Chapter Two

Demand and Supply Analysis

Chapter Two Overview

1. Motivation – *U.S. dot coms*
2. Competitive Markets Defined
3. The Market Demand Curve
4. The Market Supply Curve
5. Equilibrium
6. Characterizing Demand and Supply – Elasticity
7. Back of the Envelope Techniques

Motivations

Example: 1995 U.S. Corn Market

Historical price:
$2.00 per bushel

1995: Prices rose to $2.70 per bushel
- Long term contracts based on this price

1996: Prices rise to $5.00 per bushel
- Litigation to annul contracts

Why?
- Weather
- Asian economic boom

Motivations

Example: 1995 U.S. Corn Market

Historical price:
$2.00 per bushel

1998: Prices return to $2.00 per bushel

Why?

- Increased acreage
- Asian economic cool-down

Competitive Markets

Defined:

Competitive Markets are those with sellers and buyers that are small and numerous enough that they take the market price as given when they decide how much to buy and sell.

The Market Demand Function

Defined:

*The **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.

$$Q^d = (Q, p, p_o, I, \ldots)$$

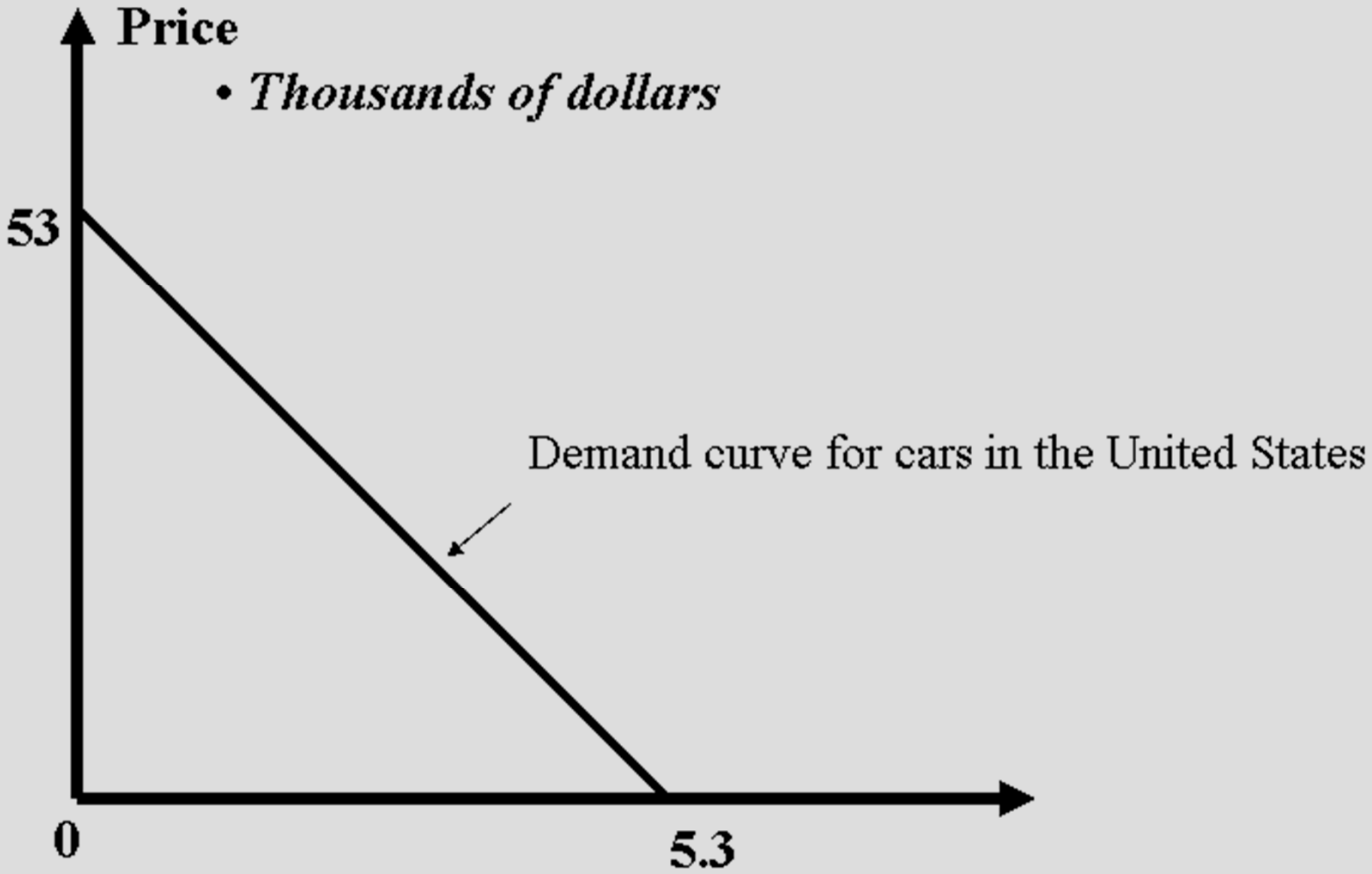
Demand Curves

Defined:

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.

$$Q^d = Q(p)$$

The Demand for Cars



The Demand for Cars

Note:

We always graph P on vertical axis and Q on horizontal axis, but we write demand as Q as a function of P… If P is written as function of Q, it is called the inverse demand.

Normal Form: $Q^d = 100-2P$

Inverse Form: $P = 50 - Q^d/2$

Markets defined by commodity, geography, time.

The Law of Demand

Defined:

The ***Law of Demand*** states that the quantity of a good demanded decreases when the price of this good increases.

The Demand Curve *shifts* when factors other than own price change such as:

✓ 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**

Demand Curve Rule

Defined:

A move along the demand 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 consumers' willingness to pay for the good results in a **shift** in the demand curve for the good.

