An Economic Theory Masterclass

Part III: Market Power

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Introduction

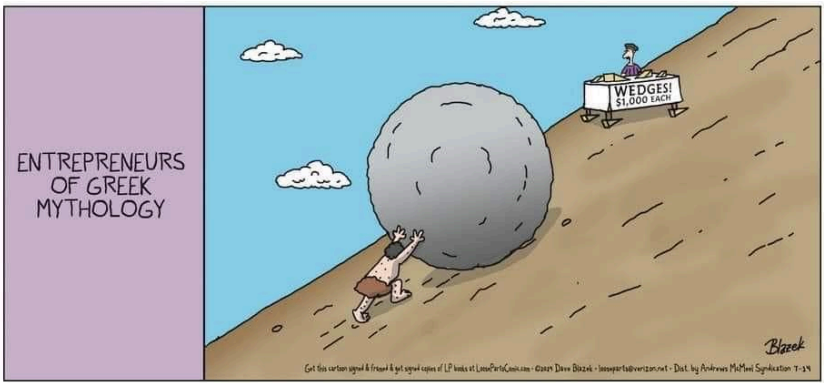
- For a while, we shift to taking pot-shots at the competitive paradigm
- Firstly, the assumption of price taking behavior is often questionable!
- With vastly many (a continuum) of firms or consumers, then this makes sense, since it is infeasible to impact them.
- **Market power**: traders impact the prices
- We prove market power reduces trade, so is socially inefficient

Productive Barriers to Entry

- Q: Why only a few firms in an industry? A: barriers to entry!
- **Technical Barriers to Entry**
  - Roughly, *minimum efficient scale* (minimum of AC) is large
    - eg. aircraft makers like Boeing, Airbus, or airlines like Delta.
  - Ownership of *unique resources* is an important barrier to entry
    - Real estate agents own the "multiple listing service" (MLS)
    - De Beers, world diamond cartel, owns mineral deposits.
    - Fancy ski resorts own a special location.
  - *Special knowledge* of low cost technique by few firms like Coke.

American Music Fairness Act: Why the market power?

Spatial Monopoly is a Technical Barrier to Entry



Other Barriers to Entry

- **Network externalities** sustain Facebook, Twitter (MLS?)
- **Legal Barriers to Entry**
  - Government may create a monopoly, via a *franchise* (gas, electric, phone, utility, post office, cable) with large fixed costs
  - Stupid: FDR's *National Industrial Recovery Act* (1933) suspended Antitrust laws to stop 'ruinous'/'cut-throat' competition. So prices rose!
  - *Patents* prevent theft of intellectual property (*copyright* for books, etc.)
- **Legal or mystery cartel**
  - Colleges empower the NCAA with a collegiate sports franchise.
  - Eyeglass cartel: Luxottica owns LensCrafters, Pearle Vision, Sears Optical, Target Optical
- **Noncompete Agreements**
  - 18% of workers are bound by a noncompete agreement
  - Jimmy John's prohibited its sandwich makers from working for a competitor within two miles of a Jimmy John's for two years.
- **Illegal Barriers to Entry**
  - Criminal enterprises guard their sales territory by violence.

Monopoly

- 1904: Lizzie Magie patented The Landlord's Game
- 1935: Parker Brothers stole it, patenting it again

