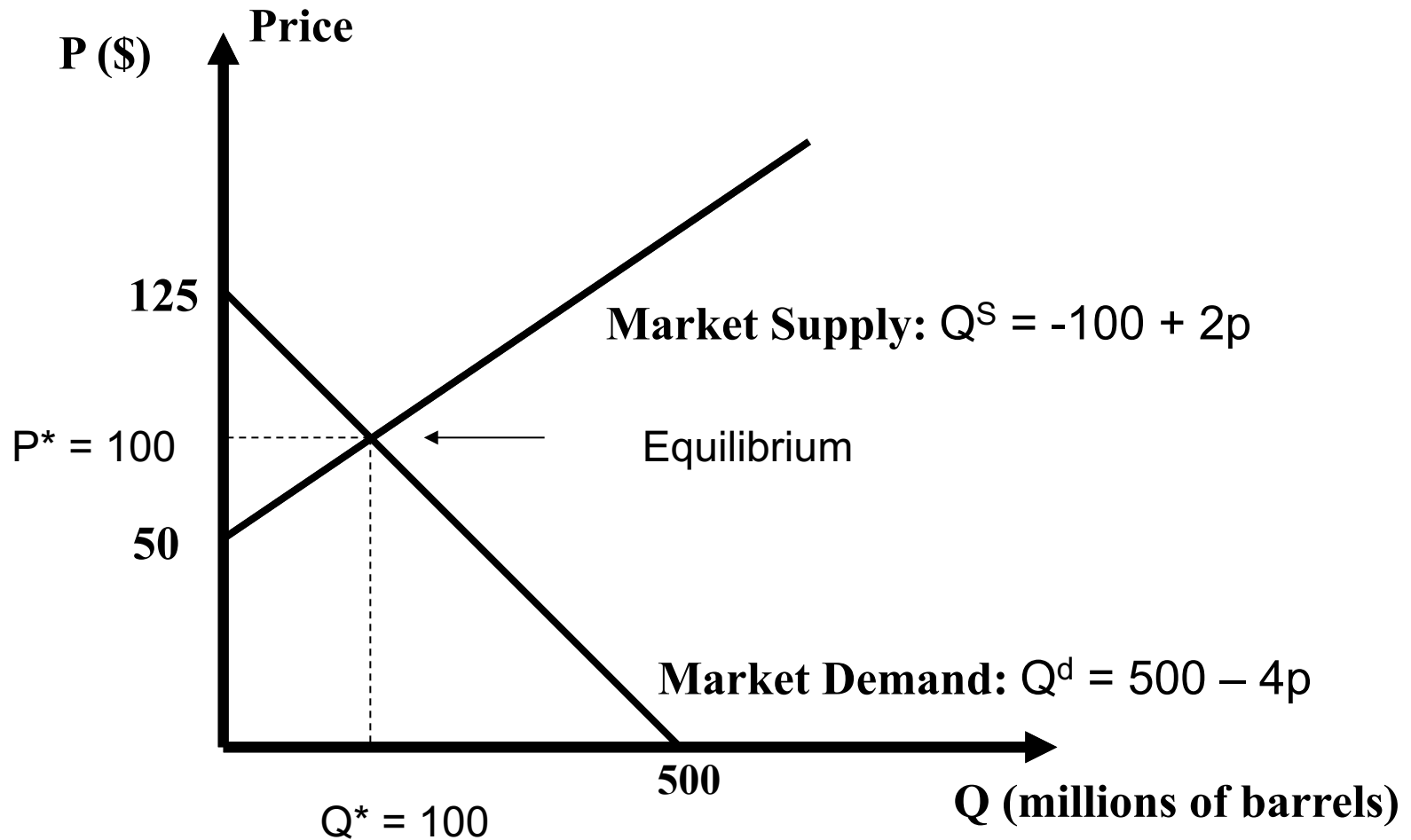
- Some folks like to rewrite so Q is on the RHS (inverse demand or supply function)

$$Q^d = 500 - 4p \text{ OR } p = 125 - Q^d/4$$

$$Q^s = -100 + 2p \text{ OR } p = 50 + Q^s/2$$

- But, I like to find the intercepts when I know I have a straight line ...
 - if $Q^d = 0$ $p = 125$, if $p = 0$ $Q^d = 500$
 - If $Q^s = 0$ then $P = 50$

Practice: Finding Equilibrium Price and Quantity for Cranberries



Elasticity – now we will learn about rubber bands well kind of

What is Elasticity?

