CLASS 11 SLIDES

8. Basic Competition Economics

Merger Antitrust Law

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Central questions

1. How does a firm price its product and choose its level of production?
2. What are the social welfare implications of these determinations?
3. How can firms coordinate their behavior—through a price-fixing agreement or a merger—to increase their aggregate profits?
4. Why is competitive pricing socially better than monopoly pricing?

Price formation models

- Standard assumptions in the neo-classical model
  - Consumers
    - Individually maximize preferences (utility) subject to their individual budget constraints
    - Yields a consumer demand function, which gives the quantity demanded $q_i^{demanded}$ by consumer *i* for a given market price *p*
  - Firms
    - Individually maximize profits subject to their available production technology (production possibility sets)
    - Yields a production function that gives the quantity produced $q_j^{produced}$ by firm *j* for a given market price *p*
  - Equilibrium condition
    - No price discrimination (all purchases are made at the single market price)
    - Market clears at the market price (i.e., demand equals supply):

$$\sum_i q_i^{demanded} = \sum_j q_j^{produced}$$

$\sum$ simply means to add up the *q*'s. So if $q_1 = 10$. $q_2 = 7$, and $q_3 = 5$, then $\sum q_i = 10 + 7 + 5 = 22$.

Consumers

- Consumers and demand curves
  - Demand curves
    - At a price p_1 for product 1 a given consumer will demand a quantity q_1 of that product
    - A consumer's individual *demand curve* for product 1 is the collection of the pair of points (p_1, q_1) that is generated by varying the price of product 1 while holding the prices of all other products constant gives the demand q_1 for product 1 at that price
    - *Law of demand*. A consumer will demand less of a product as that product's price increase, which results in a downward sloping demand curve
    - *The aggregate demand curve* is the sum of the demand curves of the individual consumers. Aggregate demand curves are downward sloping
      - A *demand function* is the mathematical relationship that describes the demand curve
      - The aggregate demand functions we will use in this course will be linear: $q = a + bp$

Demand curves

- Demand curves and inverse demand curves
  - An *inverse demand curve* gives price as a function of quantity
  - So if the demand curve is $q = a + bp$, the inverse demand curve can be derived by solving for p:
    - *Example*: If the demand curve is $q = 20 - 2p$, the inverse demand curve is:

$$p = \frac{20 - 2q}{2} = 10 - \frac{1}{2}q$$

  - Think about the inverse demand curve as the price necessary to *clear the market* given production level q
    - "Clear the market" means that consumers demand no more and no less than q at price p

Demand curves

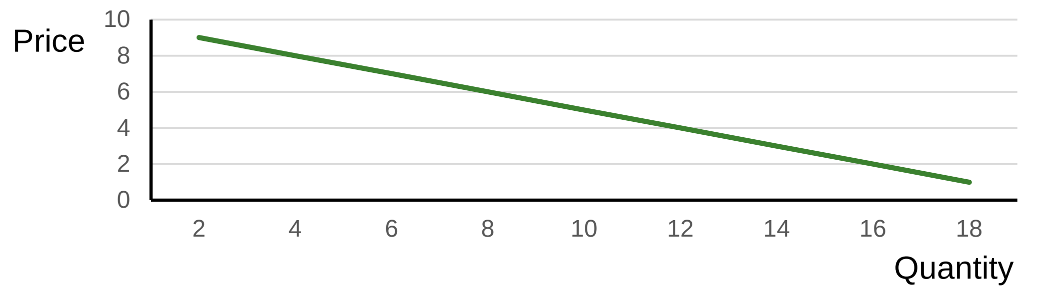
Demand: The total quantity q customers are willing to purchase at a price p
Demand curve: Traces the relationship between q and p

Demand Curve

$$q = 20 - 2p$$

Inverse Demand Curve

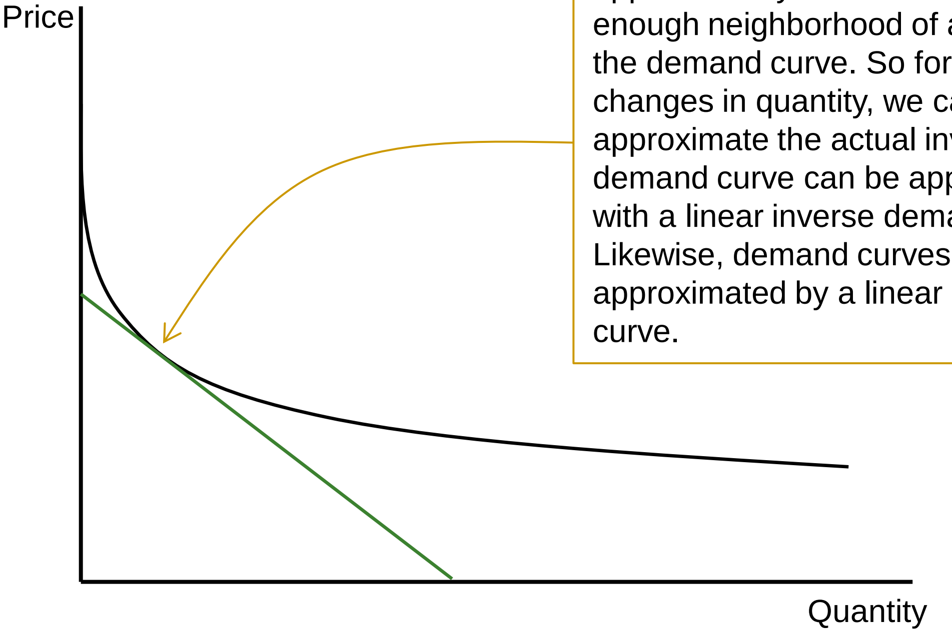
$$p = \frac{20 - 2q}{2} = 10 - \frac{1}{2}q$$



Query: Why is the demand curve downward sloping?

Demand curves

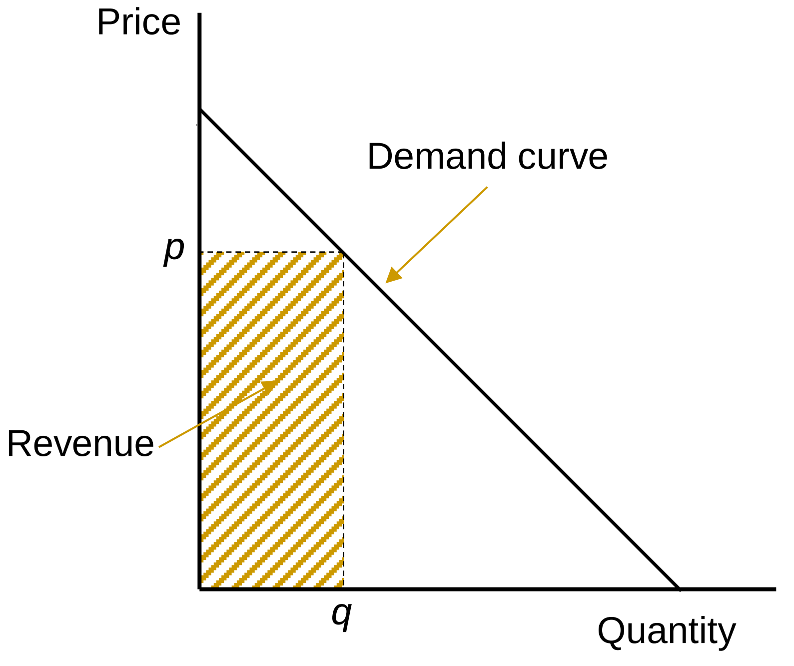
- Example: Nonlinear inverse demand curve with no x-axis intercept



Note: Demand curves are approximately linear around any small enough neighborhood of any point on the demand curve. So for small changes in quantity, we can approximate the actual inverse demand curve can be approximated with a linear inverse demand curve. Likewise, demand curves can be approximated by a linear demand curve.