Market Supply vs. Demand

The 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

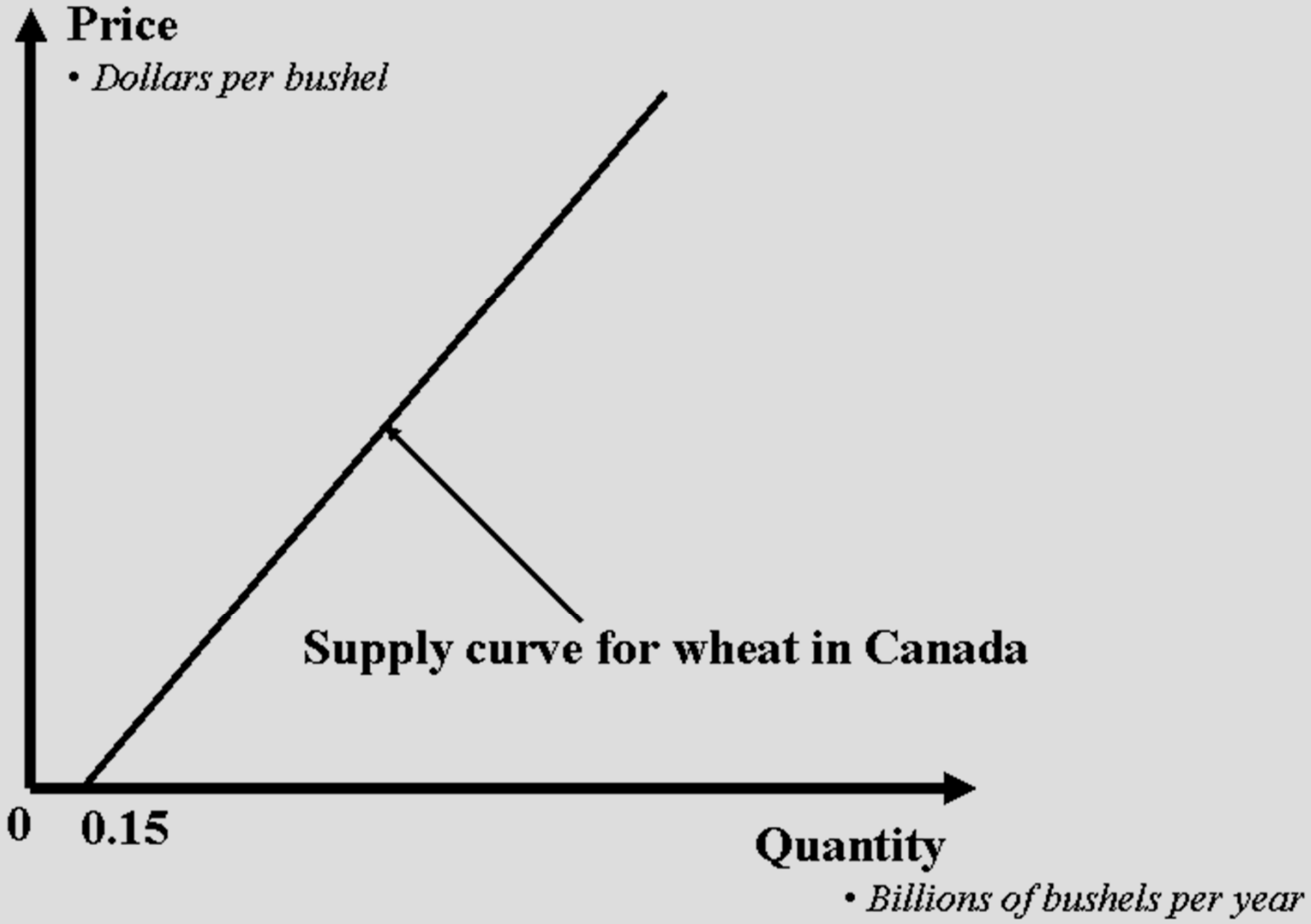
$$Q^s = Q(p, p_o, W, \ldots)$$

The Market Supply Curve:

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

$$Q^s = Q(P)$$

Supply Curve for Wheat



The Law of Supply

Defined:

The ***Law of Supply*** states that the quantity of a good offered increases when the price of this good increases.

The ***Supply Curve*** *shifts* when factors other than own price change such as:

✓ 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**

Supply Curve Rule

Defined:

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 offer for the good results in a **shift** in the supply curve for the good.

Example: Canadian Wheat

Supply Curve Rule Example

$QS = p + .05r$

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

Example: Canadian Wheat

Supply Curve Rule Example

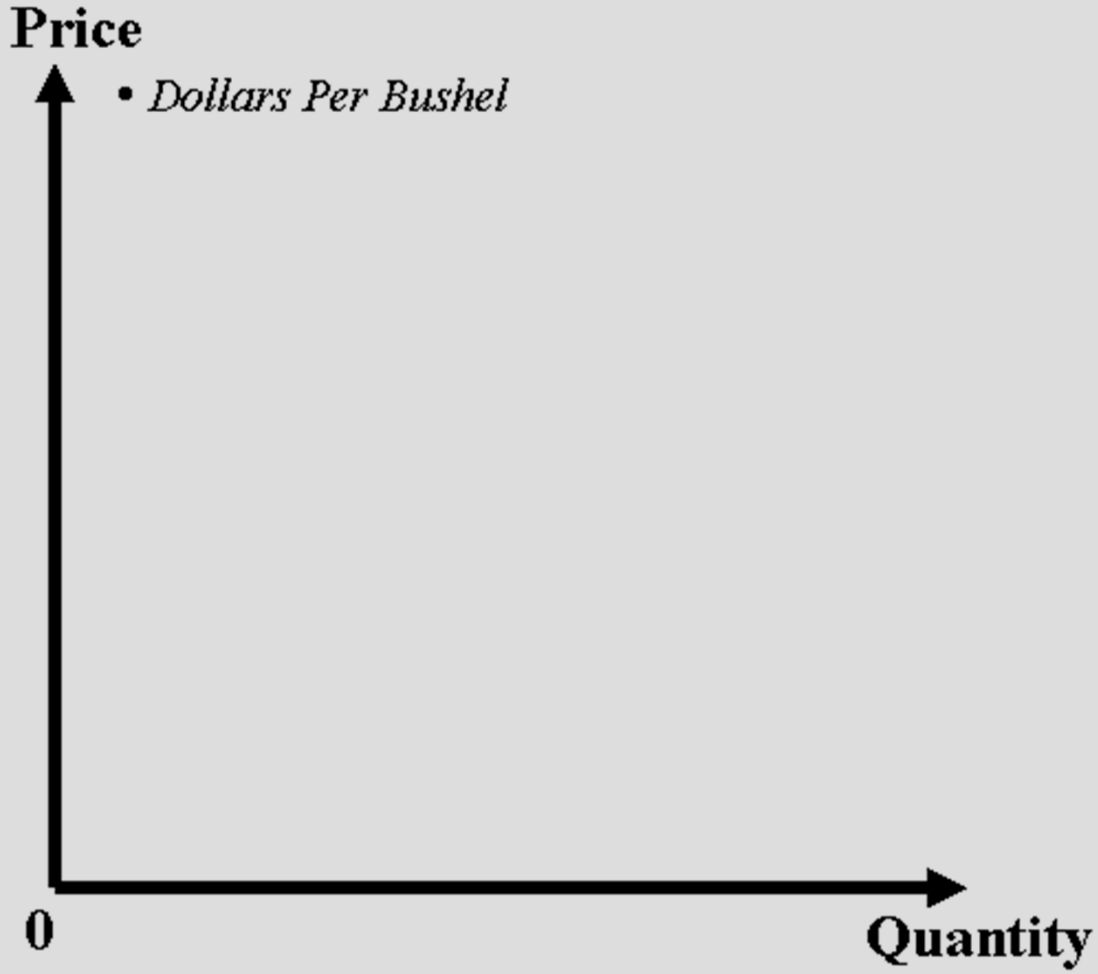
a. Quantity of wheat supplied at price of $2 and rainfall of 3 inches per month = 2.15

