

Equilibrium (Chapter 16)

Today

- Marginal Revenue
- Competitive Equilibrium Intro
- Equilibrium: Comparative Statics

Midterm Next Week

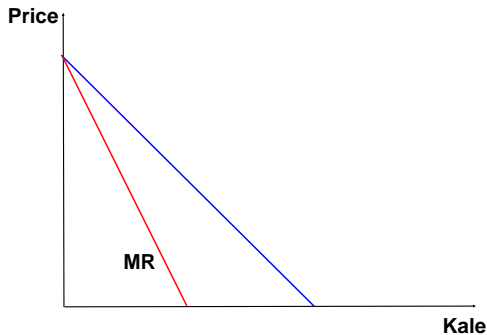
- Covers material up to end of this week: chapters 12,14,15,16
- 10-15 multiple choice, 2 blue-book
- In class on Tuesday
- Bring scantron, bluebook, pencil (and pen)
- Returned in section (or OH) following week
- See syllabus, FAQ for more details

Marginal Revenue

Q: Why is the MR curve always below D ?

A: Lower price to sell additional unit; earn extra p on additional unit, but lose revenue w/ lower price on all previous units.

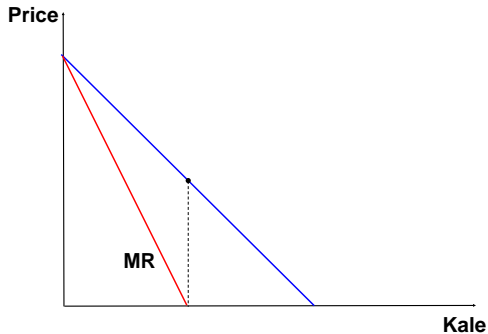
$$R = pq \implies MR = \frac{\partial R}{\partial q} = p \cdot 1 + q \frac{\partial p}{\partial q}$$



Marginal Revenue: Clicker Vote 2

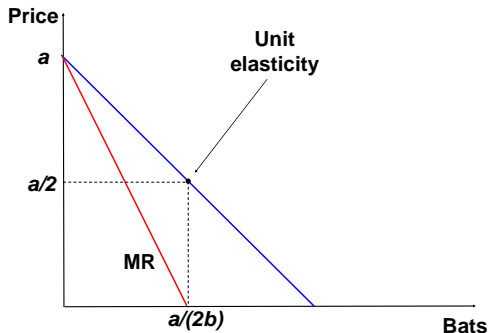
How elastic is demand at the quantity at which $MR = 0$?

- A) Elastic
- B) Unit Elastic
- C) Inelastic
- D) Not enough info



Marginal Revenue

Linear demand: $p(q) = a - bq$ (inverse demand)



$MR = a - 2bq$, so revenue maximizing $(p, q) = (\frac{a}{2}, \frac{a}{2b})$.

Competitive Equilibrium: Motivating Questions

- Firms are 'price-takers' in competitive markets, but how is the market price (and quantity) determined? **competitive equilibrium**
- What happens to equilibrium price and quantity when either supply or demand changes? **comparative statics**
- What are the effects of taxes and subsidies on prices and quantities?
- What are the welfare effects of taxes and subsidies? **deadweight loss, tax incidence**

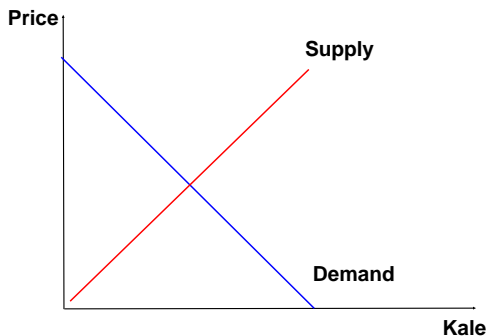
Competitive Equilibrium

Market Basics:

- How do we determine what to produce, how to do so, how to allocate produced goods, and to whom?
- One method: central planning
- Market system = *decentralized* alternative: each person/firm decides what/how to produce, individuals decide what to buy
- Market = meeting of buyers and sellers; *many different formats/institutions*
- How is price/quantity determined? *Depends on institutional rules, individuals but...*
- By understanding incentives, we arrive at the concept of **equilibrium** as a predictor of long-term behavior
- In equilibrium, no one has any reason to change behavior; disequilibrium incentive push people back towards equilibrium

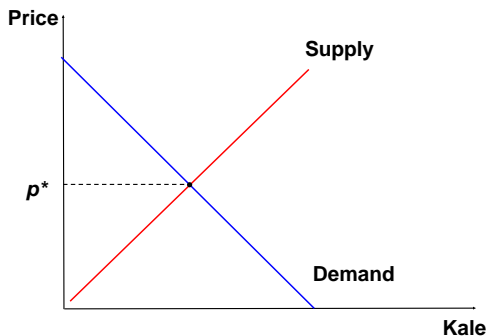
Market Forces

What is the equilibrium price?