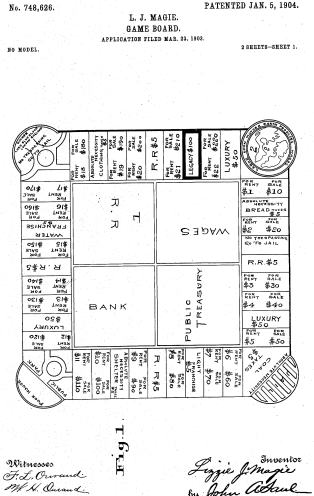
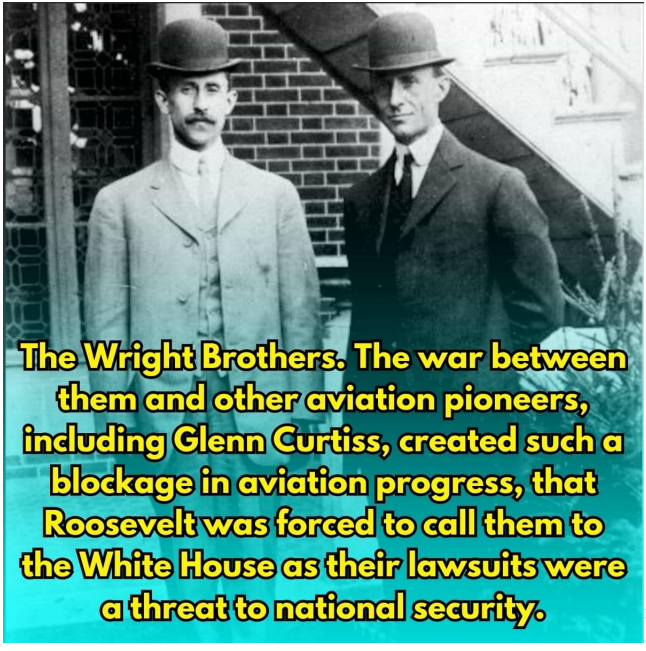


Fig 1.

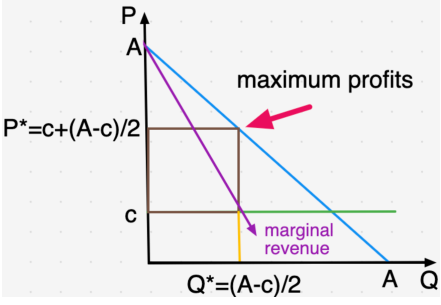

The Wright Brothers. The war between them and other aviation pioneers, including Glenn Curtiss, created such a blockage in aviation progress, that Roosevelt was forced to call them to the White House as their lawsuits were a threat to national security.

Monopoly with Linear Demand

- Assume constant marginal costs $c \in (0, A)$
- Linear demand $P(Q) = A - Q$.
- **Competition: Marginal Revenue = Average Revenue**
  - $P(Q) = c$ and $Q = A - c$.
- **Monopoly: Marginal Revenue < Average Revenue**
  - $\max_Q P(Q)Q - cQ = (A - Q)Q - cQ$.

  $\Rightarrow$ FOC: Marginal revenue is $MR = A - 2Q = c$

  $\Rightarrow$ $Q = (A - c)/2$ and $P = (A + c)/2$.



Monopoly

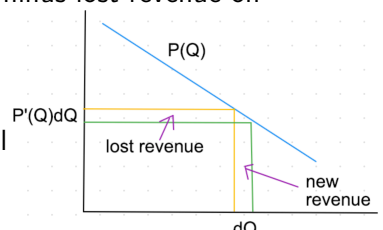
- Profits if seller faces a downward sloping demand curve:

$$\Pi(Q) = R(Q) - C(Q) \equiv P(Q)Q - C(Q)$$

- Competitive firms: $P(Q) = \bar{P} \Rightarrow$ marginal revenue is price!
- FOC: Marginal revenue equals marginal cost:

$$R'(Q) = P(Q) + \boxed{\text{QP'(Q)}} = C'(Q)$$

- Marginal revenue is revenue on the last unit minus lost revenue on inframarginal units
- $\not\exists$ boxed term with perfect competition
- Privately profitable but socially inefficient: Profit transfer to consumers is welfare neutral
- *Monopoly quantity < competitive level*



Rear View Mirror on Markets and Market Power

- Double Auctions: We explored the Extensive Margin (entry or exit)
  - called the IR constrained ("individual rationality") in 713B
  - Efficient: All units traded worth more to demand than supply
- Markets: We also allowed Intensive Margins to derive supply and demand
  - called the IC constrained in game theory and 713B ("incentive compatibility")
  - Still Efficient: All units produced and sold worth more to demand than supply
- Short run: no time for entry and fixed costs are inescapable (costs are lower)
- Do this for demand or imaginative "markets": crime, disease transmission, etc
- Competitive equilibrium is a Nash eq'm of a game (coming).
- Market power: If you impact the price, you trade less $\Rightarrow$ inefficient eq'm