b. Supply curve when rainfall is 3 inches per month:
$QS = p + 0.15$

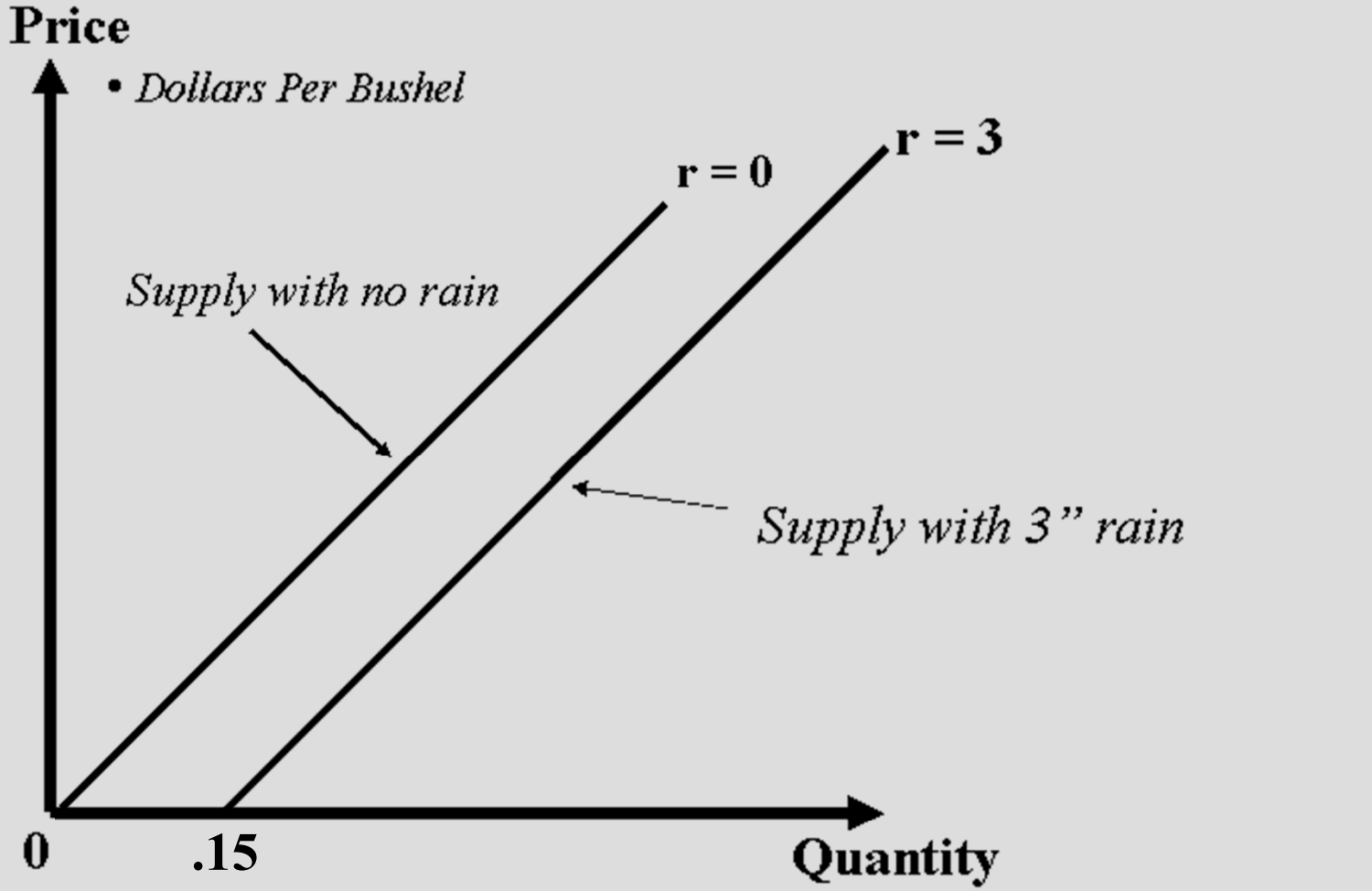
c. Law of supply holds

d. As rainfall increases, supply curve shifts right
(e.g., $r = 4 \Rightarrow Q = p + 0.2$)

Example: Canadian Wheat



Example: Canadian Wheat

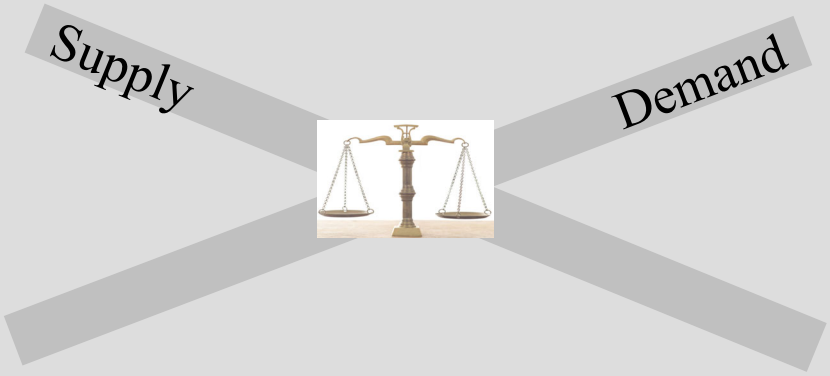


Market Equilibrium

Defined:

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



Market Equilibrium for Cranberries

Qd = 500 – 4p
QS = -100 + 2p

Example:

p = price of cranberries *(dollars per barrel)*

Q = demand or supply in millions of barrels per year

The equilibrium price of cranberries is calculated by equating demand to supply:

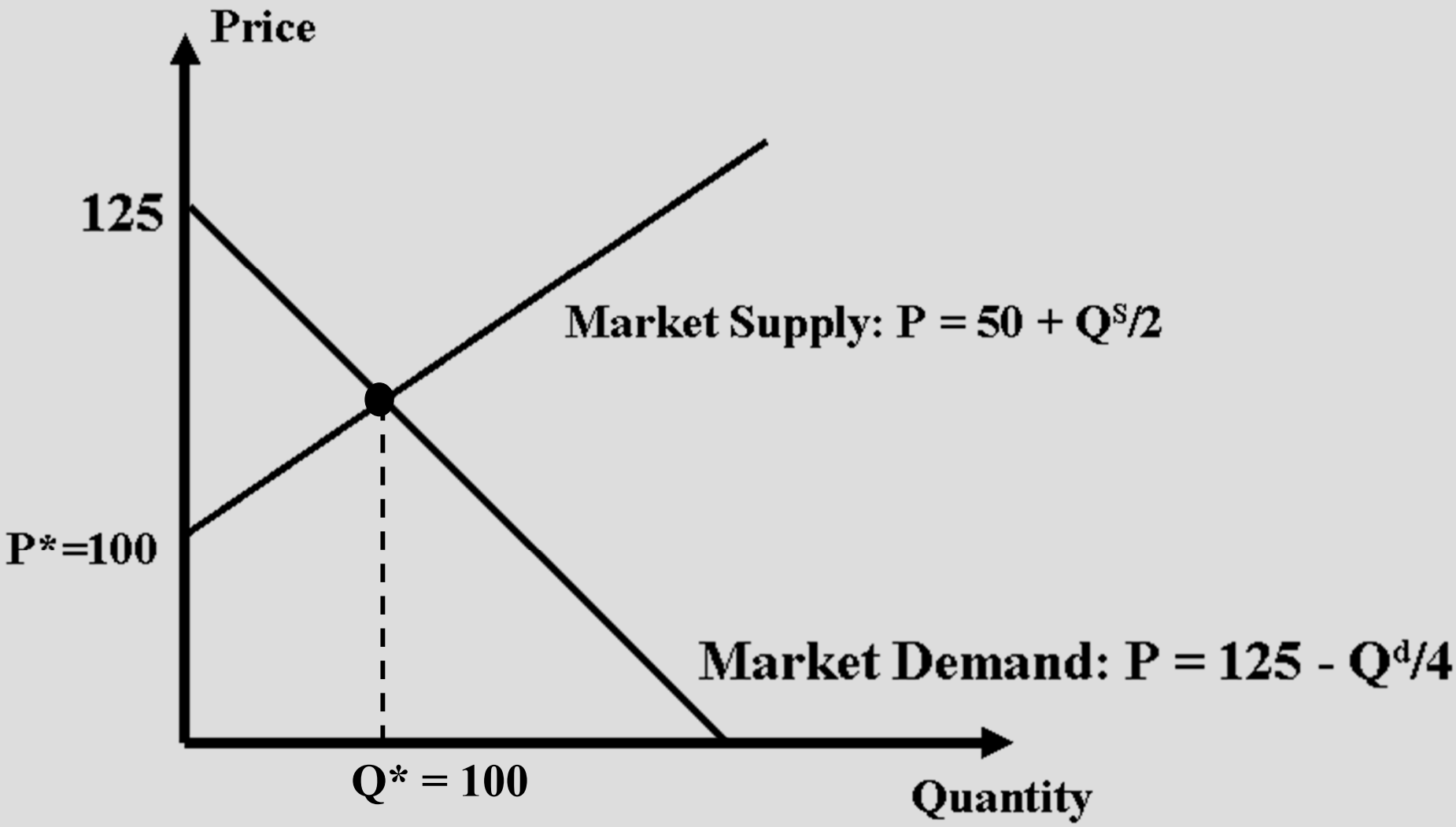
Qd = QS … or…

500 – 4p = -100 + 2p …solving

p* = $100

Plug equilibrium price into either demand or supply to get equilibrium quantity:

Market Equilibrium for Cranberries



Excess Supply

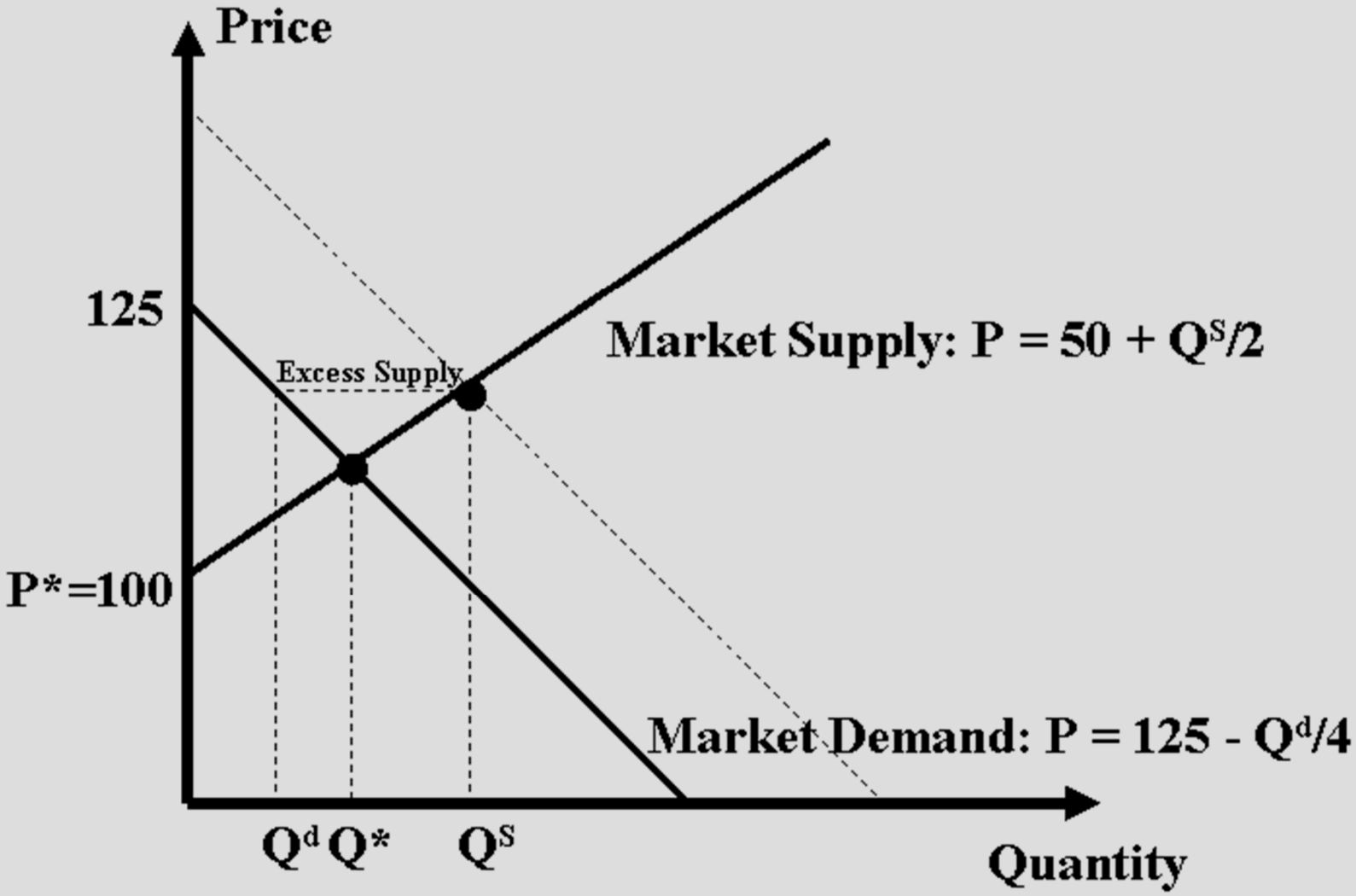
Defined:

If sellers cannot sell as much as they would like at the current price, there is ***Excess Supply***.

If there is no excess supply or excess demand, there is no pressure for prices to change and thus there is equilibrium.

When a change in an exogenous variable causes the demand curve or the supply curve to shift, the equilibrium shifts as well.

Excess Supply



Price Elasticity

Defined:

The ***Price Elasticity of Demand*** is the percentage change in quantity demanded brought about by a one-percent change in the price of the good.

$$\varepsilon_{Q,P} = \frac{(\Delta Q/Q)}{(\Delta p/p)} = (\Delta Q/\Delta p)(p/Q)$$

Price Elasticity

Elasticity is not slope

• Slope is the ratio of absolute changes in quantity and price. (= $\Delta Q/\Delta P$).

• Elasticity is the ratio of relative *(or percentage)* changes in quantity and price.