- Tells us how much one variable changes (in percent terms) with a 1 percent change in a different variable. The change can be an increase or a decrease.
- Elasticity, $\epsilon_{X,Y} = \frac{\% \text{ change } X}{\% \text{ change } Y} = \frac{\text{Endogenous var}}{\text{Exogenous var}}$
- **Examples**
 - How much quantity demand changes with an increase in price
 - How much output changes with a decrease in capital
 - How much wages change with an increase in labor

Elasticity

Some elasticity get special names and attention

Elasticity of Demand (own price elasticity of demand): A measure of the rate of change in the quantity demanded with respect to price, holding all other determinants of demand constant.. In other words, it is the percent change in quantity demand from a 1 percent change in price.

$$\epsilon_{Q^d, P} = \frac{\text{percent change in quantity}}{\text{percent change in price}} = \frac{\% \Delta Q^d}{\% \Delta P}$$

Where Q^d is a demand function.

Elasticity continued

- ***How do we calculate it?*** I'm not good at memorizing so I start with the definition on the last page

$$\epsilon_{Q^d, P} = \frac{\% \Delta Q^d}{\% \Delta P}$$

$$\epsilon_{Q^d, P} = \frac{\Delta Q^d / Q}{\Delta P / P}$$

$$\epsilon_{Q^d, P} = \frac{\Delta Q^d}{\Delta P} \frac{P}{Q^d}$$

$$\epsilon_{Q^d, P} = \frac{\partial Q^d}{\partial P} \frac{P}{Q^d}$$

Elasticity: examples

$$\frac{\% \Delta Q^d}{\% \Delta P} = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\partial Q^d}{\partial P} * \frac{P}{Q}$$

But we have to know what this means – explain it in plain English.

