An Economic Theory Masterclass

Part III: Market Power

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Market Power

- Competitive paradigm assumes that price taking behavior
- With vastly many (a continuum) of firms or consumers, then this makes sense, since it is infeasible to impact them.
- If firms act knowing that they can impact prices —namely, have **market power**.
- We argue that market power is socially inefficient, and then predict how it changed the competitive outcome.

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.

John Pemberton

Special recipe?
9mg cocaine per glass

Barriers to Entry

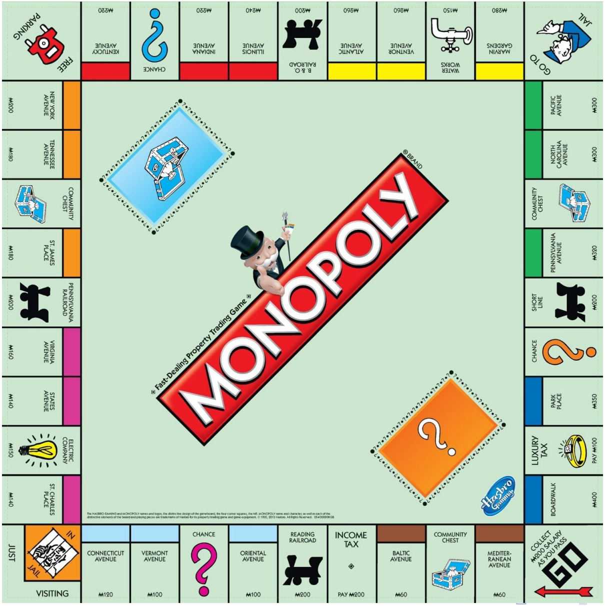
- **Network externalities** sustain Facebook, Twitter (MLS?)
- **Legal Barriers to Entry**
  - Government may create a monopoly, via a *franchise* (gas, electric, phone, utility, post office, cable) with large fixed costs
  - FDR's *National Industrial Recovery Act* sought to stop "ruinous" / "cut-throat" competition by insisting on "code of fair competition" (Great Depression lasted over a decade)
  - To prevent theft of intellectual property, it gives a firm a *patent* or give someone a *copyright* to a book.
- **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.

Market Power via Brand Names

- **Brand Name**
  - Reputational inertia: Luxottica owns most eye glass brands.

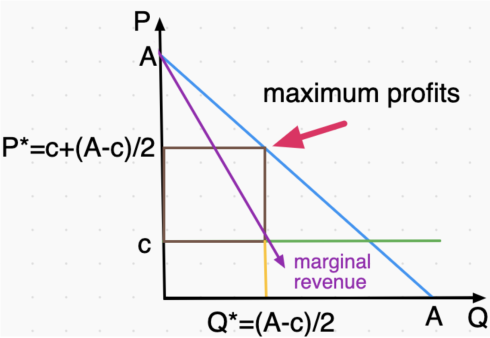

First you learn.
FB/Sarcasmlol
Then you remove 'L'.

Monopoly


FREE PARKING
KENTUCKY AVENUE
₩220
CHANCE
INDIANA AVENUE
₩220
ILLINOIS AVENUE
₩240
B. & O. RAILROAD
₩200
ATLANTIC AVENUE
₩260
VENTNOR AVENUE
₩260
WATER WORKS
₩150
MARVIN GARDENS
₩280
GO TO JAIL
NEW YORK AVENUE
₩200
TENNESSEE AVENUE
₩180
COMMUNITY CHEST
ST. JAMES PLACE
₩180
PENNSYLVANIA RAILROAD
₩200
VIRGINIA AVENUE
₩160
STATES AVENUE
₩140
ELECTRIC COMPANY
₩150
ST. CHARLES PLACE
₩140
PACIFIC AVENUE
₩300
NORTH CAROLINA AVENUE
₩300
COMMUNITY CHEST
PENNSYLVANIA AVENUE
₩320
SHORT LINE
₩200
CHANCE
PARK PLACE
₩350
LUXURY TAX
PAY ₩100
BOARDWALK
₩400
Fast-Dealing Property Trading Game
MONOPOLY
® BRAND
Hasbro Gaming
JUST VISITING
IN JAIL
CONNECTICUT AVENUE
₩120
VERMONT AVENUE
₩100
CHANCE
ORIENTAL AVENUE
₩100
READING RAILROAD
₩200
INCOME TAX
PAY ₩200
BALTIC AVENUE
₩60
COMMUNITY CHEST
MEDITER-RANEAN AVENUE
₩60
COLLECT ₩200 SALARY AS YOU PASS
GO