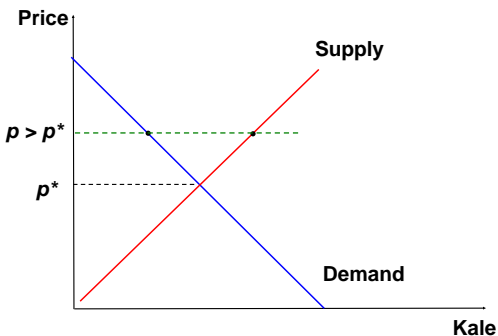
Market Forces

What is the equilibrium price?



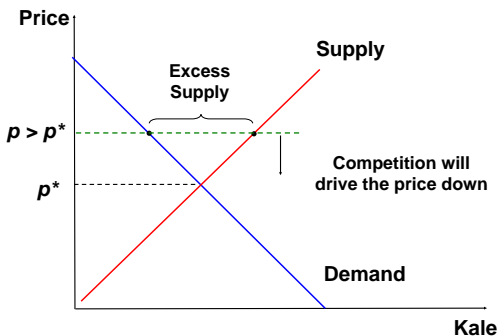
Market Forces

What are the sellers' disequilibrium incentives?



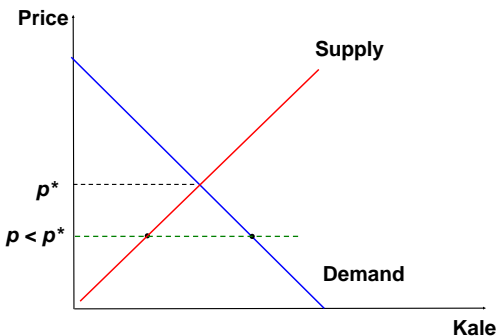
Market Forces

What are the sellers' disequilibrium incentives?



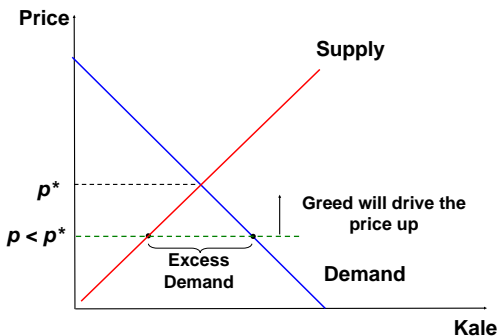
Market Forces

What are the sellers' disequilibrium incentives?



Market Forces

What are the sellers' disequilibrium incentives?



Competitive Equilibrium

Q: What is a competitive equilibrium?

A: The price p^* and quantity q^* such that

$$D(p^*) = S(p^*) = q^*.$$

Alternatively, using inverse demand and supply we can write

$$P_D(q^*) = P_S(q^*) = p^*$$

Example

Market for kale

- Demand for kale: $D(p) = 100 - 2p$
- Supply of kale: $S(p) = 10 + 7p$
- Equilibrium condition:

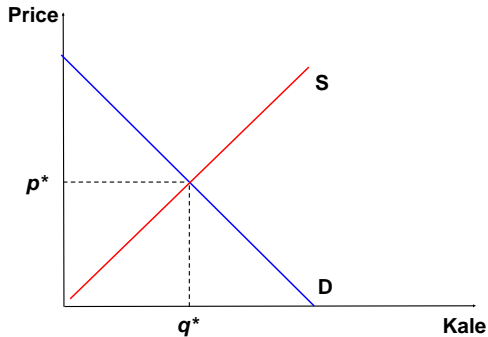
$$\begin{aligned}D(p^*) = S(p^*) &\implies 100 - 2p^* = 10 + 7p^* \implies 9p^* = 90 \\ &\implies p^* = 10\end{aligned}$$