Revenues

Revenue = Price times quantity (= *pq*)



Revenues and marginal revenues

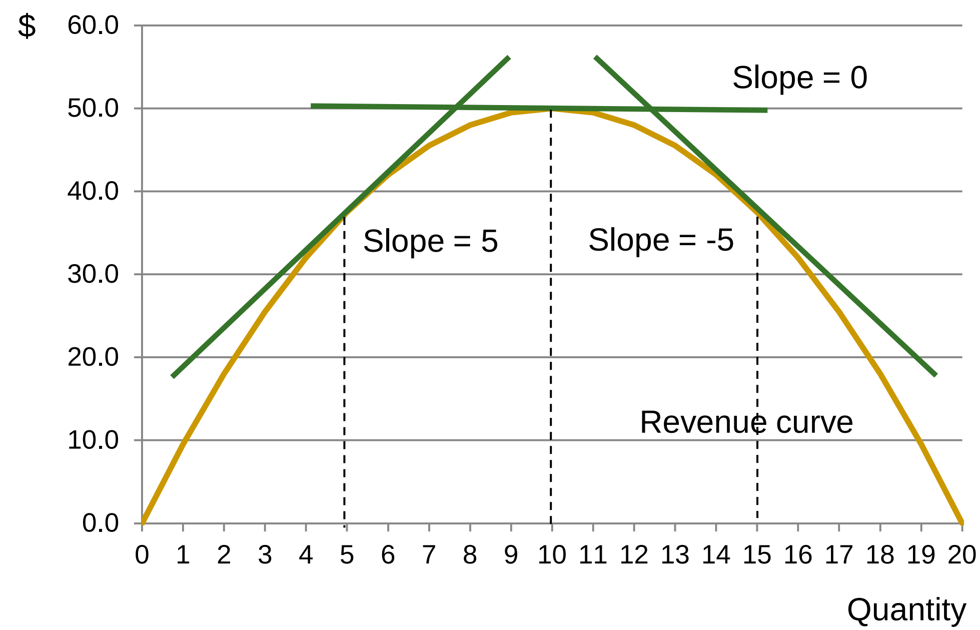
- *Marginal revenue*: The net additional revenue the firms earns by increasing its output by one unit
  - *Note*: If the firm faces a downward sloping demand curve, marginal revenue will be less than price—the market price will have to decrease after adding the incremental output in order to clear the market
    - This lower price will apply to preexisting sales as well as incremental sales

Revenues and marginal revenues

- *Example:*
  - Demand curve: $q = 20 - p$
  - This yields an inverse demand curve: $p = 10 - \frac{1}{2}q$
  - Revenues:

$$r(q) = p(q)q$$
$$= \left[10 - \frac{1}{2}q\right]q$$
$$= 10q - \frac{1}{2}q^2.$$

This is a quadratic equation.
Its curve is a parabola



  - Marginal revenue at *q* is simply the slope of the demand curve at *q*

Marginal revenues

Marginal revenue (mr) = The revenue gain from the incremental sales without any price adjustment
– the revenue loss from decrease price on all sales necessary to clear the market given the additional units of output

or equivalently

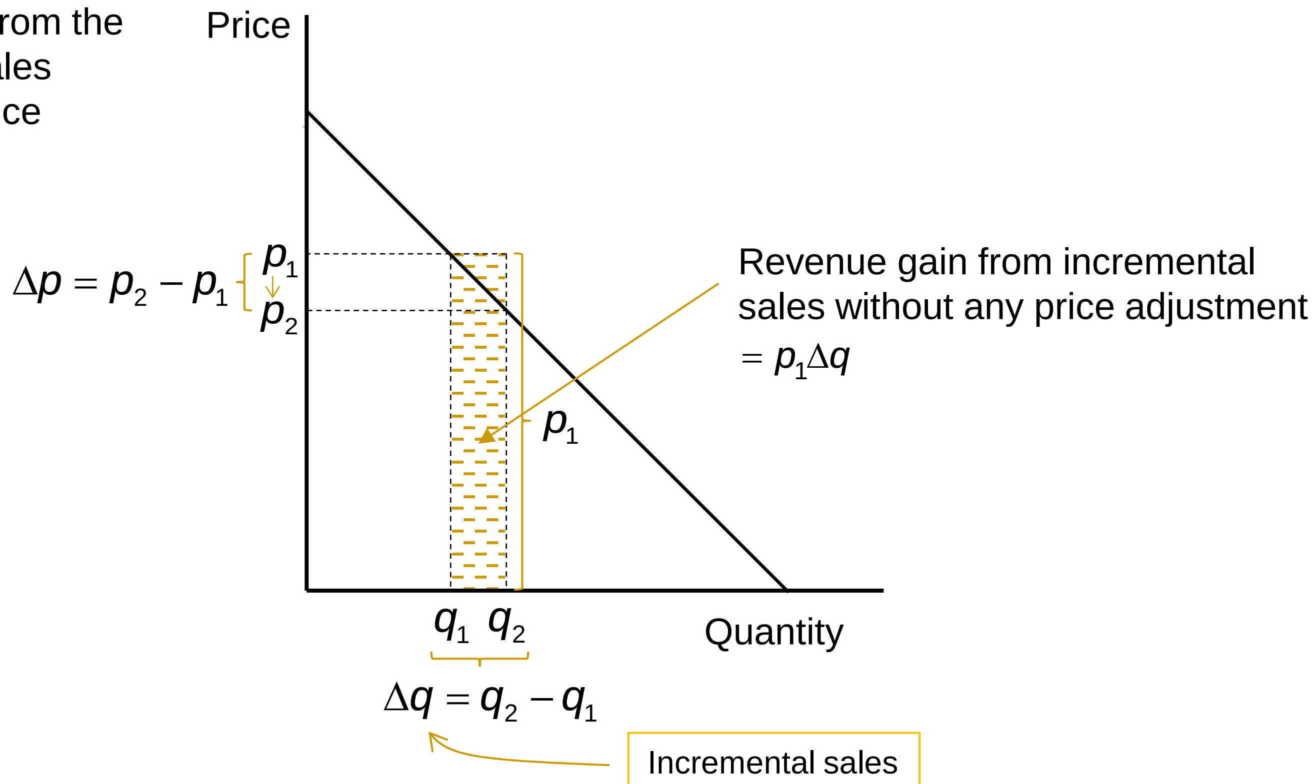
= the revenue gain from incremental sales (the sale of one additional unit)
– revenue loss from lower price on preexisting sales

The next three slides demonstrate this

Marginal revenues

Marginal revenue (mr) = The revenue gain from the incremental sales without any price adjustment
– the revenue loss from decrease price on all sales necessary to clear the market given the additional units of output

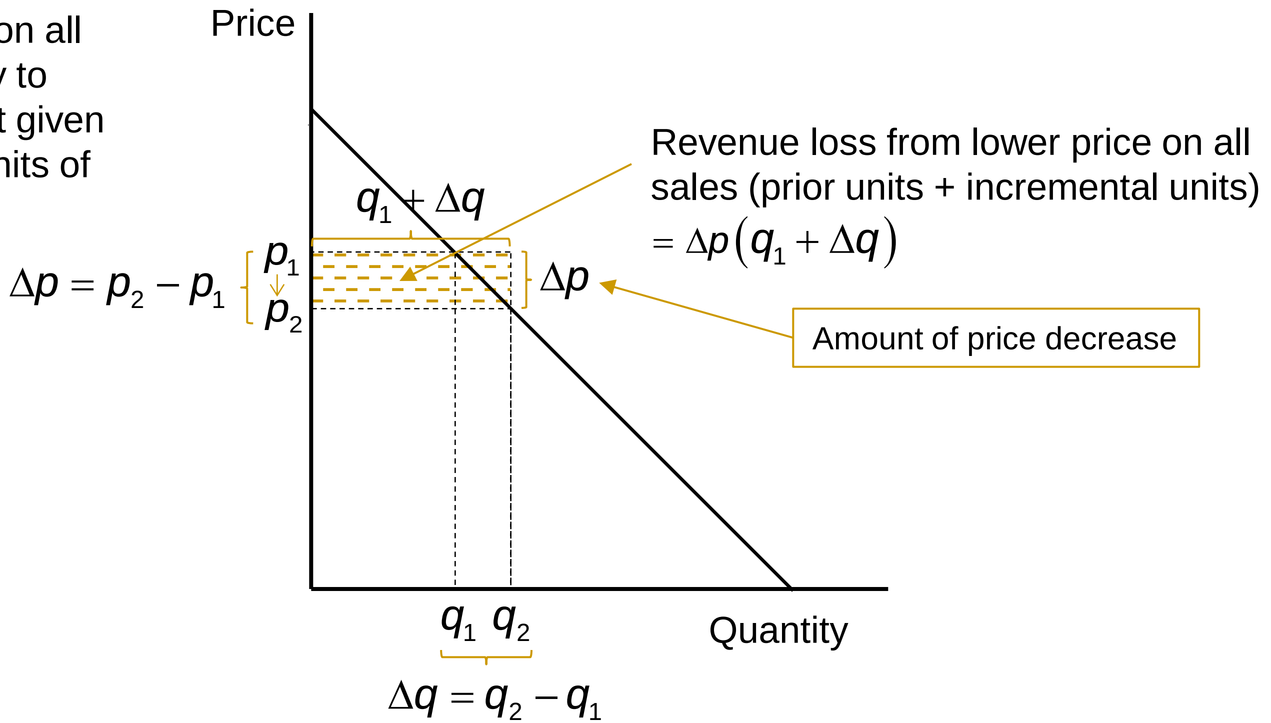
Step 1. Look first at the revenue gain from the incremental sales without any price adjustment:



Marginal revenues

Marginal revenue (mr) = The revenue gain from the incremental sales without any price adjustment
– the revenue loss from decrease price on all sales necessary to clear the market given the additional units of output

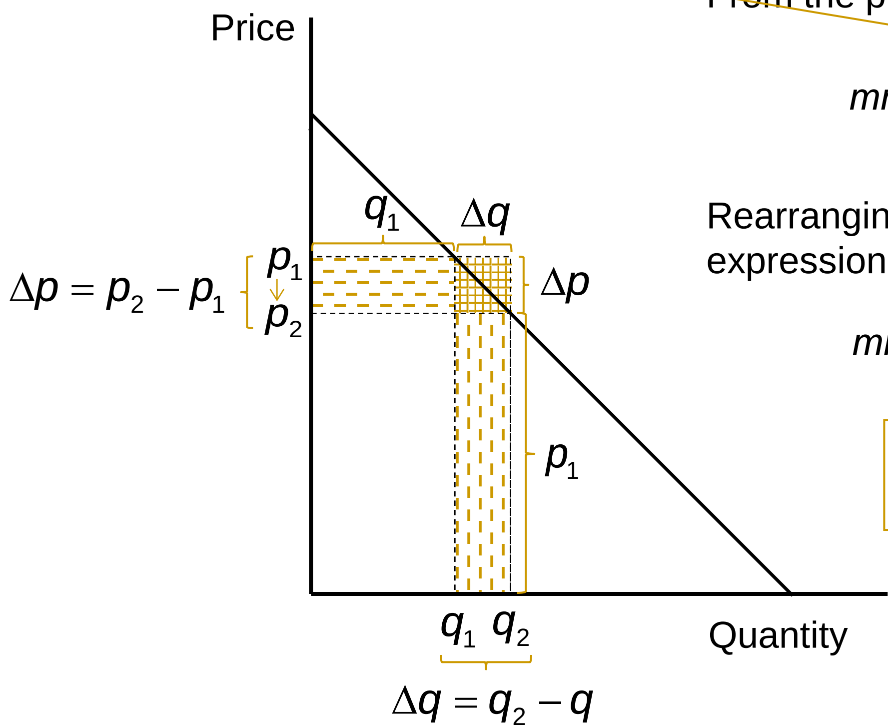
Step 2. Now look at the revenue loss from decrease price on all sales necessary to clear the market given the additional units of output



Marginal revenues

Marginal revenue (mr) = The revenue gain from the incremental sales without any price adjustment
– the revenue loss from decrease price on all sales necessary to clear the market given the additional units of output

Step 3. Putting it together:



From the prior two slides:

$$mr \equiv \frac{\Delta r}{\Delta q} = p_1 \Delta q + \Delta p (q_1 + \Delta q)$$

Rearranging for an alternative but equivalent expression:

$$mr \equiv \frac{\Delta r}{\Delta q} = (p_1 + \Delta p) \Delta q + \Delta p q_1$$

Revenue gain from lower price on *incremental* sales

Revenue loss from lower price on *preexisting* sales

Revenues and marginal revenues

- Relationship between revenues and marginal revenue
  - Discrete case

Read this " *r* of *q*": This is the revenues at production level *q*.

$$r(q) = \sum_{i=1}^{q} mr_i$$

    - That is, total revenues for a production level *q* is equal to the sum of the marginal revenues for units 1 to *q*
  - Continuous case (for diehard calculus fans):

$$\frac{dr(q)}{dq} = mr(q)$$

and

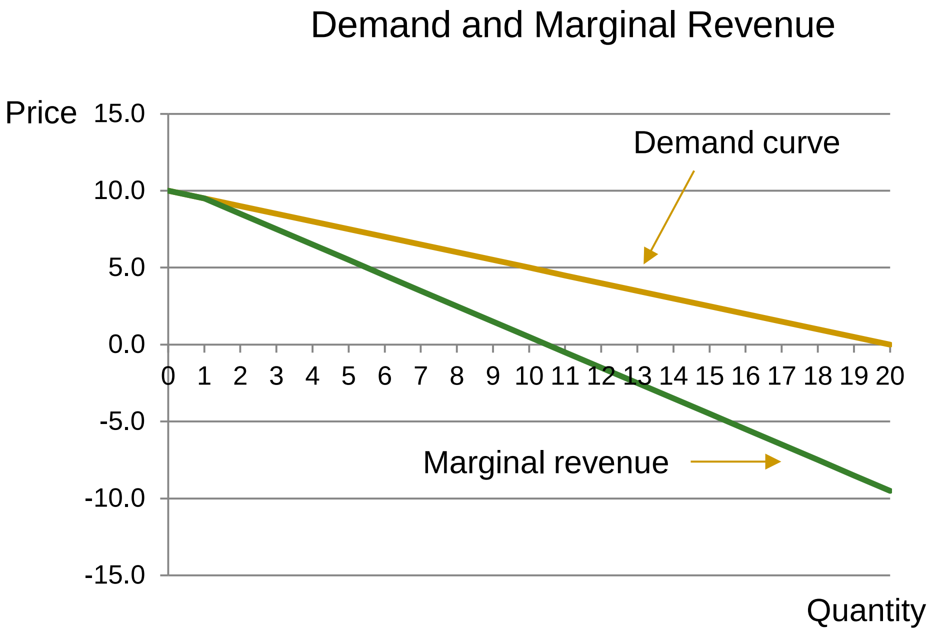
$$r(q) = \int_0^q mr(q)dq$$

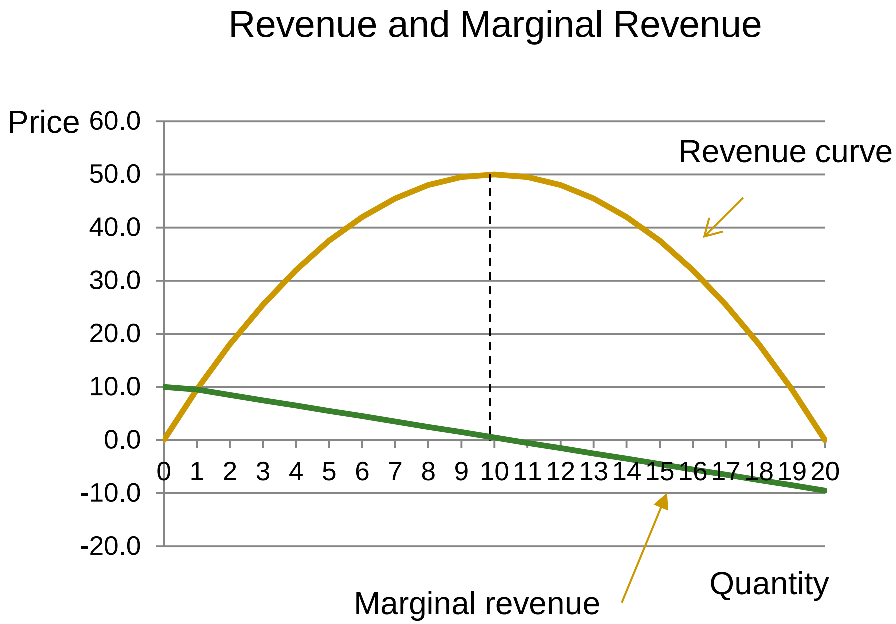
Revenues and marginal revenues

- Linear (inverse) demand curves
  - If $p = a + bq$ is the inverse demand curve, then
  - $R = pq = (a + bq)q = aq + bq^2$
  - *Rule*: Marginal revenue is then $mr = a + 2bq$
    - If you know calculus, marginal revenue is the derivative of the revenue function
    - If you do not know calculus, you should just memorize the result

Revenues

- Graphing revenue and marginal revenue curves
  - Inverse demand: $p = 10 - \frac{1}{2}q$





Notes:

1. When demand is linear, the slope of the marginal revenue curve is twice as steep as the demand curve. This means that marginal revenue crosses the *x*-axis at half of the distant to where the demand curve crosses the *x*-axis. In the first chart, the marginal revenue curve crosses the x-axis at 10, half of the distance to where the demand crosses the *x*-axis at 20.
2. When marginal revenue equals zero (here, a q = 10), revenues are at their maximum.