Monopoly with Linear Demand

- Assume constant marginal costs $c \in (0, A)$
- Linear demand $P(Q) = A - Q$.
- **Competition**
  - $P(Q) = c$ and $Q = A - c$.
- **Monopoly**
  - $\max_Q P(Q)Q - cQ = (A - Q)Q - cQ$.
  - FOC: Marginal revenue is $MR = A - 2Q = c$
  - $Q = (A - c)/2$ and $P = (A + c)/2$.



Monopoly

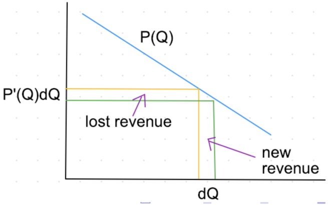
- Profits if seller faces a downward sloping demand curve:

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

- FOC: Marginal revenue equals marginal cost:

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

- For competitive firms, marginal revenue equals the price!
- gains P on last units & loses $|P'(Q)dQ|$ on inframarginal units
- $\nexists$ $\boxed{\text{boxed term}}$ in $R'(Q)$ with perfect competition
- This privately profitable consideration is socially inefficient: transfer of firm profits to consumer surplus is welfare neutral.
- *Monopoly quantity is less than the competitive level*
- SOC: $\Pi''(Q) \leq 0$
- i.e. MC is steeper than MR
- Marginal revenue is new revenue on the last unit minus lost revenue on inframarginal units (right)



Inverse Elasticity Rule

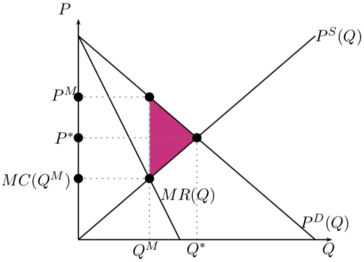
- Rewriting the FOC

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

- This brings us to the *inverse elasticity rule*

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

- Mcdonalds varies prices to learn elasticities and set prices
- The *inverse elasticity* measures **market power**. It vanishes with perfect competition, and explodes with a captive market

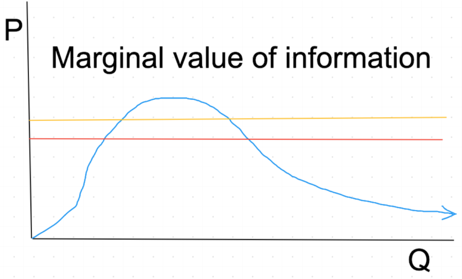


How to Consult for McDonald's

- 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:

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

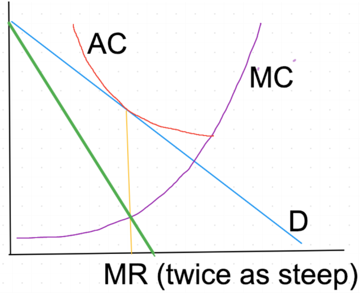
- The demand for Gaussian information is logarithmic for small unit prices: $Q(p) = -A \log p$ for $p > 0$ small
  - Its elasticity is $\epsilon = -Q'(p)p/Q = A/Q < 1$, and thus it is never optimal to set a constant unit price.
  - Source: Keppo, Moscarini, and Smith (2008)
  - For Thurs: What's the demand for information for this plot?



