Supply & Demand

Researchers at the Savannah River (S.C.) Ecology Laboratory have suggested how low-level nuclear waste at weapons sites might be cleaned up: feed it to chickens. The chickens' high metabolism burns off the waste, the researchers say, and after removal from the site and feeding the chickens non-contaminated food for 10 days, any leftover radiation in their bodies is eliminated. Would the meat sell? "If that meat is cheaper and you call it radioactively cleaned meat and you put it on the shelf for half price, I bet people in this country would eat it," one of the researchers claims. (AP)

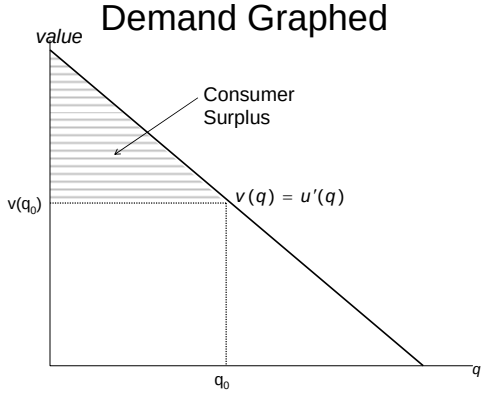
Demand

- Value of consumption q is $u(q)$
- Marginal value = $v(q) = u'(q)$,
- Consumer Surplus = $u(q) - pq$

$$= \int_0^q (u'(x) - p)dx = \int_0^q (v(x) - p)dx.$$

- Maximized at q satisfying $v(q)=p$.

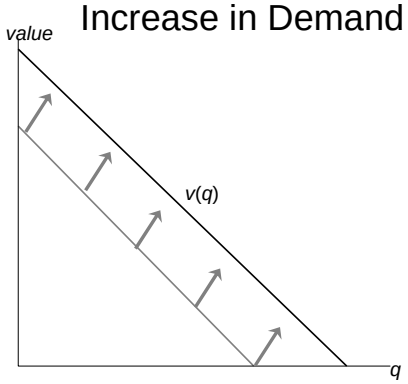
Demand Graphed



Key Insight

- Marginal value curve is the inverse function of the quantity demanded
- $v(x(p))=p$, where $x(p)$ is the quantity demanded at price p

Increase in Demand



Demand Changers

- Increase in demand: higher value for a given quantity, or higher quantity at a given price
- Factors increasing demand
  - Income
  - Prices of other goods
  - Technology
  - Preference changes

Prices of Other Goods

- Complements: Increase in price of complement decreases demand
  - pasta and tomato sauce
  - gasoline and automobiles
  - hotels and air travel
- Substitute: Increase in the price of substitute increases demand
  - Computers and typewriters

Income

- Inferior good: quantity demanded falls with income
- Normal good: quantity demanded rises with income

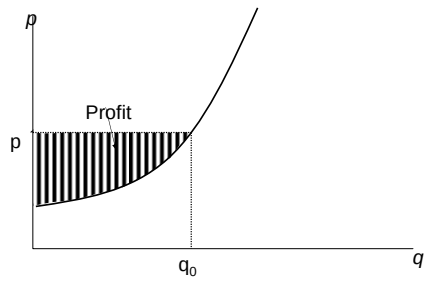
Supply

- Max $pq - c(q)$

$$0 = \frac{d}{dq} pq - c(q) = p - c'(q^*).$$

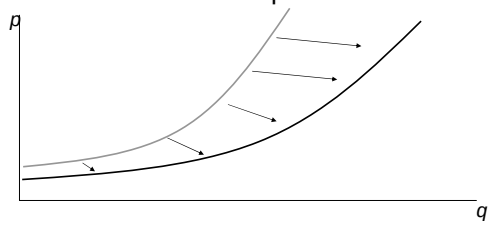
- Price equals marginal cost
- The supply (of a price-taking firm) is the inverse of the marginal cost curve

Supply



Increase in Supply

- More supplied at given price, or accept a lower price to supply the same
- Curve shifts down in picture