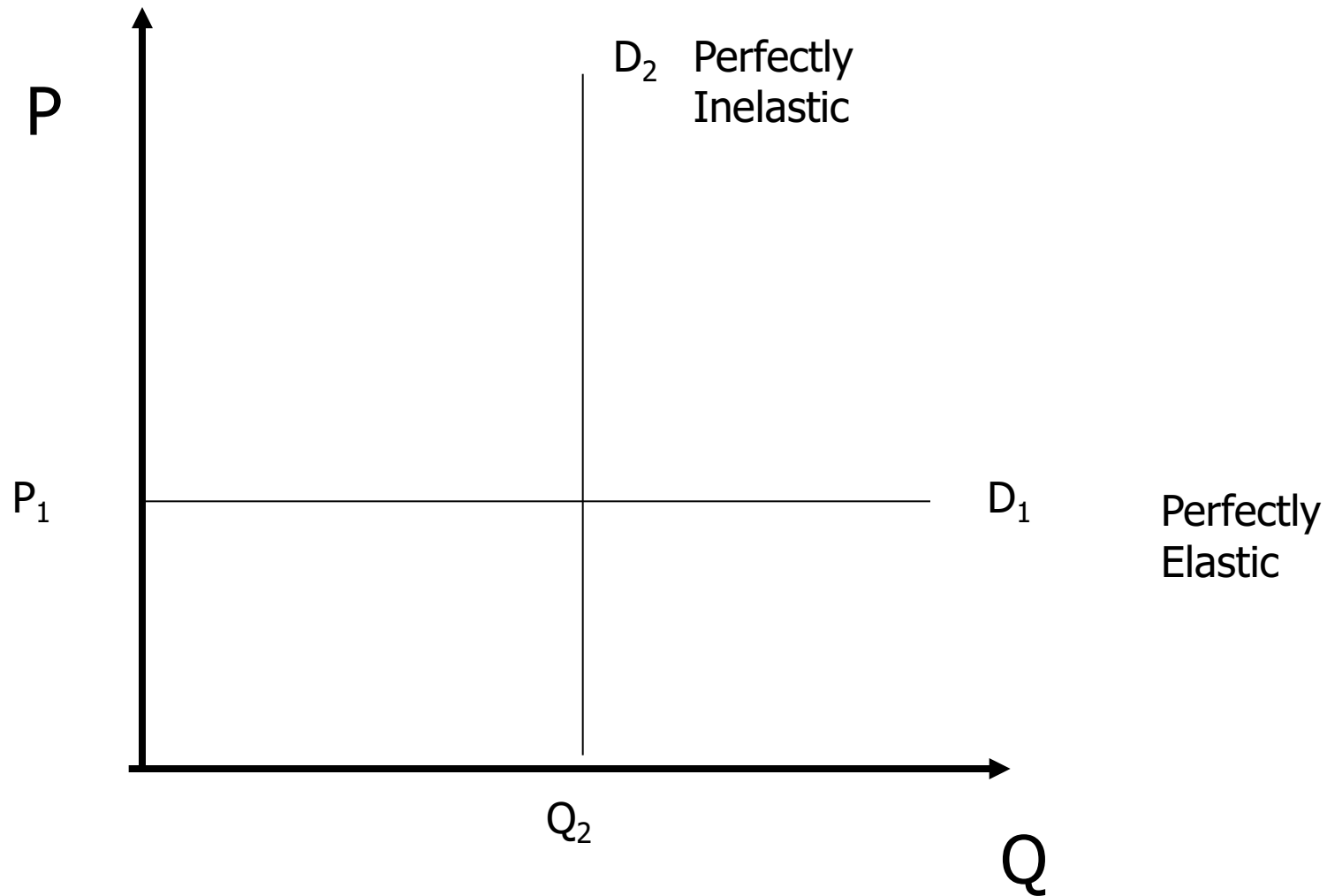
- E.g. elasticity = -2 (imagine it is -2/1)
 - If the price goes up by 1 percent demand will be reduced by 2 percent
- E.g. elasticity = -0.5 (imagine it is 0.5/1)
 - If the price goes up by 1 percent demand will be reduced by .5 percent percent.

How do we classify elasticity?

...think rubber bands

- When a one percent change in price leads to a *greater than* one-percent change in quantity demanded, the demand curve is **elastic**. ($\epsilon_{Q,P} < -1$)
 - In general elastic if ($\epsilon > |1|$)
- When a one-percent change in price leads to a *less than* one-percent change in quantity demanded, the demand curve is **inelastic**. ($0 \geq \epsilon_{Q,P} > -1$)
 - In general inelastic if ($\epsilon < |1|$)
- When a one-percent change in price leads to an *exactly* one-percent change in quantity demanded, the demand curve is **unit elastic**. ($\epsilon_{Q,P} = -1$)
 - In general unit elastic if ($\epsilon = |1|$)

How Elastic are These Curves?



Elasticity Estimates: Price Elasticity of Demand for Selected Grocery Products

Category	Estimated $\epsilon_{Q,P}$
Soft Drinks	-3.18
Canned Seafood	-1.79
Canned Soup	-1.62
Cookies	-1.6
Breakfast Cereal	-0.2
Toilet Paper	-2.42
Laundry Detergent	-1.58
Toothpaste	-0.45
Snack Crackers	-0.86
Frozen Entrees	-0.77
Paper Towels	-0.05
Dish Detergent	-0.74
Fabric Softener	-0.73

Which products is demand elastic and which is demand inelastic?

Elasticity Versus Slope

- **Slope:** is the ratio of absolute changes in quantity and price. ($= \Delta Q / \Delta P$).
 - Measures the absolute change in quantity demanded (in units of quantity) due to a one-unit change in price.
 - $Q^d = a - bP$
 - a is the intercept, $-b$ is the slope
- **Elasticity:** is the ratio of relative (or percentage) changes in quantity and price.
 - Measure percentage change in quantity demanded due to one-percent change in the price of the good

Elasticity Versus Slope

- Why elasticity is more useful?
 - it is unitless so allows us to easily compare across countries and goods
 - Units of quantities will be different for different goods. How to compare snow boards to oranges.
 - Prices are different across different countries. More difficult to compare Euro to US \$

What Affects Elasticity?