Grocery Products Elasticity

Selected Chicago Stores - 1990s

Category	Estimated $\varepsilon_{Q,P}$
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

Price Elasticity

Key Characteristics:

• When a one percent change in price leads to a *greater than* one-percent change in quantity demanded, the demand curve is ***elastic***. ($\varepsilon_{Q,P} < -1$)

• When a one-percent change in price leads to a *less than* one-percent change in quantity demanded, the demand curve is ***inelastic***. ($0 \geq \varepsilon_{Q,P} > -1$)

• When a one-percent change in price leads to an *exactly* one-percent change in quantity demanded, the demand curve is ***unit elastic***. ($\varepsilon_{Q,P} = -1$)

Elasticity – Linear Demand Curve

$Q_d = a - bp$

Where:

- a and b are positive constants
- p is price
- b is the **slope**
- a/b is the **choke price**

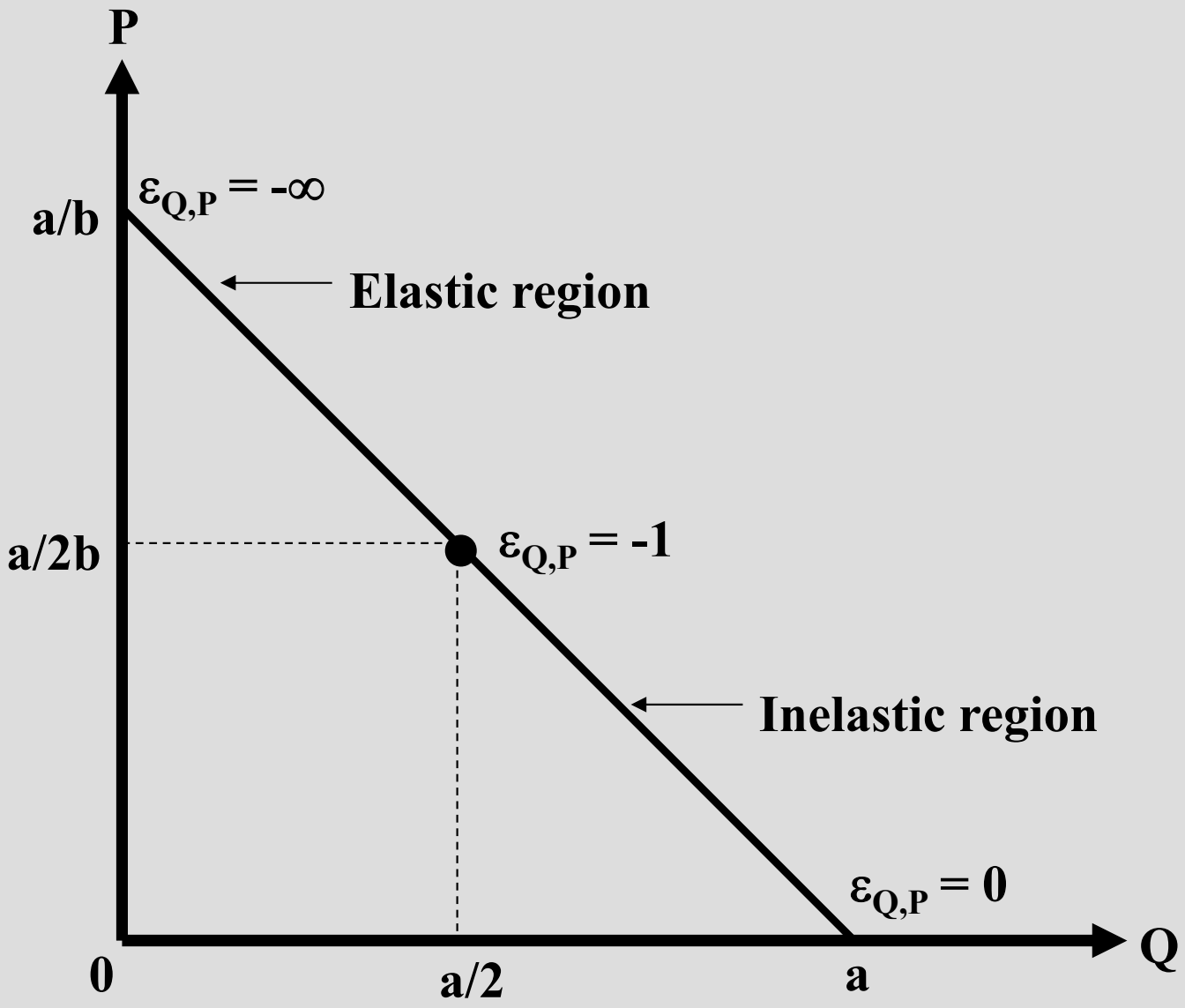
Elasticity is:

$\varepsilon_{Q,P} = (\Delta Q/\Delta p)(p/Q) = -b[p/(a-bp)]$

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

if $Q_d = 400 - 10p$, and $p = 30$, $\varepsilon_{Q,P} = (-10)(30)/(100) = -3$ *"elastic"*

Elasticity – Linear Demand Curve



Elasticity – Linear Demand Curve

Example:

$Qd = Ap\varepsilon$

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

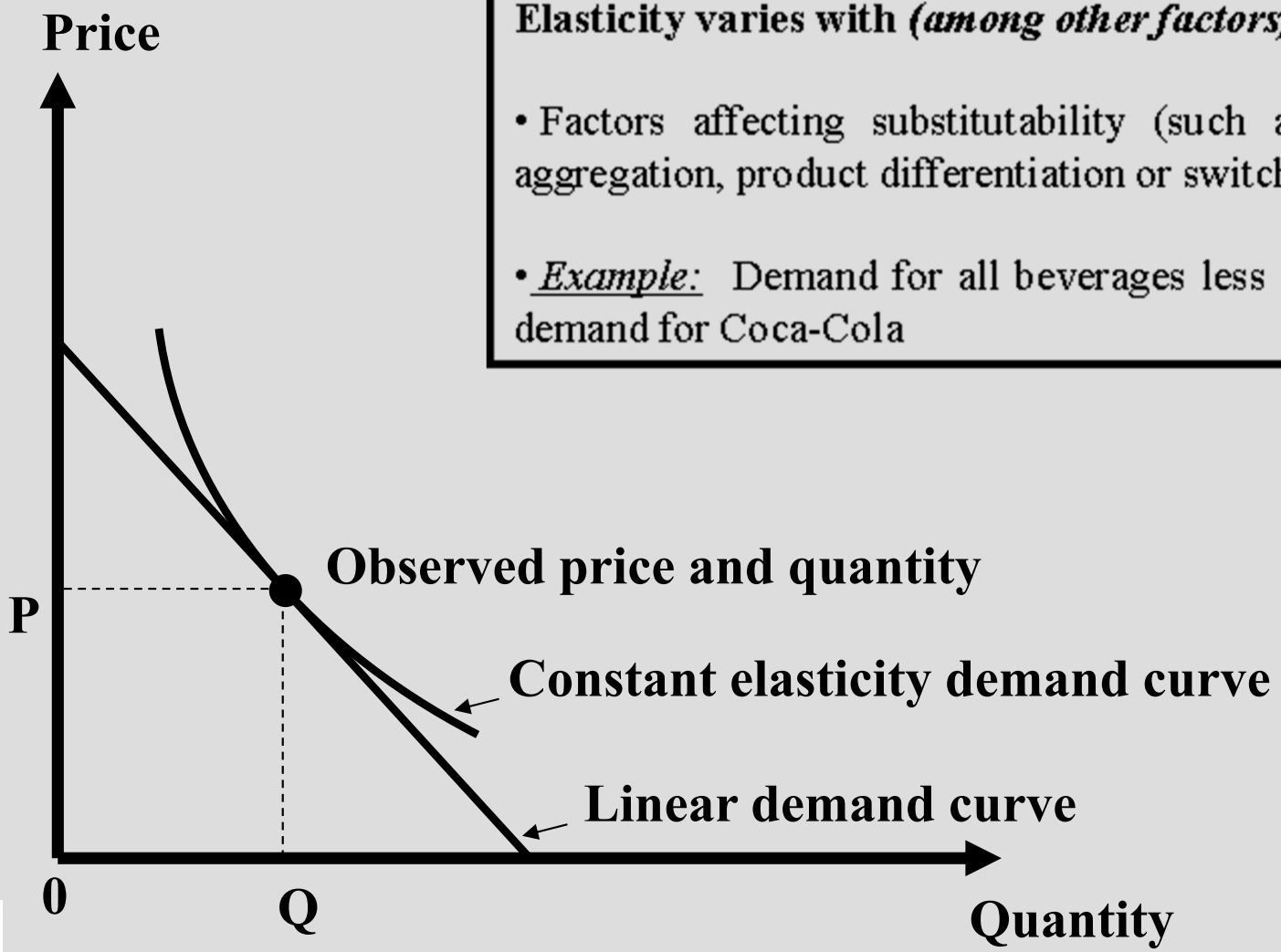
Elasticity is constant, but the slope of demand falls from 0 to $-\infty$.