Costs

- Some basic terms
  - *Revenues* (*R*(*q*))
    - Price (*p*) times quantity (*q*) sold
    - Evaluated at a production level *q*
  - *Marginal revenue (mr)*: The net additional revenues that would be earned if the firm produced an additional unit
    - If the firm faces a downward-sloping demand curve for its product, the production of an additional unit will require a decrease in price in order to clear the market of the larger volume
    - Marginal revenue may be positive or negative

Costs

- Some basic terms
  - *Costs (C(q))*
    - The total cost of producing a production level q
    - Costs $C(q)$ = fixed cost (f) + variable cost $v(q)$)
  - Fixed costs (f)
    - Costs of production that do not vary with the quantity produced
  - Variable costs ($v(q)$)
    - Costs of production that vary with the production level and that are incurred producing a level q
  - *Marginal cost (mc(q))*
    - The additional costs the firm would incur for producing one additional unit having produced q units
    - $mc(q) = C(q+1) + C(q)$

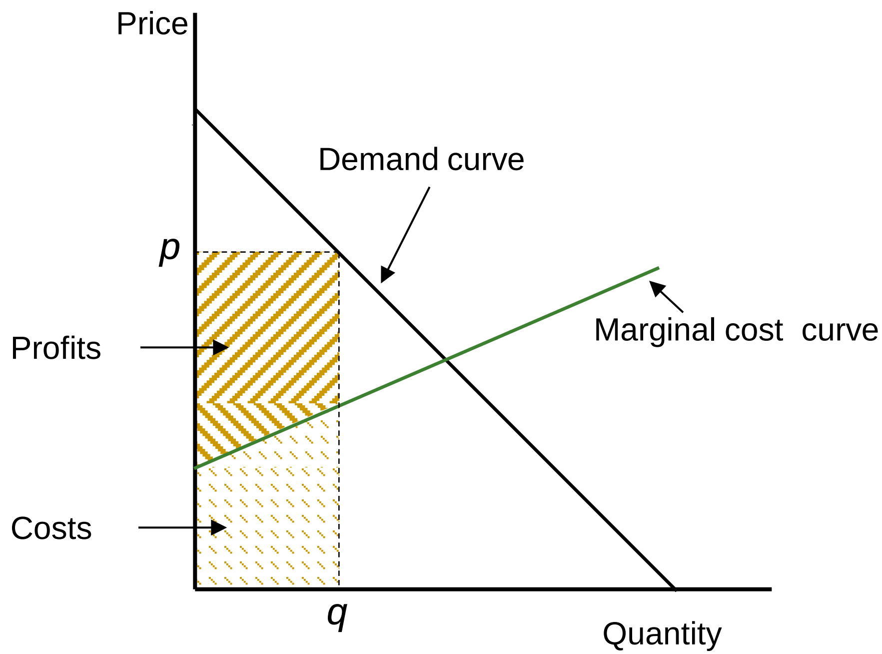
Costs

- Some basic terms
  - *Profits ($\pi(q)$)*
    - Revenues minus costs earned at a production level *q*
    - $\pi(q) = R(q) - C(q)$
  - *Marginal profit ($m\pi$)*
    - The net additional profit that the firm would make if it produced an additional unit
    - Or equivalently, marginal revenues minus marginal costs:

$$\begin{aligned} m\pi(q) &= \pi(q+1) - \pi(q) \\ &= \left[R(q+1) - C(q+1)\right] - \left[R(q) - C(q)\right] \\ &= \left[R(q+1) - R(q)\right] - \left[C(q+1) - C(q)\right] \\ &= mr(q) - mc(q) \end{aligned}$$

Marginal costs

Marginal cost (*mc*): The cost *mc* of producing the $(n + 1)^{th}$ unit after producing *n* units
Marginal cost curve: Traces the relationship between *n* and *mc*



$$c(q) = \sum_{i=1}^{n} mc_i$$

+ *f* if there are fixed costs

Query: The marginal cost curve is shown upward sloping. Why might that be?
Can the marginal cost curve be flat or even downward sloping?

Profit maximization

- A firm maximizes its profits when it sets its production level so that its marginal revenues equal its marginal costs
  - The idea
    - A firm maximizes its profits at a production level *q** when its profits decrease when it either produces more or less units than *q**
    - Let Δq be a change in the firm's production level from *q**. Then:

$$\pi\left(p^*\right) > \pi\left(p^* + \Delta q\right)$$

      where Δq may be either positive or negative
    - Let $m\pi(\Delta q)$ be the incremental profits the firm earns by changing its production level by Δq. Then:

$$\pi\left(q^* + \Delta q\right) = \pi\left(q^*\right) + m\pi\left(q^* + \Delta q\right)$$

    - These two equations imply:

$$\pi\left(q^* + \Delta q\right) - \pi\left(q^*\right) = m\pi\left(q^* + \Delta q\right) < 0$$

Profit maximization

- A firm maximizes its profits when it sets its production level so that its marginal revenues equal its marginal costs
  - The idea
    - Now profits equal revenues minus costs, so marginal profits equal marginal revenues minus marginal costs:

$$m\pi(q^* + \Delta q) = mr(q^* + \Delta q) - mc(q^* + \Delta q) < 0$$

The inequality comes from the prior equation

    - The only time when this inequality does not hold is when $\Delta q = 0$, so that:

$$mr(q^*) = mc(q^*)$$

  - The calculus version
    - The firm's profit maximization function:

$$\max_q \pi(q) = R(q) - C(q)$$

Where $p(q)$ is function that expresses p as a function of q (i.e., the inverse demand function)

    - Obtain the first order condition by setting the derivative of the profit function to zero:

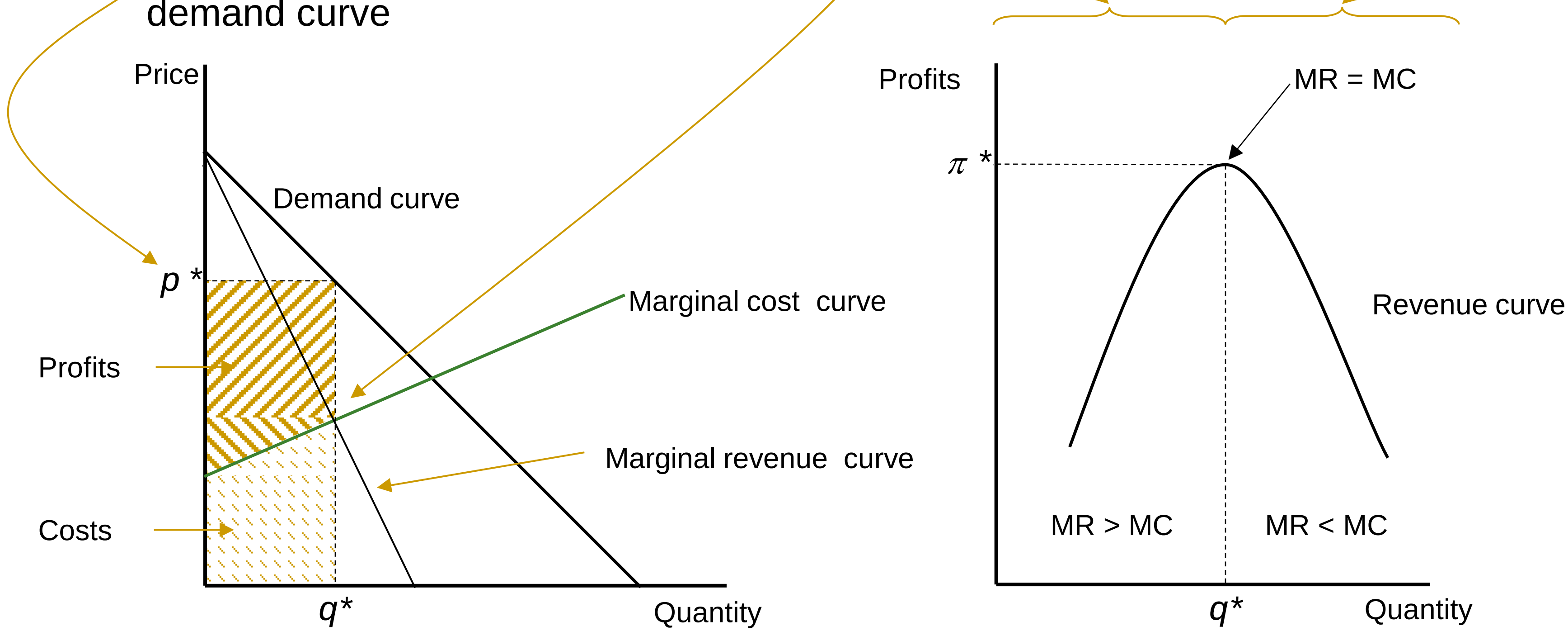
$$\frac{d\pi}{dq} = \frac{dR}{dq} - \frac{dC}{dq} = 0 \Rightarrow mr(q^*) = mc(q^*)$$

Profit maximization

- Firms maximize profits when *mr = mc*
  - *Step 1*: Find the q* where marginal revenue equals marginal cost
  - *Step 2*: find p* for q* from the inverse demand curve

Firm can make more profits by increasing *q*, since incremental revenue gains exceed incremental costs

Firm can make more profits by decreasing *q*, since incremental costs exceed incremental revenue gains