- Availability of Substitutes:
 - Demand is more(less) elastic when there are more(fewer) substitutes for a product.
 - E.g: Demand for all beverages less elastic than demand for Coca-Cola
 - There are substitute for Coca-Cola, drink Pepsi
 - It is harder to find a substitute for soda if you love soda.
- % of Income Spent on Product
 - Demand is more(less) when the consumer's expenditure on the product is large(small)
- Necessity Products
 - The demand is less price elastic when the product is a necessity
- Market Level vs Brand-Level Price
 - Demand tends to be more elastic for a particular brand of a good, than for the good in general

Linear Demand

Slope, choke price, elasticity

General Form: $Q^d = a - bp$

- a, b are positive constants
- p is price

Notice that:

- b is the **slope**
- a/b is the **choke price**: price at which quantity demanded is zero
 - Set $Q=0$ and solve for P
 - Solve for inverse demand (intercept): $P=a/b-Q^d/b$

Linear Demand Curve

Slope, choke price, elasticity

- Elasticity is:

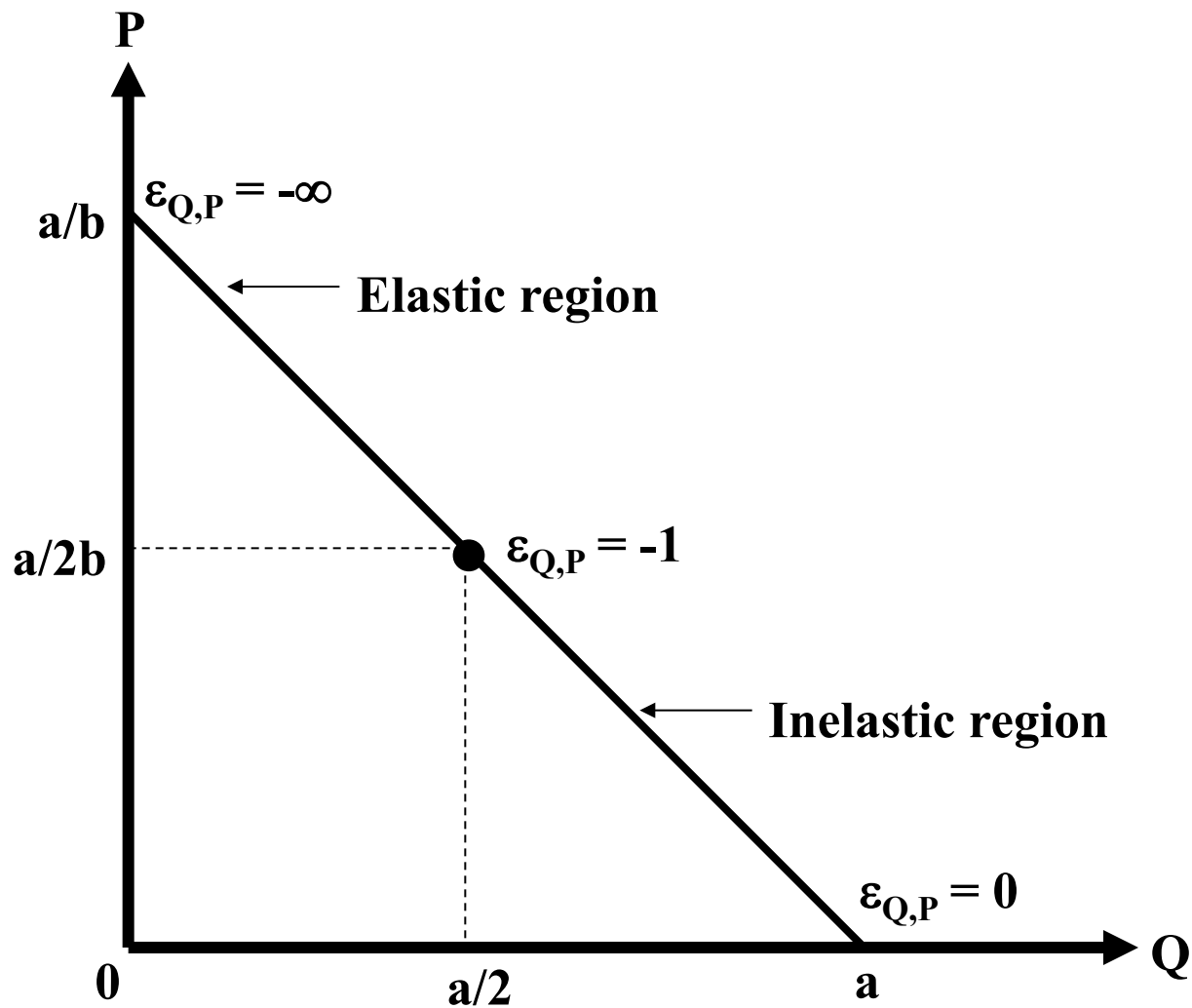
$$\begin{aligned}\varepsilon_{Q,P} &= (\Delta Q/\Delta p)(p/Q) \quad \dots\textit{definition}\dots \\ &= -b(p/Q)\end{aligned}$$