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

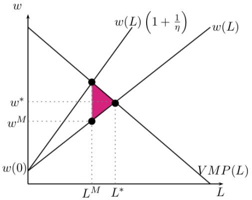
- Assume rising labor supply $w(L)$ & competitive output market
- Production function $f(L)$, but a fixed price p for output.
- Competitive labor buyer has FOC $w(L) = Pf'(L) \equiv VMP_L$
  - Workers are paid the value of the marginal product of labor
- Market power on the buying side reduces purchases.
  - Joan Robinson coined the phrase monopsony (below)
- FOC:

$$VMP = Pf'(L) = w(L) + Lw'(L)$$

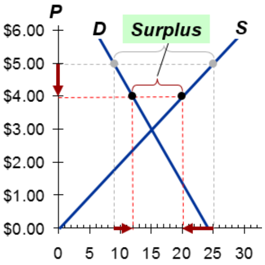
- Inverse elasticity rule:

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

- Linear $w(L) \Rightarrow$ VMP has same intercept, and is twice as steep



Price Setting Monopoly



- Revenue is higher at $P = \$4$ than $P = \$3$, because

$$\$4 \times 12 = \$48 > \$3 \times 15 = \$45$$

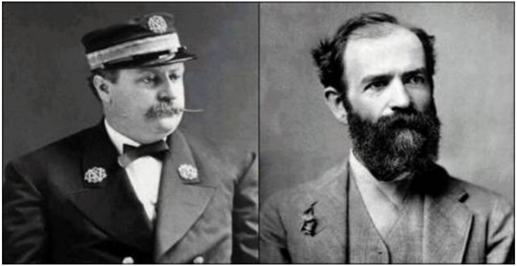
- Theorem: Cartel sellers choose a higher than equilibrium price.
- Proof: The planner maximizes $W(Q) = \int_0^Q [P_D(t) - P_S(t)]dt$
  $\Rightarrow$ FOC $P_D(Q^*) - P_S(Q^*) = 0$.
- Cartel maximizes
  $\Pi(Q) = \int_0^Q P_D(Q) - P_S(t)dt = W(Q) + \int_0^Q [P_D(Q) - P_D(t)]dt$
  $\Rightarrow$ Since $\Pi'(Q) = W'(Q) + QP_D'(Q)$, single crossing holds, moving from $\Pi(Q)$ to $W(Q)$: if $\Pi'(Q) \geq 0$, then $W'(Q) > 0$
  - Topkis $\Rightarrow Q^* = \arg\max W(Q) > \arg\max R(Q) = \hat{Q}$.

Cornering the Market

- Cornering the market is owning enough of an asset (but not all) to control the market price, buying low and selling high
- Static models cannot make sense of this. It requires deception
- Anderson and Smith (AER, 2013) "Dynamic Deception" tell a dynamic private information story of market manipulation
- Dynamic Duos Who Tried to Corner the Market
  - Black Friday (1869) — as opposed to Black Tuesday, 1987
    - James Fisk and Jay Gould tried to corner the gold market on the New York Gold Exchange
    - Government gold hit the market, and ended it
  - Siegel and Kosuga tried to corner the onion market
    - They bought over 98% of all onions in 1956
    - Trading in the US onion futures market has since been banned
  - Silver Thursday, March 27, 1980
    - Three Hunt brothers tried to corner the silver market
    - bought over half of all silver silver on margin (now banned).
    - In four months, silver prices rose from $11 / ounce in September 1979 to nearly $50 before collapsing to below $11
  - Nathan Mayer Rothschild (1815) after Battle of Waterloo
  - Endings of "Trading Places" (1983) and "Wall Street" (1987)

Cornering the Market

Fisk and Gould:



"Trading Places" ending:

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:

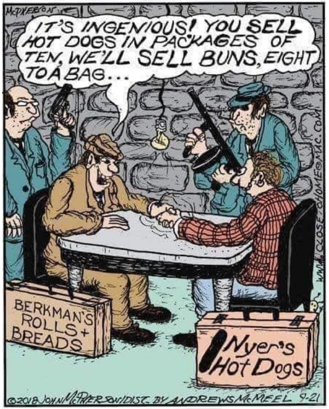
$$\max_{\{q_i\}_{i=1}^{n}} \left(P(Q)Q - \sum_{i=1}^{n} C_i(q_i) \right) = \max_{\{q_i\}_{i=1}^{n}} \left(R(Q) - \sum_{i=1}^{n} C_i(q_i) \right)$$