Inverse Elasticity Rule

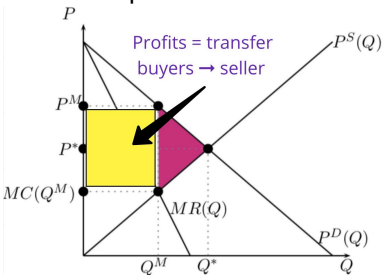
- Rewriting the FOC

$$P(Q)\left[1+\frac{QP'(Q)}{P(Q)}\right]=C'(Q) \Rightarrow P(Q)\left[1-\frac{1}{|\epsilon|}\right]=C'(Q)$$

- This brings us to the *inverse elasticity rule*

$$\text{Lerner index} = L = \frac{P(Q)-C'(Q)}{P(Q)} = \frac{1}{|\epsilon|} < 1$$

- McDonald's varies prices to learn elasticities and set prices
- *Inverse elasticity* measures **market power**.
- $\frac{1}{|\epsilon|} = 0$ with perfect competition



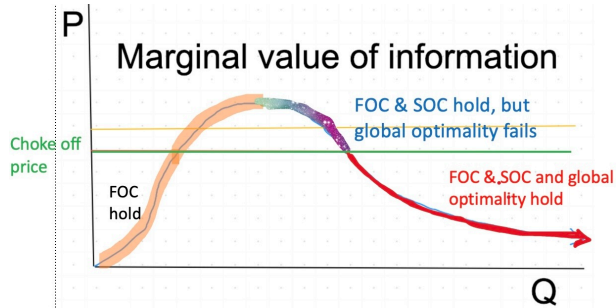
How to Consult for McDonald's

- A *monopolist never sells for any price along the inelastic portion of his demand curve*, namely, where $|\epsilon| < 1$.
  - He can raise his revenue and reduce his costs by selling less:

$$R'(Q) = P(Q) + QP'(Q) = P(Q)[1 + 1/\varepsilon] < 0 \qquad \text{if} \quad 0 > \varepsilon > -1$$

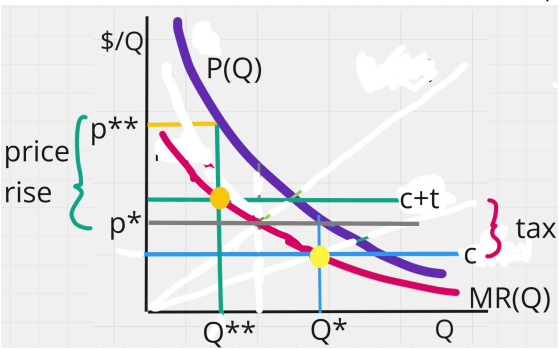
Global Optimality

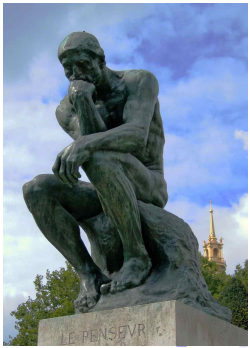
- The demand for Gaussian information is logarithmic for small unit prices: $Q(p) = -A \log p$ for $p > 0$ small
  - Proof is tricky and skipped. See Keppo, Moscarini, and Smith (2008)
  - $|\epsilon| = |Q'(p)p/Q| = A/Q < 1 \Rightarrow$ fixed unit price is suboptimal
  - Q: What's the demand for information for this plot?
- (★) Econ 711 "The FOC gives the demand curve" fails here.
  - FOC + SOC suggests demand is falling MB of info. False!
  - Global optimality (benefit > cost) rules out all but red. Why?