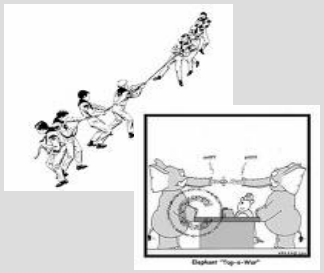
Example: *If demand can be expressed as $QP = 100$, what is the price elasticity of demand?*

Constant Elasticity vs. Linear Demand Curve

Elasticity varies with *(among other factors)*:

- Factors affecting substitutability (such as level of aggregation, product differentiation or switching costs)
- *Example:* Demand for all beverages less elastic than demand for Coca-Cola





Price Elasticity and Cars

Model	Price	Estimated $\varepsilon_{Q,P}$
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

Berry, Levinsohn and Pakes, "Automobile Price in Market Equilibrium," Econometrica 63 (July 1995), 841-890

Price Elasticity and Cars

	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

Berry, Levinsohn and Pakes, "Automobile Price in Market Equilibrium," Econometrica 63 (July 1995), 841-890

Durable Goods

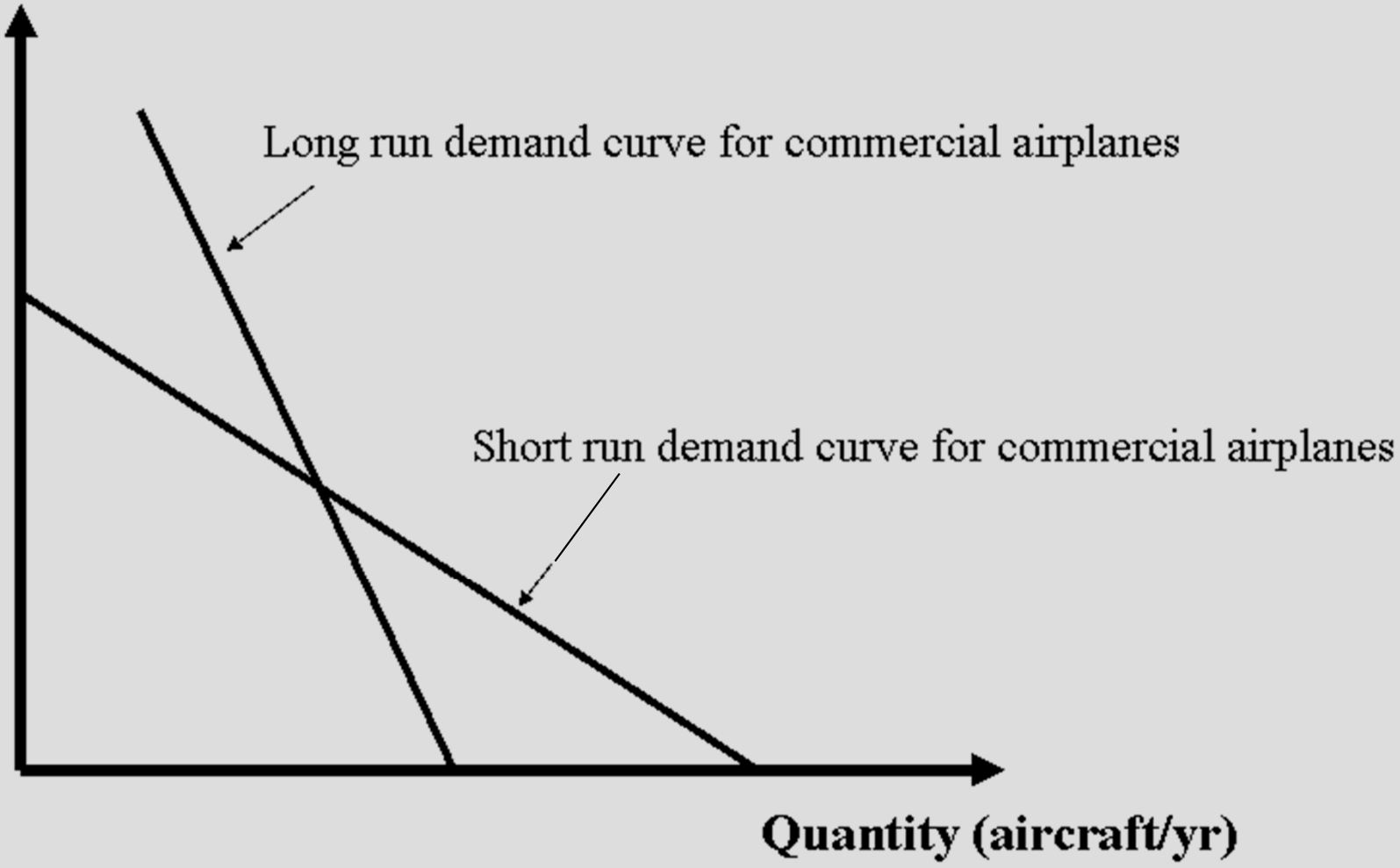
Defined:

The ***Durable Good*** is a good that provides valuable services over a long time *(usually many years)*.

Demand for non-durables is less elastic in the *short run* when consumers can only partially adapt their behavior. Demand for durables is more elastic in the *short run* because consumers can delay purchase.