- 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:

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

- So each firm wants to increase production, and marginally "chisel" at their quota.
  - Cartels keep awesome accounting production records to stop this, and these records in many cases have been found by law enforcement and used to prosecute the cartels
  - 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)
  - 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)

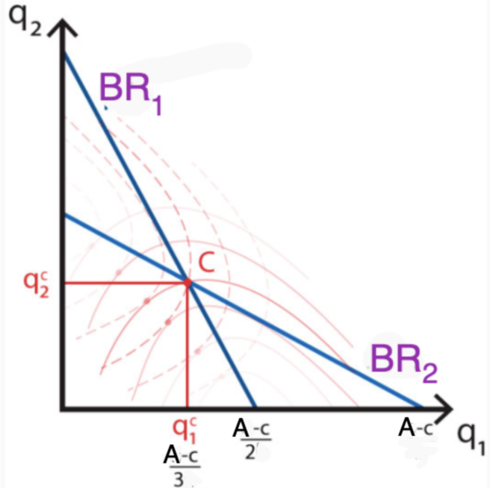
- Each of n firms has constant marginal cost $c \in (0,1)$
- Demand $P(Q) = A - Q$.
- **Competition**
  - $c = P(Q) = A - \sum_{j=1}^{n} q_j \Rightarrow q_i = \frac{A-c}{n}$, $P = c$
- **Cartel**
  - $\max_Q P(Q)Q - cQ = (A-Q)Q - cQ$.
  - FOC: $A - 2Q = c \;\Rightarrow Q = (A-c)/2$ and $P = (A+c)/2$.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

$$\max_{q_i} \left(\left(A - \sum_{j=1}^{n} q_j \right) q_i - c q_i \right)$$

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

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

Cournot Duopoly as a Crossing of Best Reply Functions



- Isoprofit curves plotted for firm 1 (solid red) and firm 2 (dashed red) are inverted parabolas to q_1, q_2 axes
- Best reply function is the locus of maxima of isoprofit curves
- Cournot game $\leftrightarrow$ *strategic substitutes*: falling best reply maps

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 $H = \sum_i s_i^2 \equiv \sum_i (q_i/Q)^2$
  - i's profits $\pi_i(q_i) = P(Q)q_i - c_i q_i$ (constant marginal costs c_i)
  - Cournot competition implies

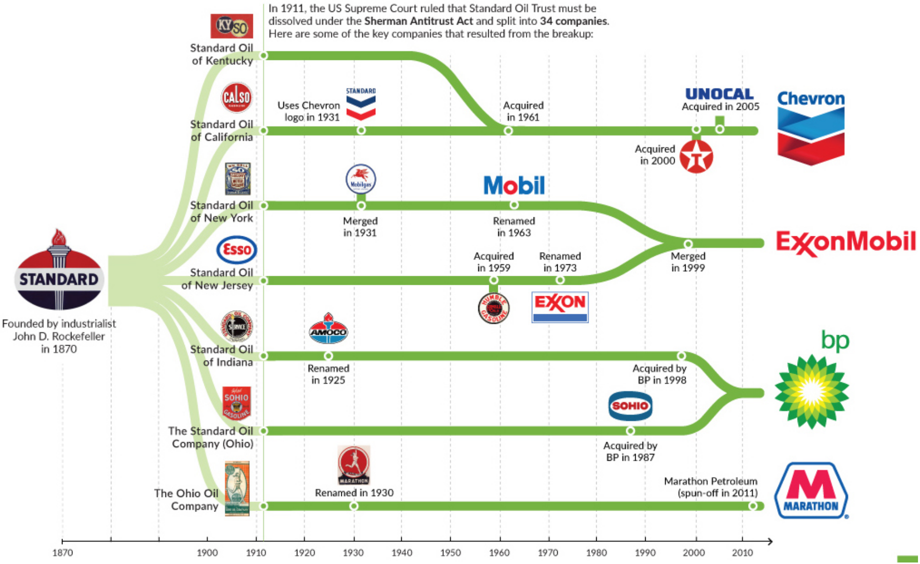
$$0 = \frac{\partial \pi_i}{\partial q_i} = P'(Q)q_i + P(Q) - c_i \quad \Rightarrow \quad P(Q) - c_i = -P'(Q)q_i$$