Note that:

- When $Q=0$, elasticity is $-\infty$
- When $p=0$, elasticity is 0

- so...elasticity falls from 0 to $-\infty$ along the linear demand curve, but slope is constant.

Elasticity with a Linear Demand Curve



Problem: Determining Elasticity

Linear demand curve

if $Q^d = 400 - 10p$, and $p = 30$, what is the elasticity of demand w.r.t own price?

$$\varepsilon_{Q,P} = (-b)(P)/(Q)$$

$$Q = 400 - 10(30) = 100$$

$$\varepsilon_{Q,P} = (-10)(30)/(100) = -3 \text{ "elastic"}$$

Or use calculus

$$\frac{\partial Q^d}{\partial P} * \frac{P}{Q^d} = -10 * \frac{30}{400 - 10P} = -10 * \frac{30}{400 - 10(30)} = -3$$

- Why is elasticity negative?
 - demand curve downward sloping.

Problem: Determining Elasticity

Constant elasticity demand curve

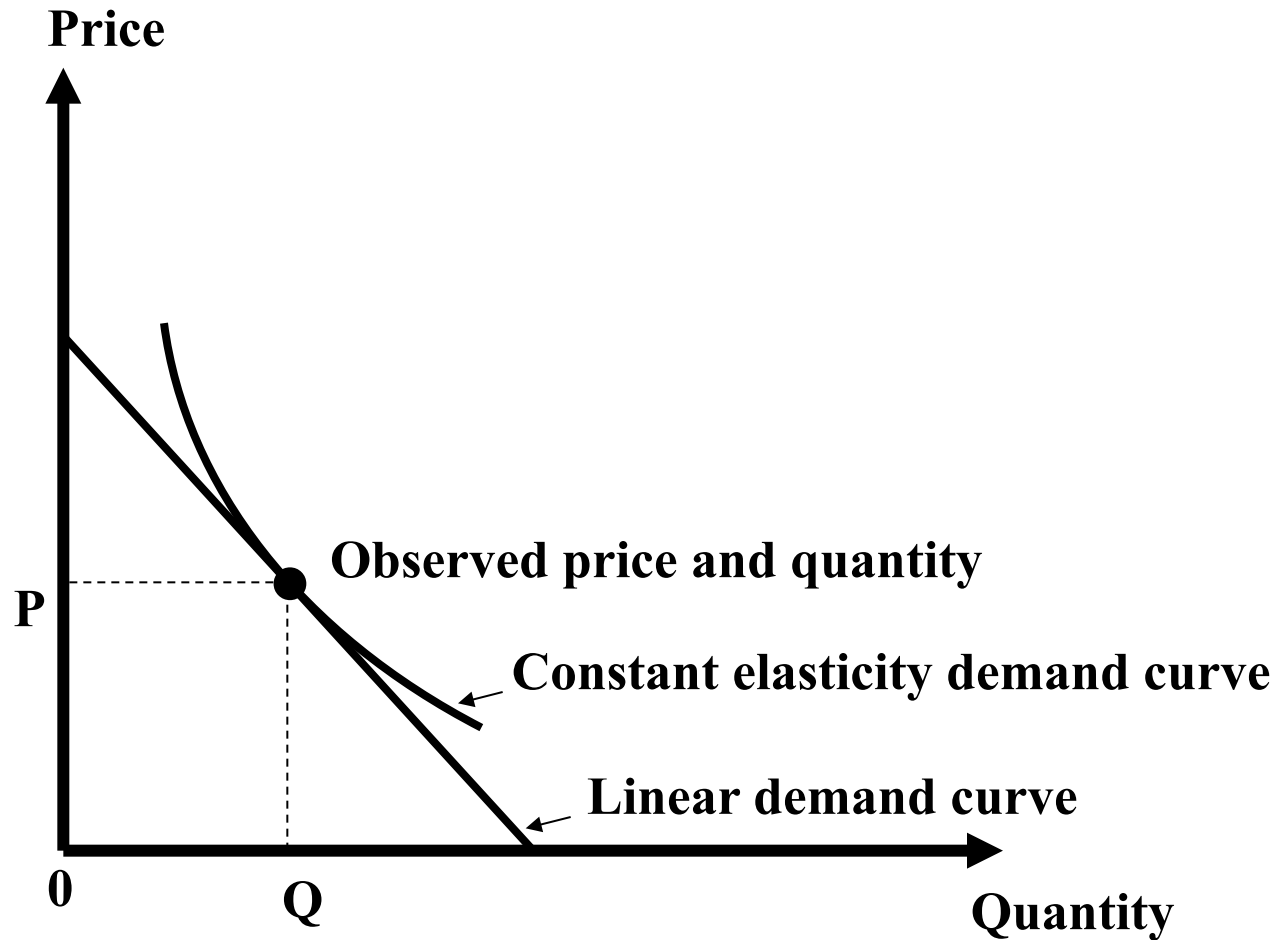
Constant Elasticity Fn (general form): $Q^d = Ap^\varepsilon$