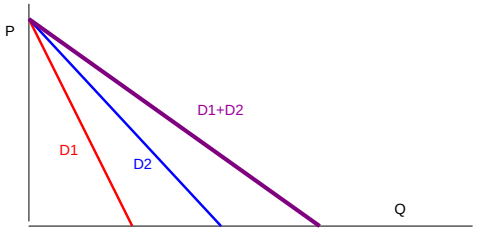


Prices of Other Goods

- Increase in the price of a complement increases supply of good
  - Joint production
  - beef & hides
  - natural gas and oil
  - lumber and wood chips
  - copper and silver
- Increase in the price of a substitute decreases supply
  - Corn & soybeans
  - Military and civilian aircraft

Market Demand & Supply

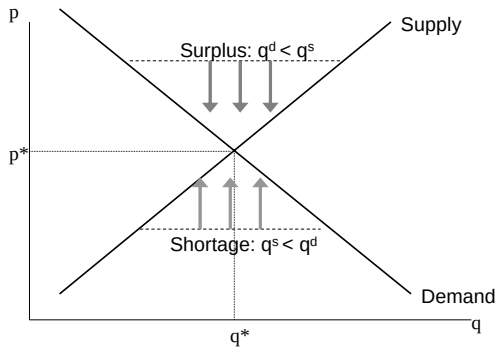
- Add quantities of individual demanders and suppliers to obtain market demand



Equilibrium

- Equilibrium is a steady state concept
- No one who would like to trade at going price is unable to trade
- Rationed parties have incentive to offer concessions to circumvent rationing
  - with surplus, sellers cut price
  - with shortage, buyers bid more

Equilibrium

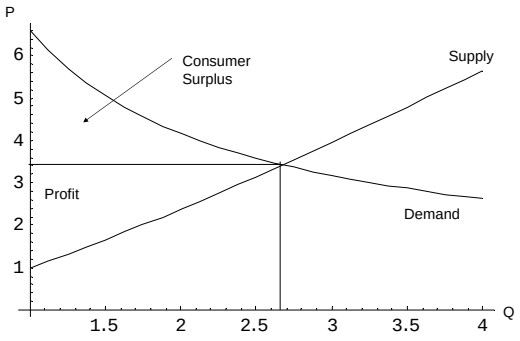


Sample Problem

- Quantity supplied = $p^{0.8}$
- Quantity demanded = $17p^{-1.5}$
- Equilibrium equates these, so

$$p^* = 17^{1/2.3} = 3.43, \quad q^* = p^{*0.8} = 2.68$$

Example Continued



Gains From Trade

- Consumer Surplus

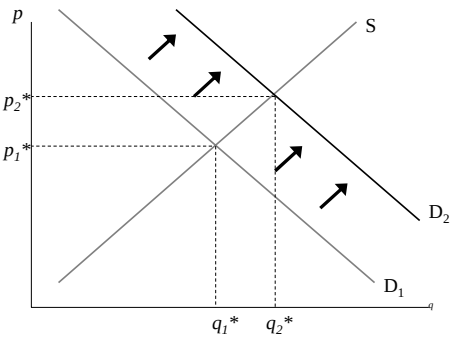
$$\int_{p^*}^{\infty} 17p^{-1.5}dp = \frac{17p^{*-.5}}{.5} = 62.9$$

- Profit $\int_{0}^{p^*} p^{.8}dp = \frac{p^{*1.8}}{1.8} = 5.1$

Efficiency

- The supply and demand equilibrium maximizes the gains from trade, provided the only parties affected by a transaction are buyer and seller
- Maximizing gains from trade requires
  - supplying with the lowest cost sellers
  - supplying the highest value buyers
  - trading only when value > cost

Increase in Demand: p↑, q ↑



The following is from The Big Issue:

"One of the primary reasons cat flaps are called cat flaps is that they're flaps specifically designed for cats, as opposed to dogs, or giraffes, or humans. All of this became abundantly clear to teenager Jason Evans, of Eastleigh, Hampshire, when he recently spent six hours stuck in one after using it in an attempt to get into his house. He was eventually cut free by firemen. In Germany, meanwhile, Gunther Burpus remained wedged in his front-door cat flap for two days because passers-by thought he was a piece of installation art. Mr Burpus, 41, of Bremen, was using the flap because he had mislaid his keys. Unfortunately he was spotted by a group of student pranksters who removed his trousers and pants, painted his bottom bright blue, stuck a daffodil between his buttocks and erected a sign saying 'Germany Resurgent, an Essay in Street Art. Please give Generously'. Passers-by assumed Mr Burpus' screams were part of the act and it was only when an old woman complained to the police that he was finally freed. "I kept calling for help," he said, "but people just said 'Very good! Very clever!' and threw coins at me." "

Changes in Demand, Supply

- D ↑: p ↑, q ↑
- S ↑: p ↓, q ↑
- Mix and Match: D ↑, S↓: p ↑, q?
- Problems:
  - Oil & natural gas are complements in supply, substitutes in demand. An increase in demand for oil (e.g. more summer driving) has what effect in the gas market?

Elasticities

Elasticity of Demand

$$\varepsilon = -\frac{x'(p)/x(p)}{1/p} = -\frac{px'(p)}{x(p)}.$$

- Percent change in quantity for a percent change in price
- Unit free
- $\varepsilon<1$ is *inelastic*, $\varepsilon>1$ is *elastic*

Total Revenue

$$\frac{d}{dp}px(p) = x(p) + px'(p) = x(p)\left(1+\frac{px'(p)}{x(p)}\right) = x(p)(1-\varepsilon).$$

$$\frac{\frac{d}{dp}TR}{\frac{1}{p}TR} = 1-\varepsilon.$$

- Thus, total revenue rises as $p\uparrow$ iff $\varepsilon<1$
- Constant elasticity $x(p)=ap^{-\varepsilon}$,

Supply Elasticity

$$\eta = \frac{s'(p)/s(p)}{1/p} = \frac{ps'(p)}{s(p)}.$$

- Constant $s(p)=ap^{\eta}$

Constant Elasticity Equilibrium

$$ap^{*-\varepsilon} = q_d(p^*) = q_s(p^*) = bp^{*\eta}.$$

$$p^* = \left(\frac{a}{b}\right)^{1/\varepsilon+\eta} \qquad q^* = a^{\eta/\varepsilon+\eta} b^{\varepsilon/\varepsilon+\eta}$$

Comparative Statics

- Increase demand by a fixed percentage
  - Replace a with $a(1+\Delta)$

$$\frac{\Delta p^*}{p^*} = (1+\Delta)^{1/\varepsilon+\eta} - 1 \approx \frac{\Delta}{\varepsilon+\eta}$$

$$\frac{\Delta q^*}{q^*} = (1+\Delta)^{\eta/\varepsilon+\eta} - 1 \approx \frac{\eta\Delta}{\varepsilon+\eta}$$

Comparative Statics

- Increase supply by a fixed percentage
  - Replace b with $b(1+\Delta)$

$$\frac{\Delta p^*}{p^*} = (1+\Delta)^{-1/\varepsilon+\eta} - 1 \approx \frac{-\Delta}{\varepsilon+\eta}$$

$$\frac{\Delta q^*}{q^*} = (1+\Delta)^{\varepsilon/\varepsilon+\eta} - 1 \approx \frac{\varepsilon\Delta}{\varepsilon+\eta}$$

Sample Problem

- Elasticity of demand for gasoline is 0.2
- Elasticity of supply for gasoline is 0.5
- A refinery outage reduces supply by 1% (at each price, 1% less quantity)
- Approximately what happens to price and quantity?

Solution

- Δ= -0.01,

$$\frac{\Delta p^*}{p^*} \approx \frac{-\Delta}{\varepsilon+\eta} = \frac{1\%}{.2+.05} = 4\%$$

$$\frac{\Delta q^*}{q^*} \approx \frac{\varepsilon\Delta}{\varepsilon+\eta} = \frac{.2(-1\%)}{.2+.05} = -0.8\%$$