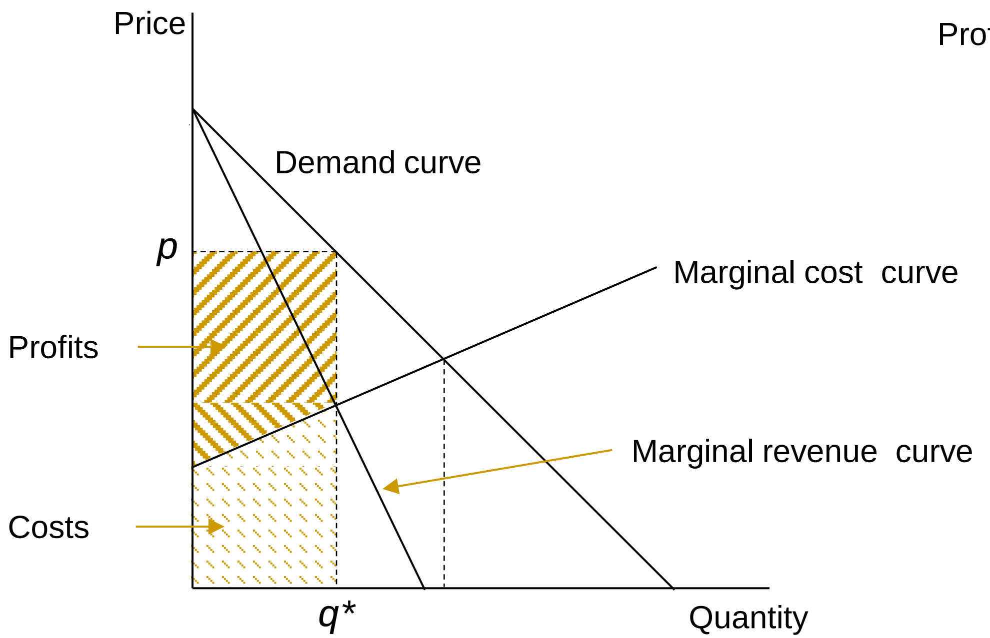
Profit maximization

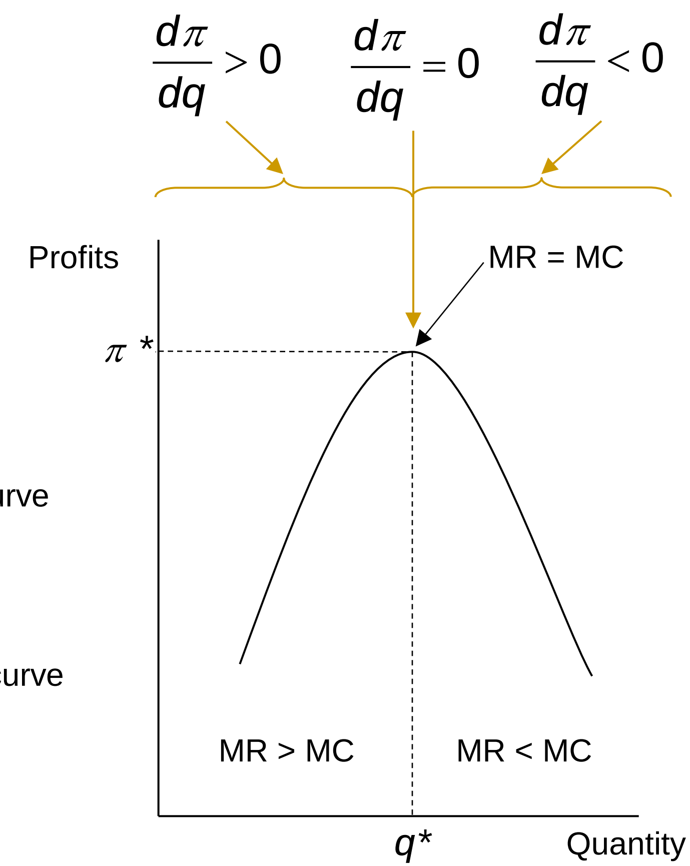
- The calculus version

Profits = Revenues - Costs

$$\max_q \pi(q) = R(q) - C(q)$$

$$\frac{d\pi}{dq} = \frac{dR}{dq} - \frac{dC}{dq} = 0$$

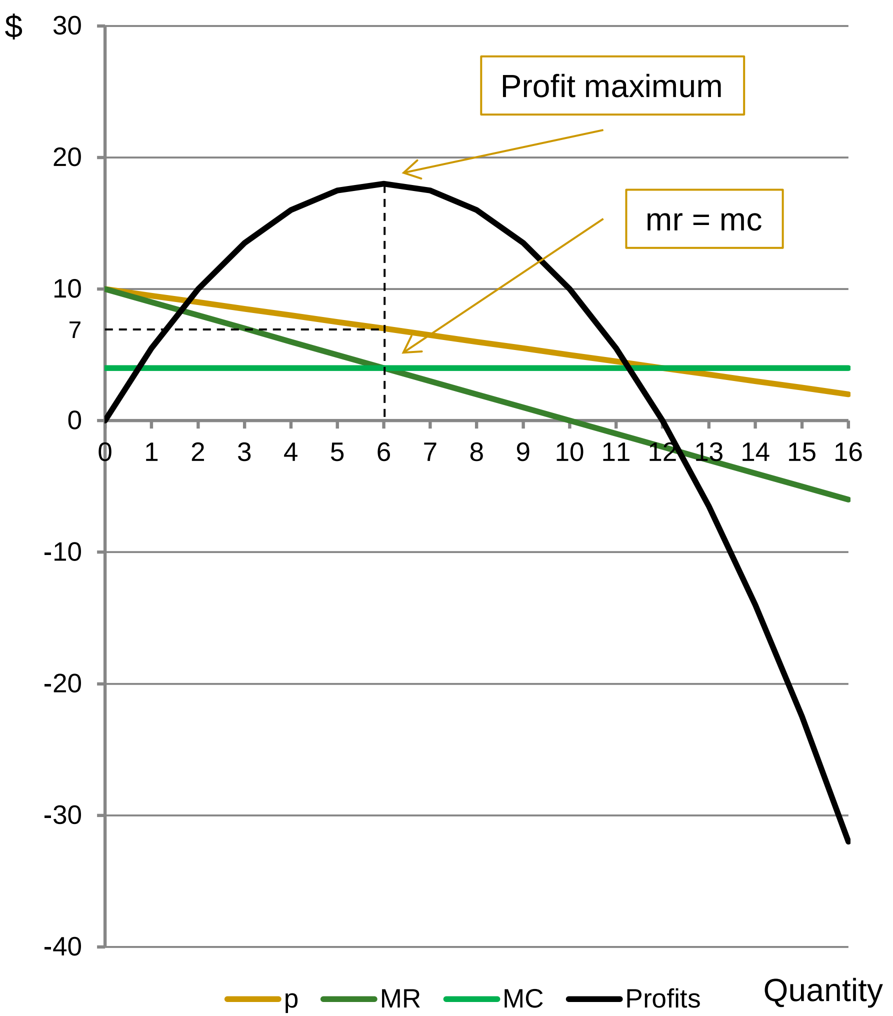




Profit maximization

- Numerical version $p = 10 - \frac{1}{2}q$

Quantity q	Price p	Revenue r	Marginal Revenue mr	Marginal Costs mc	Total Costs c	Profits Π
0	10.0	0.0			0.0	0.0
1	9.5	9.5	9.5	4.0	4.0	5.5
2	9.0	18.0	8.5	4.0	8.0	10.0
3	8.5	25.5	7.5	4.0	12.0	13.5
4	8.0	32.0	6.5	4.0	16.0	16.0
5	7.5	37.5	5.5	4.0	20.0	17.5
6	7.0	42.0	4.5	4.0	24.0	18.0
7	6.5	45.5	3.5	4.0	28.0	17.5
8	6.0	48.0	2.5	4.0	32.0	16.0
9	5.5	49.5	1.5	4.0	36.0	13.5
10	5.0	50.0	0.5	4.0	40.0	10.0
11	4.5	49.5	-0.5	4.0	44.0	5.5
12	4.0	48.0	-1.5	4.0	48.0	0.0
13	3.5	45.5	-2.5	4.0	52.0	-6.5
14	3.0	42.0	-3.5	4.0	56.0	-14.0
15	2.5	37.5	-4.5	4.0	60.0	-22.5
16	2.0	32.0	-5.5	4.0	64.0	-32.0
17	1.5	25.5	-6.5	4.0	68.0	-42.5
18	1.0	18.0	-7.5	4.0	72.0	-54.0
19	0.5	9.5	-8.5	4.0	76.0	-66.5
20	0.0	0.0	-9.5	4.0	80.0	-80.0



Profit maximization

- Example (calculus version):

Demand: $p = 10 - \frac{1}{2}q$

Revenue: $r = pq = 10q - \frac{1}{2}q^2$

Marginal revenue: $mr = \frac{dr}{dq} = 10 - q$

Marginal cost: $mc = 4$

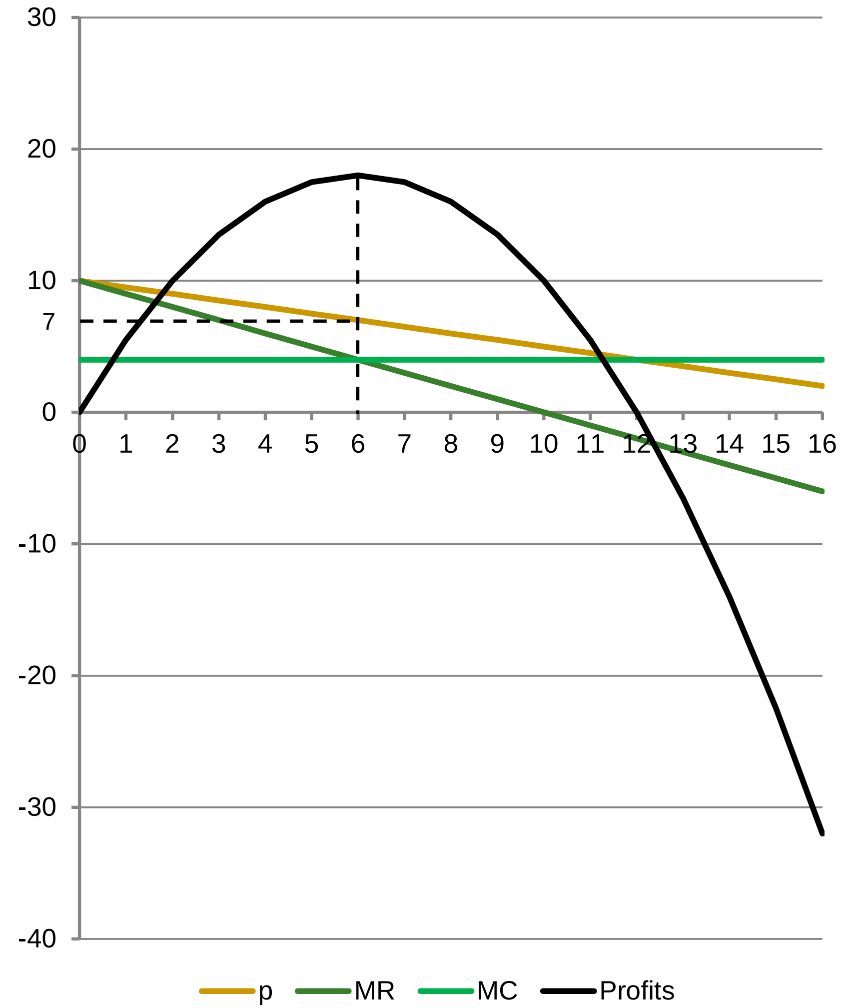
Profit max: $mr = mc$

$$10 - q = 4$$

$$q = 6$$

$$p = 7$$

Profits: $\pi = r - (mc)q = 42 - (4)6 = 18$

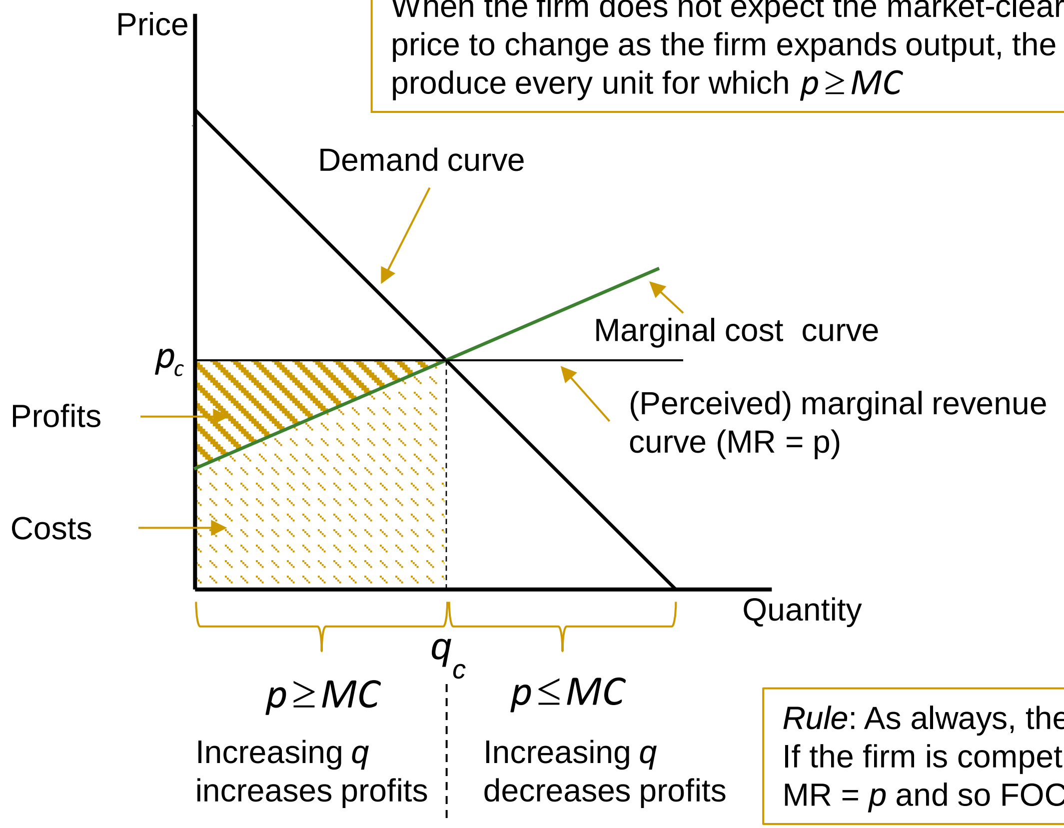


Perfect Market Equilibria

Competitive firms

- Competitive firms take prices as given
  - → Individual output decisions do not affect the market-clearing price