Durable Goods

Aircraft Demand



Other Elasticities

- Other Elasticities -- Elasticity of "X" with respect to "Y": $(\Delta X/\Delta Y)(Y/X)$

- Price elasticity of supply $(\Delta QS/\Delta p)(p/QS)$ *…measures curvature of supply curve*

- Income elasticity of demand $(\Delta Qd/\Delta I)(I/Qd)$ *…measures degree of shift of demand curve as income changes…*

- Cross price elasticity of demand $(\Delta Qd/\Delta Po)(Po/Qd)$…*measures degree of shift of demand curve…*

Elasticities & the Cola Wars

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

Source: Gasmi, Laffont and Vuong, "Econometric Analysis of Collusive Behavior in a Soft Drink Market," Journal of Economics and Management Strategy 1 (Summer, 1992) 278-311.

Estimating Demand & Supply

- Estimating Demand and Supply from Own Price Elasticities and Equilibrium Price and Quantity

- Choose a general shape for functions

- Estimate parameters of demand and supply using elasticity and equilibrium information

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Example:

- Suppose demand is linear: $Qd = a-bp$
- *Hence,* elasticity is $\varepsilon Q,P = -bp/Q$

- If we have data on ε, Q and P, we can calculate b from elasticity equation and then calculate a by substituting into demand.

Estimating Elasticity

Estimating Demand & Supply

Example:

If…$Qd = a - bP$

Per capita consumption 70lbs/person – price \$.70/lb.

$\varepsilon Q,P = -.55$

but… $\varepsilon = -bp/Q \Leftrightarrow b = -\varepsilon Q/p$

$b = -(-.55(70/.7)) = 55$

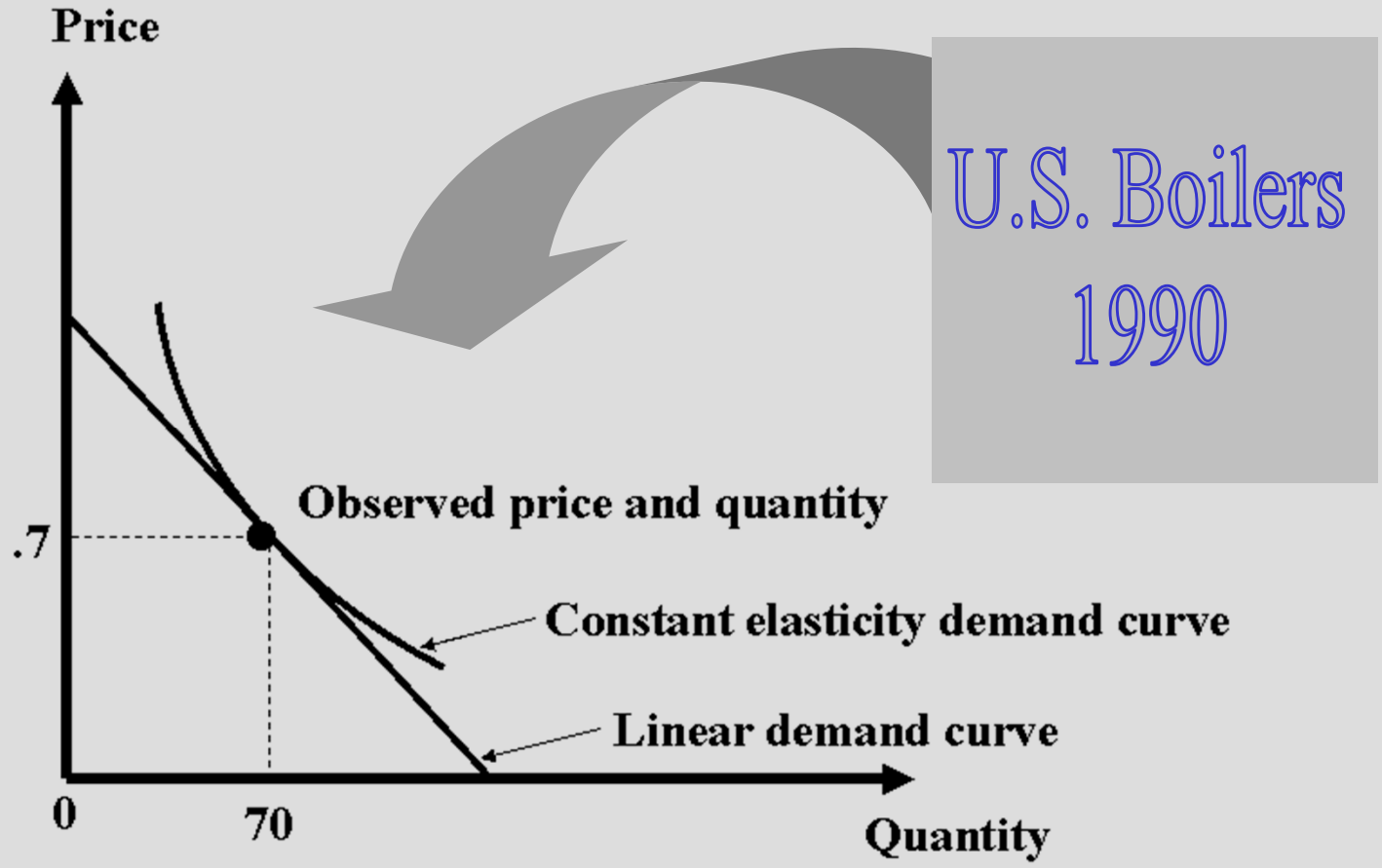
$a = Qd + bp = 108.5$

$\Rightarrow Qd = 108.5 - 55p$

U.S. Boilers 1990

Estimating Demand & Supply

Example:



Estimating Demand & Supply

From Past Shifts

A shift in the supply curve reveals the slope of the demand curve while a shift in the demand curve reveals the slope of the supply curve.

Suppose, then, that the supply curve shifts back. Both the old equilibrium point (p1,Q1) and the new equilibrium point (p2,Q2) lie on the same (linear) demand curve. Therefore, if QD = a-bp