Thinker Problem: Tax Incidence with Monopoly

- Competition: Demand and supply share tax incidence.
- Does monopoly price ever rise more than the tax?
- Constant elasticity demand curve and a linear constant elasticity supply
- The price rises more than the tax with elastic demand.
- Quickie: What happens with a subsidy (eg. Obamacare subsidies for health)





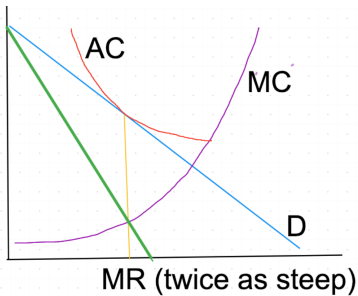
DON'T PEEK: Tax Incidence with Monopoly Problem Solved

- **TAXES + MONOPOLY = SURPRISING OUTCOMES**
- Assume constant marginal cost $c > 0$
- Assume constant demand elasticity $\varepsilon < -1$
- Impose an excise tax on suppliers, so that it formally raises c
- Demand $P(Q) = Q^{1/\varepsilon} \Rightarrow MR(Q) = (1 + 1/\varepsilon)Q^{1/\varepsilon} = c$
- The tax is not muted as it is shared by supply and demand.
- Rather, it is amplified under monopoly! Gasp!
- Monopoly supply $Q(c) = \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} c^{\varepsilon}$
- Monopoly price $P(Q(c)) = \left(\frac{\varepsilon}{1+\varepsilon}\right) c \equiv A(\varepsilon)c$
- The price rises more than the tax with elastic demand.
  - Proof: $A(\varepsilon) > 1$ when $\varepsilon < -1$ (for instance, $A(-4) = 4/3$)
- Food for thought: What about linear demand?

Profit versus Market Power

- Market power $\not\Rightarrow$ high profits
- Why? Profits also reflect fixed costs.
- *A firm can have high market power and yet zero profits.*

$\Rightarrow$ tangency of the average cost and demand curves.



Profit versus Market Power

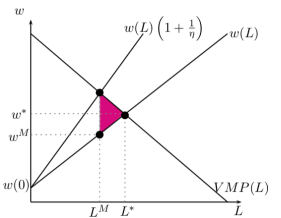
Monopsony: Buyers Monopoly

- Production function $f(L)$ & competitive output market (output price p)
- Competitive labor buyer: FOC $w(L) = pf'(L) \equiv VMP_L$
  - Workers are paid the value of the marginal product of labor
- Market power on the buying side reduces purchases.
  - Joan Robinson coined the phrase monopsony $\longrightarrow$
- FOC: $VMP = MFC_L$ where $MFC_L \doteq w(L) + Lw'(L)$

- Inverse elasticity rule:

$$VMP(L) = w(L)\left(1 + \frac{1}{\eta}\right) \rightarrow \frac{VMP(L) - w(L)}{w(L)} = \frac{1}{\eta}$$

- Linear $w(L) \Rightarrow$ VMP has double slope
  - Is η constant/rising/falling?
  - Q: Impact of a tax on monopsony?
  - Q: Impact of a tax on monopsony input?



The Cartel as a Multiplant Firm

- $n < \infty$ firms face demand $P(Q)$, where $Q = \sum_{i=1}^{n} q_i$
- Cost functions $C_i(q_i)$ for firm $i = 1, 2, \ldots, n$
- Competition: every firm i solves $C_i'(q_i) = P$.
- If the firms act as a monopoly — an illegal **cartel** — they act as a multiplant firm, choosing outputs q_i to maximize joint profits:

$$\max_{\{q_i\}_{i=1}^{n}} \left(P(Q)Q - \sum_{i=1}^{n} C_i(q_i) \right) = \max_{\{q_i\}_{i=1}^{n}} \left(R(Q) - \sum_{i=1}^{n} C_i(q_i) \right)$$

- First order conditions for this common objective function:

$$R'(Q) = P(Q) + QP'(Q) = P(Q) + Q\frac{\partial P(Q)}{\partial q_i} = C_i'(q_i) \quad \forall i$$

- Cartel examples: OPEC (44% of world oil production), de Beers Diamonds (was 90% market share, now 33%), Quebec Maple Syrup, Sinaloa Drug Cartel

Great Light Bulb Conspiracy (1924-30s)

On September 21, 1932, in a dank basement in Sheboygan, Wisconsin, one of the greatest conspiracies of all time is formed.