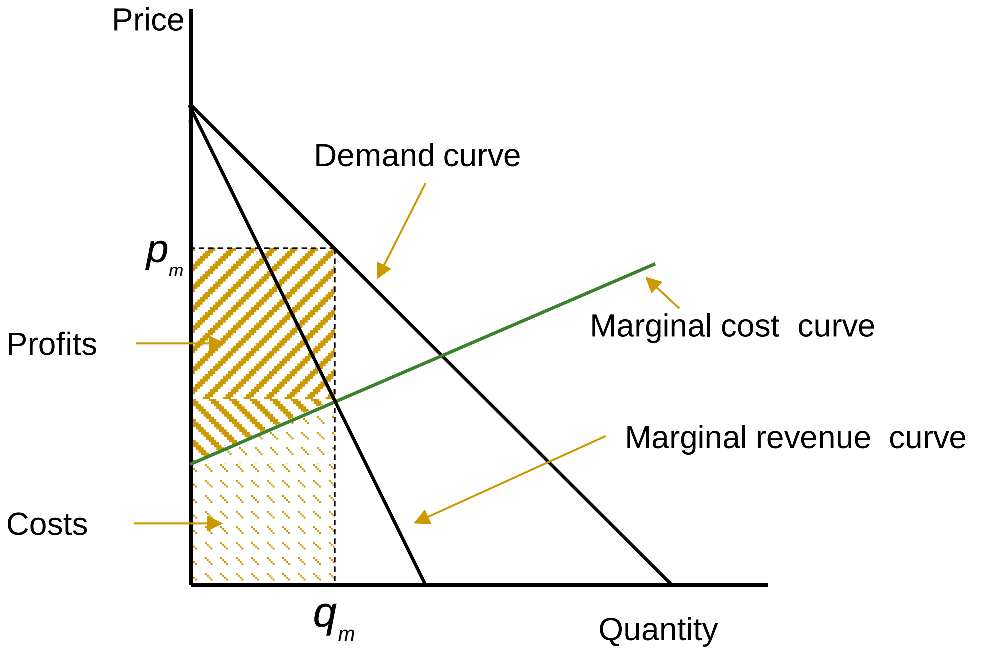
When the firm does not expect the market-clearing price to change as the firm expands output, the firm will produce every unit for which $p \geq MC$



Rule: As always, the FOC is MR = MC. If the firm is competitive, then MR = *p* and so FOC is *p* = MC

Monopolist Firm

- A monopolist choice of output *q* affects the market-clearing price *p*



Rule: Monopolists price at MR = MC, where marginal revenue is determined by the aggregate demand curve

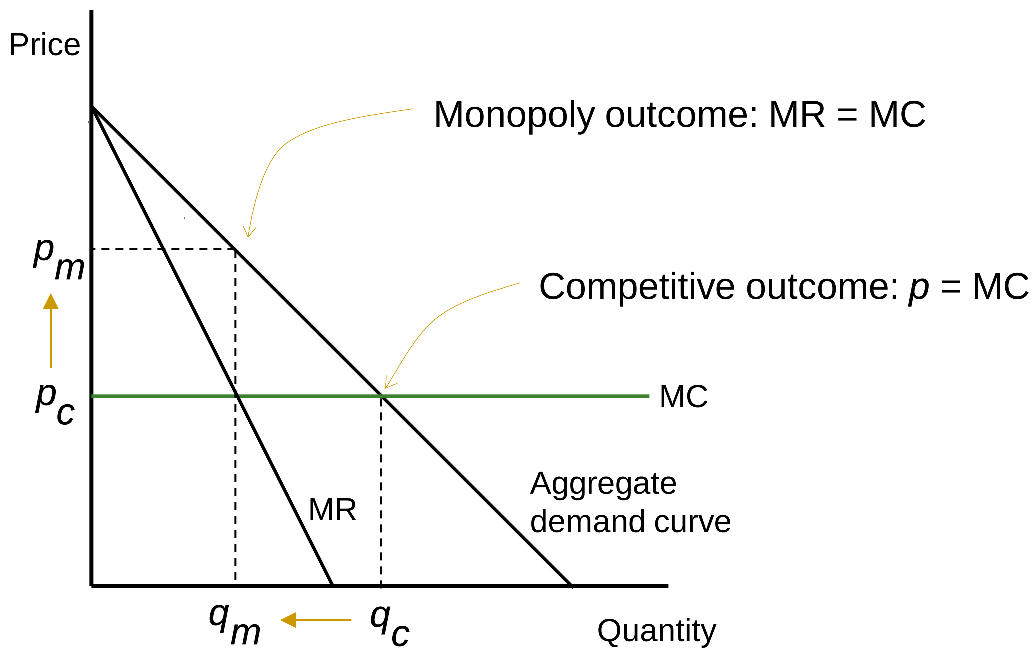
Public policy on monopolies

- Modern view on why monopolies are bad:
  - Increase price and decrease output
  - Shift wealth from consumers to producers
  - Create economic inefficiency (“deadweight loss”)

  - May (or may not) have other socially adverse effects
    - Decrease product or service quality
    - Decrease the rate of technological innovation or product improvement
    - Decrease product choice

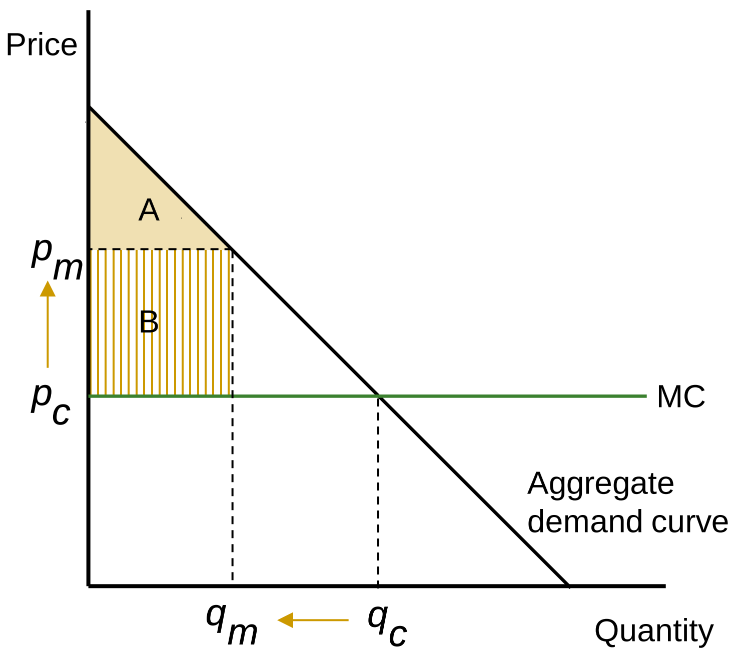
Public policy on monopolies

- Output decreases: $q_c \searrow q_m$
- Prices increase: $p_c \nearrow p_m$



Public policy on monopolies

- Shift in wealth from inframarginal consumers to producers*
  - Total wealth created ("surplus"): A + B
  - Sometimes called a "rent redistribution"