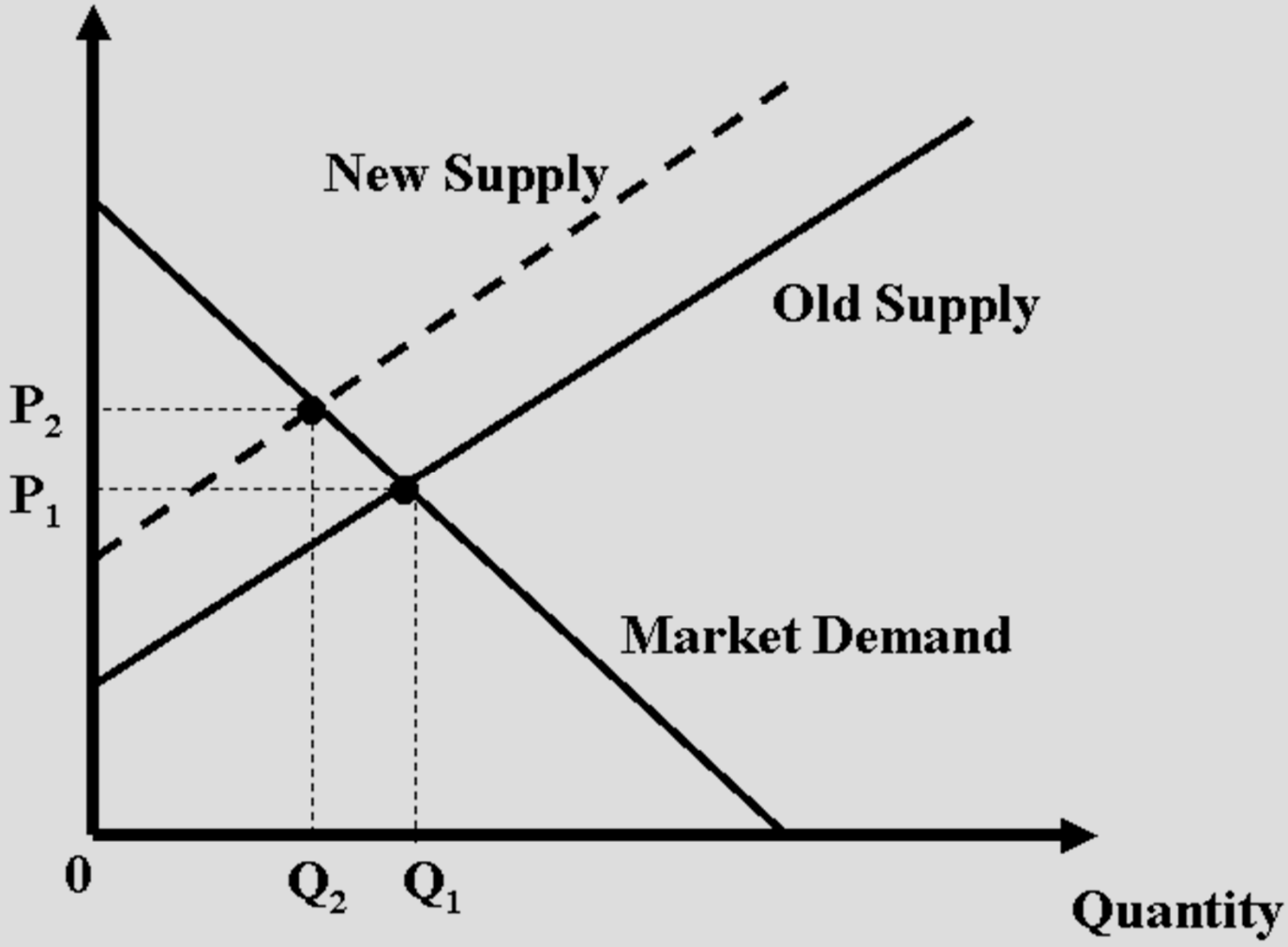
$b = \Delta Q/\Delta p = (Q2 - Q1)/(p2 - p1)$
$a = Q1 + bp1$

We can "identify" the slope of supply by a shift in demand

We can "identify" the slope of demand by a shift in supply, similarly

Identifying Demand

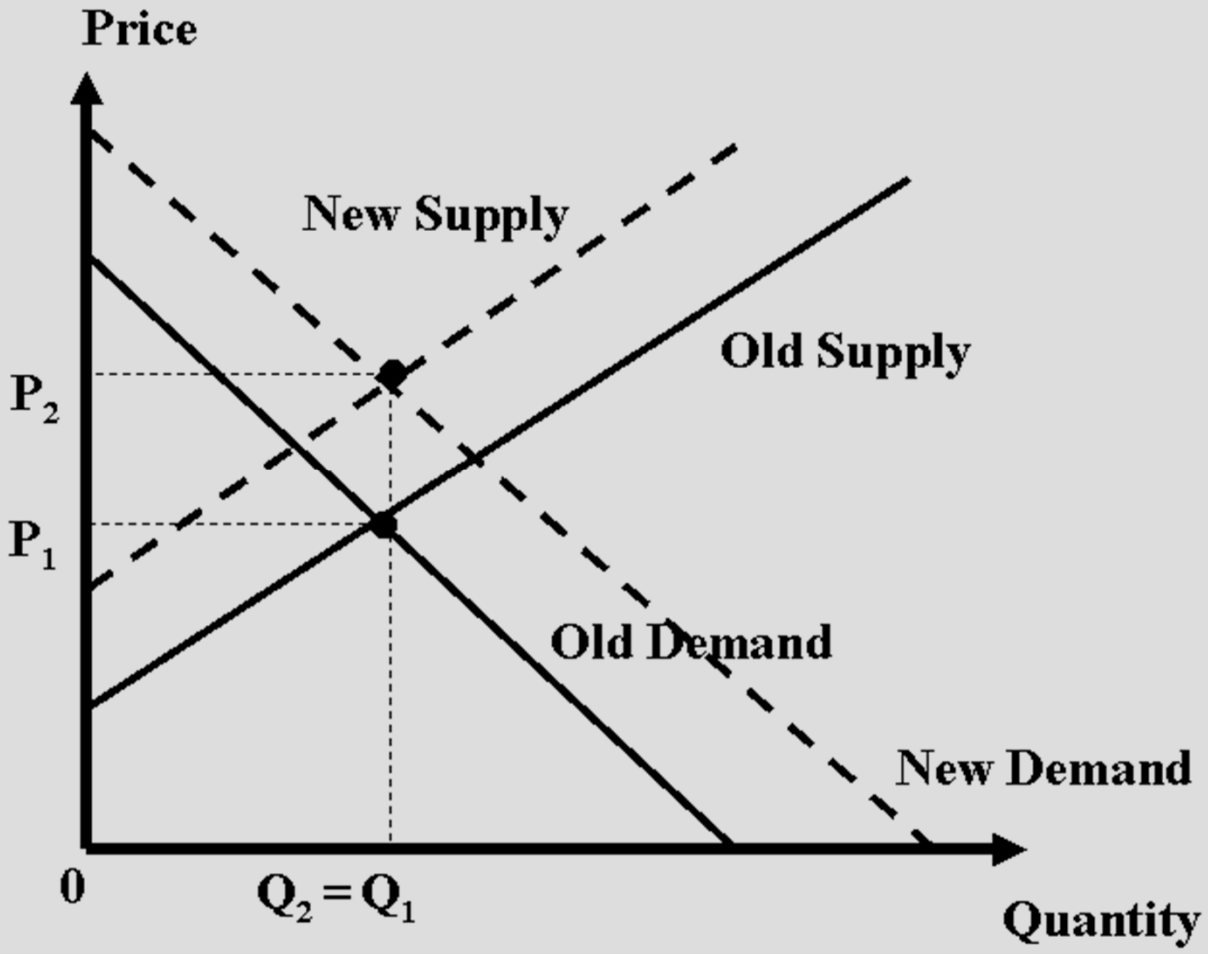
By a Shift in Supply



Identifying Demand

By a Shift in Supply

This technique only works if *one or the other* of the curves stays constant. Identifying demand when both curves shift



Chapter Three

Consumer Preferences and the Concept of Utility