- "first cartel in history to enjoy a truly global reach...The cartel's grip on the lightbulb market lasted only into the 1930s. By early 1925, this became codified at 1,000 hours for a pear-shaped household bulb, a marked reduction from the 1,500 to 2,000 hours that had previously been common"

How Chiseling Erodes the Cartel

- But firms do not share a common objective function!
- Each firm sees that its marginal revenue $>$ its marginal cost:

$$R_i'(Q) = P(Q) + q_i \frac{\partial P(Q)}{\partial q_i} > P(Q) + QP'(Q) = R'(Q) = C_i'(q_i)$$

- Each firm wants to increase production, and "chisel" at their quota.
  - Cartels keep awesome accounting production records to stop this.
  - Records have been found by law enforcement and used to prosecute them
  - This idea, which brought down Al Capone, is the plotline of "The Untouchables" (1987) — with Sean Connery, Kevin Costner and probability professor Patrick Billingsley

How Chiseling Brings us to Cournot

- Marginal revenue falls in Q_i until no one wishes to chisel.

$\Rightarrow$ $P + q_i P'(Q) = C_i'(q_i)$ for all i, namely, the first order condition for

$$\max_{q_i} P(Q)q_i - C_i(q_i)$$

$\Rightarrow$ each firm optimizes, taking as given others' production.

- Antoine-Augustin Cournot "Recherches sur les principes mathématiques de la théorie des richesses" (1837) $\longrightarrow$ duopoly for spring water
  - first to define and draw a demand curve (without foundation)
  - profit-maximization: marginal cost equals marginal revenue
  - "Cournot Nash Equilibrium" — an accidental coincidence?

Example: Cournot Oligopoly Example (Linear Demand)

- Each of n firms has constant marginal cost $c \in (0, A)$
- Demand $P(Q) = A - Q$.
- **Competition**
  - $c = P(Q) = A - \sum_{j=1}^{n} q_j \Rightarrow q_i = \frac{A-c}{n}$, $P = c$
- **Cartel**
  - $\max_Q P(Q)Q - cQ = (A - Q)Q - cQ$.
  - FOC: $A - 2Q = c \Rightarrow Q = (A - c)/2$ and $P = (A + c)/2$.
  - The price - marginal cost markup is $(P - c)/P = \frac{A-c}{A+c}$
- **Cournot Oligopoly**
  - Each firm i acts like a monopolist on residual demand $q_i = Q - Q_{-i}$, and solves:

$$\max_{q_i} \left((A - [Q_{-i} + q_i])\, q_i - cq_i \right)$$

  - FOC: $A - 2q_i - Q_{-i} = c \ \forall i \Rightarrow q_i = [A - c - \sum_{j \neq i}^{n} q_j]/2 \ \forall i$
  - Firm i *best replies* as if he knows other outputs (Nash equilibrium)
  - Cournot Foundation for Perfect Competition with many firms

$$q_n^* = \frac{A-c}{n+1} \quad \text{and} \quad P_n = \frac{A/n + c}{1/n + 1} \downarrow c \text{ as } n \to \infty$$

Dynamic Insight: From Monopoly to Competition

1. Most markets are started by monopolists
2. Entry happens, and we hit oligopoly
3. Technology often lowers costs, leading toward competition

- Example: personal computer industry and Microsoft

Cournot Oligopoly Approaches Competition

- USA Antitrust history:
  - 1890 Sherman Act banned "every contract, combination, or conspiracy in restraint of trade" and "attempted monopolization, or conspiracy or combination to monopolize"
  - 1914: Federal Trade Commission Act created the FTC
  - 1914 Clayton Act banned mergers / acquisitions that "substantially lessen competition" create a monopoly.
- Herfindahl index of market power is $H = \sum_i s_i^2 \equiv \sum_i (q_i/Q)^2 \in [1/n, 1]$
  - constant marginal costs $c_i \Rightarrow i$'s profits $\pi_i(q_i) = P(Q)q_i - c_i q_i$
  - Cournot competition:

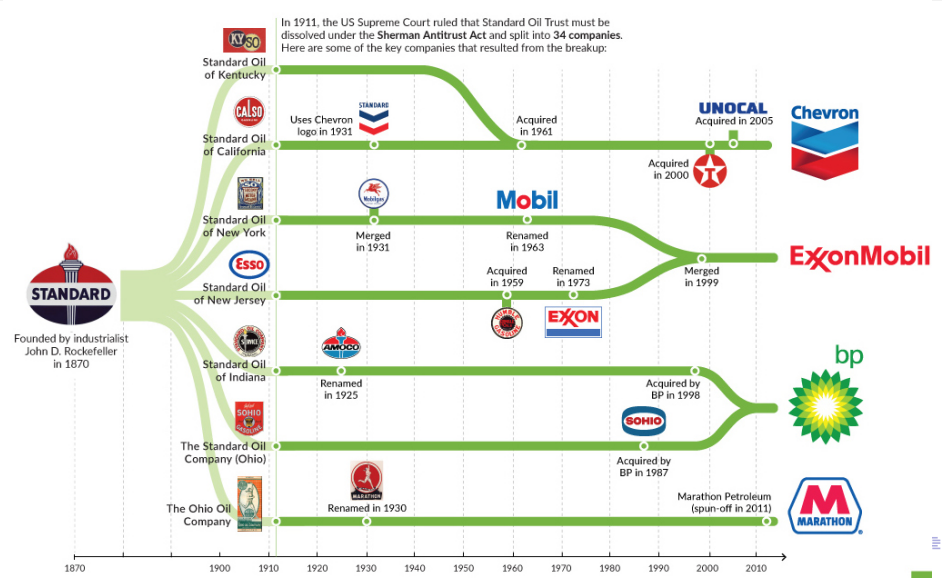
$$0 = \frac{\partial \pi_i}{\partial q_i} = P'(Q)q_i + P(Q) - c_i \quad \Rightarrow \quad P(Q) - c_i = -P'(Q)q_i$$

  - Weighted average of price-marginal cost markups is a good market power index

(clever elasticity work)
$$\sum_i s_i \frac{P - c_i}{P} = -\sum_i s_i \frac{dP}{dQ}\frac{Q}{P}(q_i/Q) = \frac{1}{|\varepsilon|}\sum_i s_i^2 = H/|\varepsilon|$$

  - Herfindahl index and demand elasticity should govern antitrust behavior

Standard Oil Breakup, 1911



AT&T Breakup, 1982

Stackelberg Quantity Leadership with Linear Demand

- Cournot (1837): simultaneous actions (anticipates Nash)
- Stackelberg (1934): Leader moves, then follower (anticipates SPNE)
  - NOT COOL (JUST LIKE ELON MUSK): "Heinrich von Stackelberg was a convinced National Socialist, having participated in active Nazi student groups while at Cologne, joined the NSDAP in 1931 and after their arrival to power in 1933, Stackelberg promptly enlisted in the notorious SS."
  - We solely give credit Subgame perfection to a later German: Reinhard Selten
  - Selten's father was Jewish, and as a result, Selten was forced to drop out of high school after the Nazis came to power. In 1945 he and his family fled Germany and settled in Austria, where he worked as a labourer
- Linear Demand Constant Marginal Cost Example:
  - Demand $P(Q) = A - Q$ and marginal costs $c \in (0, A)$
- Backward Induction: Maximize follower's profits (inverted parabola):

$$\max_{q_F}(A - q_F - q_L)q_F - cq_F \Rightarrow \text{ FOC: } (A - 2q_F - q_L) - c = 0$$

- Follower's best reply is $q_F = \max(0, (A - c - q_L)/2)$

Stackelberg Quantity Leadership with Linear Demand

- We then maximize leader's profits (also an inverted parabola)

$$\begin{cases} (A - q_L - \frac{A-c-q_L}{2})q_L - cq_L & \text{if } q_L \leq A - c \\ (A - q_L)q_L - cq_L & \text{if } q_L > A - c \end{cases}$$