- So equilibrium q is

$$q^* = D(10) = 100 - 2 \times 10 = 80 = S(10)$$

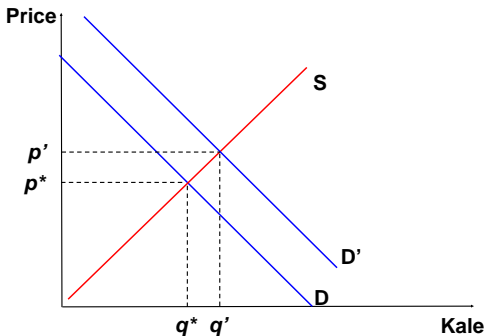
Comparative Statics: Shifting Demand

A new study reveals health benefits of eating kale. How does this affect (p^*, q^*) ?



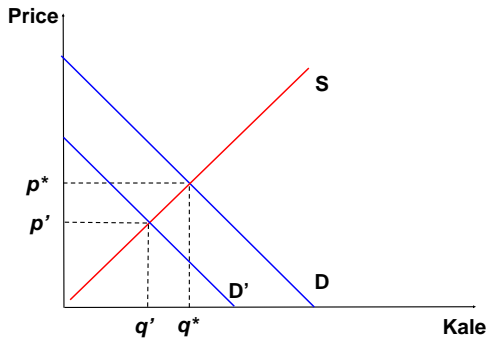
Comparative Statics: Shifting Demand

A new study reveals health benefits of eating kale.



Comparative Statics: Shifting Demand

An *E. coli* outbreak is traced to a kale farm.

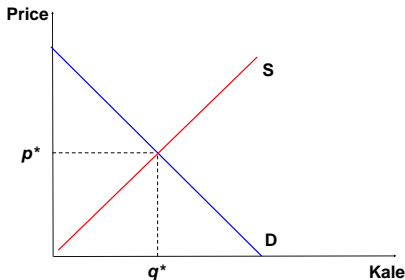


Comparative Statics: Shifting Supply

Kale-weevils decimate crop

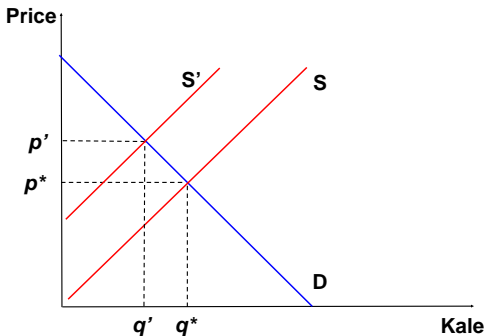
Clicker Vote: Which way does supply shift?

- Up
- Down
- Left
- Right



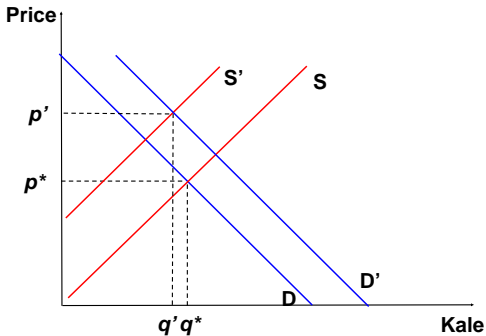
Comparative Statics: Shifting Supply

Kale-weevils decimate crop



Comparative Statics: Shifting Both Curves

The effect on (p^*, q^*) of shifting both curves: ambiguous for one, unambiguous for the other.



Quantity Taxes

- Levied on each unit sold.
- E.g. gasoline tax: seller sets price at \$2.05/gallon and gasoline tax is \$0.35/gallon. Consumer must pay $p_d = 2.05 + 0.35 = 2.40$ dollars/gallon
- Seller gets $p_s = 2.05$
- Like any tax, this creates a wedge between what consumer pays and what producer receives
- The \$0.35 tax, collected by the govt., is the difference between the *consumer price*, p_d , and the *producer price*, p_s :

$$p_d - p_s = 0.35$$

Equilibrium with a Quantity Tax

Suppose gasoline tax is t dollars/gallon.