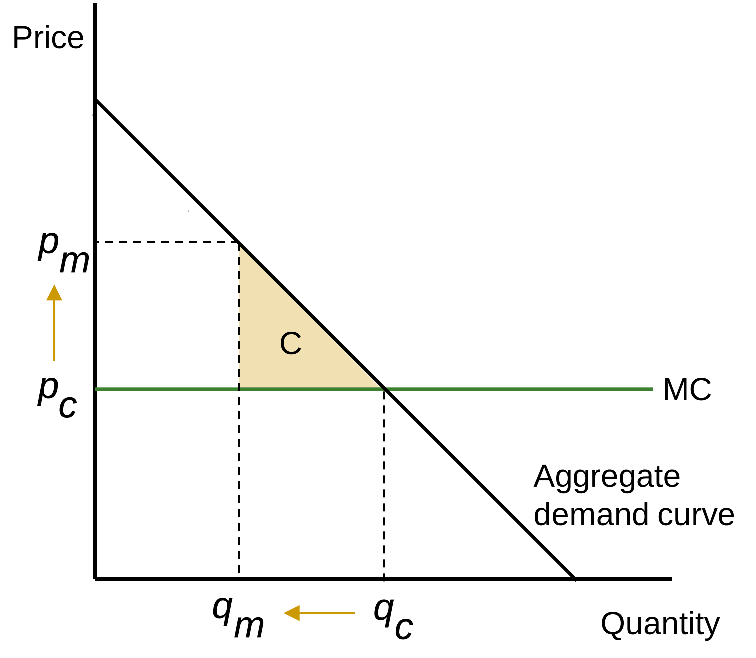


	Competitive	Monopoly
Consumers	A + B	A
Producers	0	B

* Inframarginal customers here means customers that would purchase at both the competitive price and the monopoly price

Public policy on monopolies

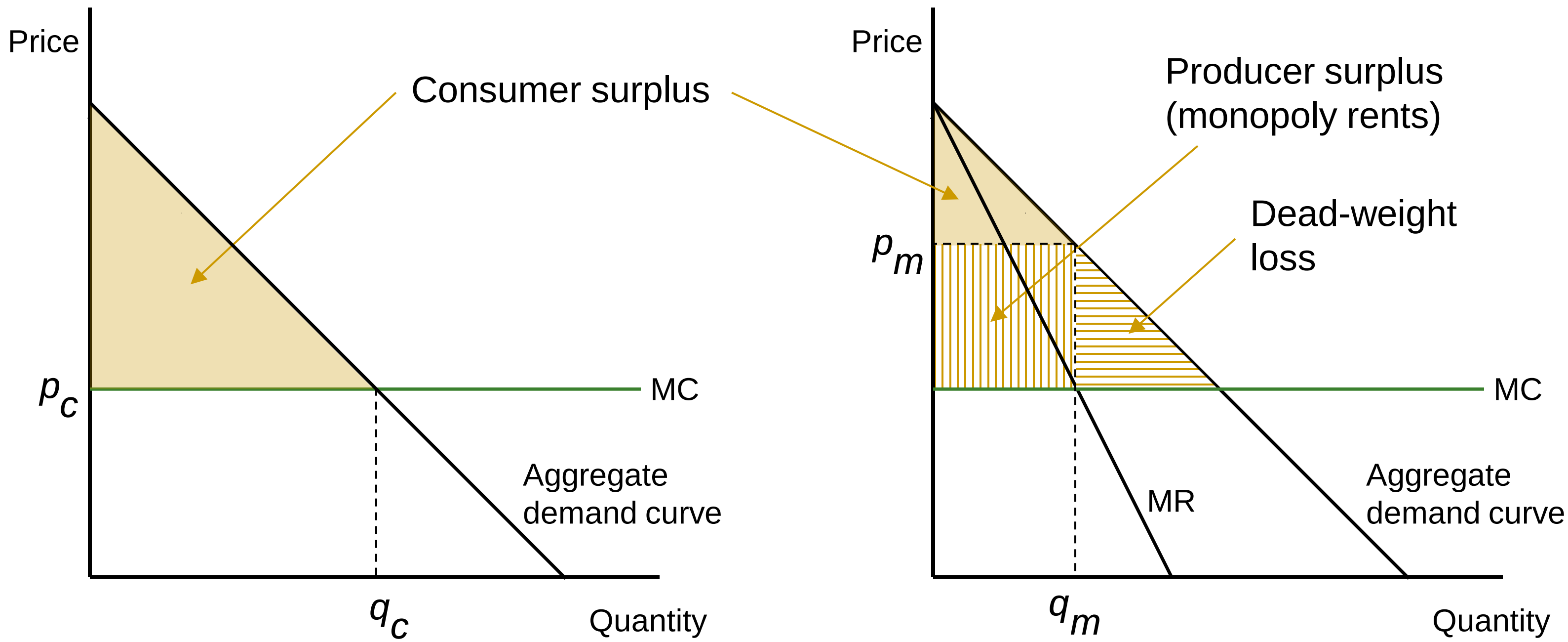
- "Deadweight loss" of surplus of marginal customers*
  - Surplus C just disappears from the economy
  - Creates "allocative inefficiency" because it does not exhaust all gains from trade



* Marginal customers here means customers that would purchase at both the competitive price and the monopoly price

Public policy on monopolies

1. Shift in wealth from consumers to producers
2. Deadweight loss
3. May retard innovation

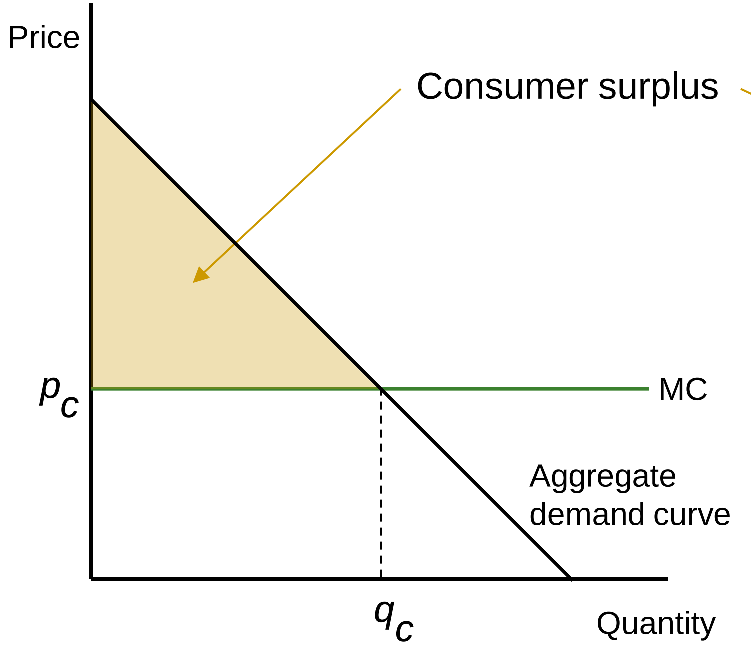


Perfectly Competitive Market

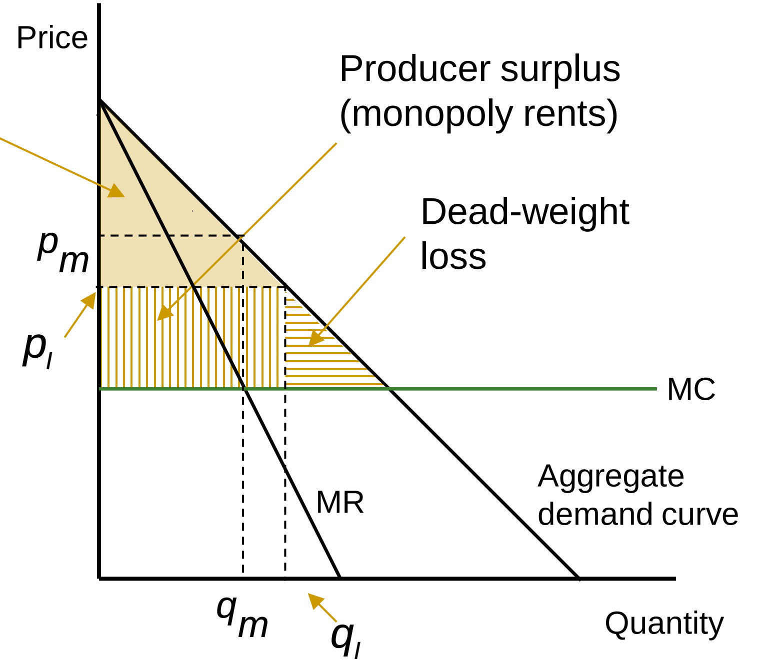
Perfect Monopoly Market

Oligopolies

- What if the merger does yields something less than a monopoly?
  - Can result in the shift of wealth and deadweight loss, only smaller in magnitude



Perfectly Competitive Market



Oligopolistic Market