- ε = elasticity of demand and is negative
- p = price
- A = constant

Example: *If demand can be expressed as $QP = 100$, what is the price elasticity of demand?*

- $Q=100P^{-1}$, so elasticity is -1

Constant Elasticity Demand Curve



Importance of Brands

<u>Model</u>	<u>Price</u>	<u>Estimated</u> <u>$\epsilon_{Q,P}$</u>
Mazda 323	\$5,039	-6.358
Nissan Sentra	\$5,661	-6.528
Ford Escort	\$5,663	-6.031
Lexus LS400	\$27,544	-3.085
BMW 735i	\$37,490	-3.515

- Demand for individual models is highly elastic
- Market-level price elasticity of demand for automobiles -1 to -1.5
- Compact automobiles have lots of substitutes
Luxury cars have less substitutes
- Demand for compact cars more elastic than luxury cars.

Example: Price Elasticities of Demand for Automobile Makes, 1990.

Other Common Types of Elasticities

- Other Elasticities -- Elasticity of "X" with respect to "Y":
 $(\Delta X/\Delta Y)(Y/X)$
 - X and Y could be anything
- **Price elasticity of supply:** $(\Delta Q^S/\Delta p)(p/Q^S)$
 - measures curvature of supply curve
- **Income elasticity of demand:** $(\Delta Q^d/\Delta I)(I/Q^d)$
 - measures degree of shift of demand curve as income changes.
- **Cross price elasticity of demand:** $(\Delta Q^d/\Delta P_o)(P_o/Q^d)$
 - measures degree of shift of demand curve when the price of a substitute changes

The Cross-Price Elasticity of Cars

		PRICE			
		Sentra	Escort	LS400	735i
Demand	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

Practice Questions:

- What is the cross price elasticity of demand of the Sentra with respect to Escort?
 - 0.454
- If the price of the Escort increases by 10 %, what will happen to the demand for the Sentra?
 - The demand for Sentra will increase by 4.54 %

Elasticities of Demand for Coke/Pepsi

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

Practice Question:

- What will happen to the demand for coke if income increases by 10%?
 - If income increases by 10%, the demand for coke will increase by 5.8%