- Leader's FOC $\Rightarrow$ optimal output $q_L^* = \frac{1}{2}(A-c) > \frac{1}{3}(A-c) = q_C^*$

$\Rightarrow$ Follower's optimal output $q_F^* = \max(0, \frac{1}{2}(A - c - q_L)) = \frac{A-c}{4}$

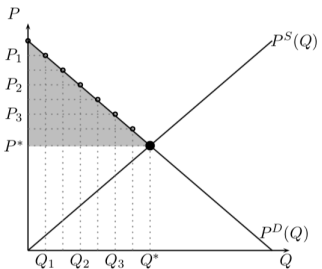
$\Rightarrow$ Total Stackelberg output $q_L^* + q_F^* > 2q_C^*$ total Cournot output

$\Rightarrow$ Market profits $(A-c)^2/8 + (A-c)^2/16 < 2(A-c)^2/9$

- strategic substitutes property $\Rightarrow q_L^* > q_C^*$, since Stackelberg leader has an extra incentive to raise quantity: It depresses the follower's reply.

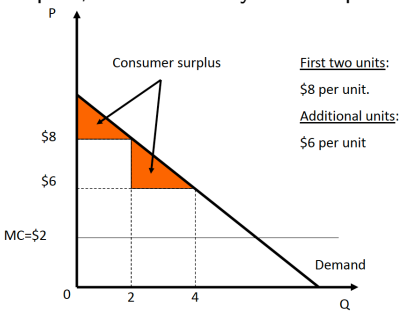
Beyond Linear Pricing: Price Discrimination

- Competition forces firms to employ constant linear prices
- Monopolists need not use constant linear prices
- Monopoly varies prices to seize consumer surplus
- **Price discrimination**: charging different prices to different consumers, or different prices for different quantity demands
- **First degree price discrimination**: personalized prices
- This is efficient, as no positive surplus trades are eliminated.
- The seller wishes to maximize surplus, since she gets all of it!



Second Degree Price Discrimination

- **Second degree price discrimination**: seller charges a different price for different quantities consumed
  - **two part tariff**: a fixed fee for the right to buy at a fixed price (Disneyland)
  - quantity discounts (frequently flyer or buyer programs)
  - Why? Second degree price discrimination captures some of the consumer surplus, due to strictly convex preferences



  - useful when different consumers cannot be distinguished

Second Degree Price Discrimination: Bundling

Third Degree Price Discrimination

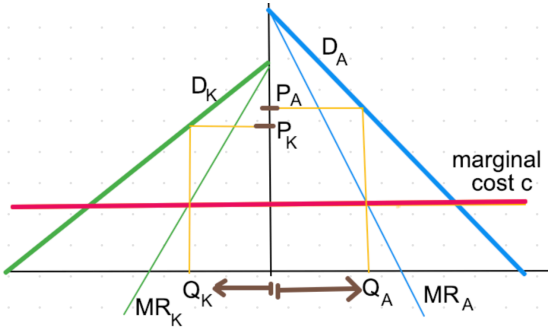
- **Third-degree price discrimination**: a seller charges a different price to different consumer groups.
  - Even using grocery scan cards gives the store information to adjust prices, knowing who tends to buy what goods together $\Rightarrow$ combine second and third degree price discrimination
  - Sometimes it is ruled out: can charge different prices for men and women for life insurance, but not to blacks and whites

Third Degree Price Discrimination: Movie Ticket Pricing

- E.g. demand $P_A(Q)$ and $P_K(Q)$ for adults A and kids K.
- Separately apply our inverse elasticity rule for each group
- Lerner pricing rule: The more inelastic group is charged more:

$$\frac{P_A}{P_K} = \frac{1 - |1/\epsilon_K|}{1 - |1/\epsilon_A|}$$

- Assume constant marginal cost $c > 0$



Easy Anti-Trust Idea: Banning Price Discrimination

- Country A has *most favored nation* status from country B if A has the best tariff treatment that B awards any nation.
  - All 159 WTO members receive Most Favored Nation status
  - MFN precludes price discrimination.
- Discussion on healthcare often include MFN provisos!