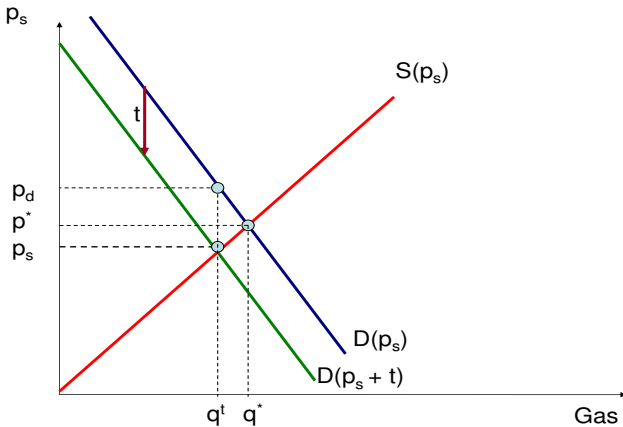
- t as a wedge:

$$p_d - p_s = t \implies p_d = p_s + t$$

- How does this affect equilibrium?
- New condition: $D(p_d) = S(p_s)$
- Rewrite as $D(p_s + t) = S(p_s)$ or $D(p_d) = S(p_d - t)$
- Can think of this as either shifting D or S

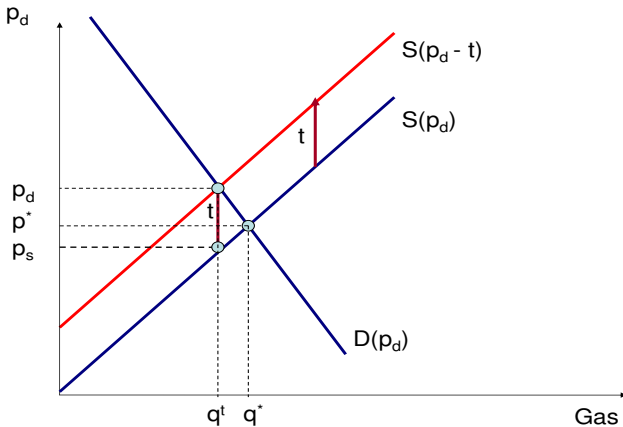
Equilibrium with a Quantity Tax

One view: demand shifts *downward*



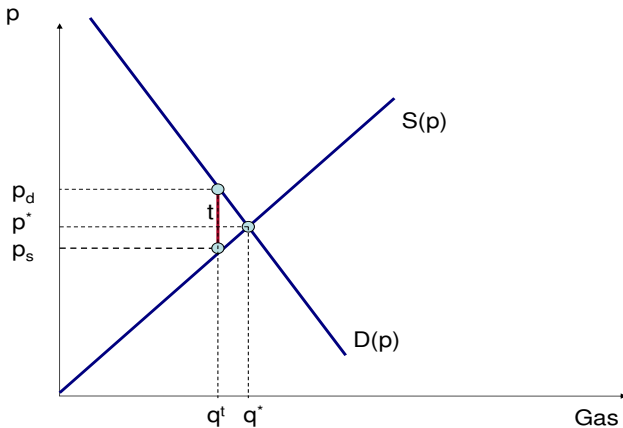
Equilibrium with a Quantity Tax

Another view: supply shifts *upward*



Equilibrium with a Quantity Tax

Either way: $q^t < q^*$ and $p_s < p^* < p_d$



Example

- Inverse Demand: $P_d(q) = 50 - \frac{q}{2}$
- Supply: $S(p) = 10 + 7p$
- Suppose govt. imposes tax $t = 0.90$ per gallon. What is the after-tax equilibrium?
- We need to find $D(p)$ first:

$$p = 50 - \frac{D(p)}{2} \implies D(p) = 100 - 2p$$

- Equilibrium condition:

$$\begin{aligned} D(p_s + t) = S(p_s) &\implies 100 - 2(p_s + 0.90) = 10 + 7p_s \\ &\implies 9p_s = 90 - 2 \times 0.90 \\ &\implies p_s = 10 - 0.2 = 9.80 \end{aligned}$$

Example

- Consumer price:

$$p_d = p_s + t = 9.80 + 0.90 = 10.70$$

- So the equilibrium quantity is

$$q^t = S(p_s) = 10 + 7p_s = 10 + 7 \times 9.80 = 78.6$$

- How much tax revenue does the government collect?

$$R_t = tq^t = 0.90 \times 78.6 \approx 70.74$$