  - Altogether, a good index of market power is the weighted average of price-marginal cost markups

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

  - 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 and anticipates Nash
- Stackelberg (1934): sequential actions, and anticipates SPNE
- LINEAR DEMAND CONSTANT MARGINAL COST EXAMPLE:
  - Demand $P(Q) = A - Q$ and marginal costs $c \in (0,1)$
  - Leader moves, then follower.
- BACKWARD INDUCTION
- We first maximize follower's profits (an 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 $q_F = \max(0, (A - c - q_L)/2)$
- We then maximize leader's profits (also an inverted parabola)

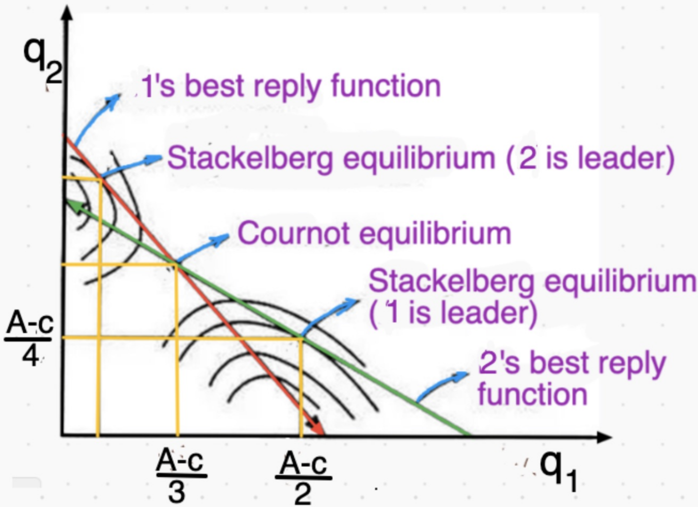
$$\begin{cases} (A - q_L - \frac{A-c-q_L}{2})q_L - cq_L & \text{if } q_L \leq A - c \\ (A - q_L)q_L - cq_L & \text{if } q_L > A - c \end{cases}$$

- 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

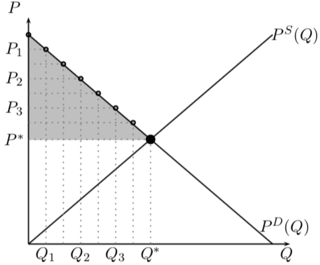
Stackelberg Leader Produces More than Cournot Duopolist



- Stackelberg leader produces more than the Cournot duopolist, & the follower less, for any cost and demand function
- 1's highest isoprofit curve touching B's best reply function: output $q_1^S > q_1^C$

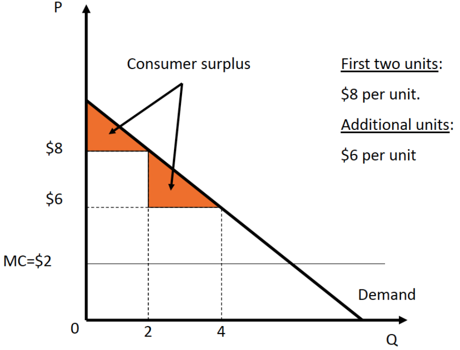
Beyond Linear Pricing: Price Discrimination

- Competition forces firms to employ constant linear prices
- Monopolists need not
- **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**, involving a fixed fee for the right to trade at a linear price, like Disneyland tickets
  - 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

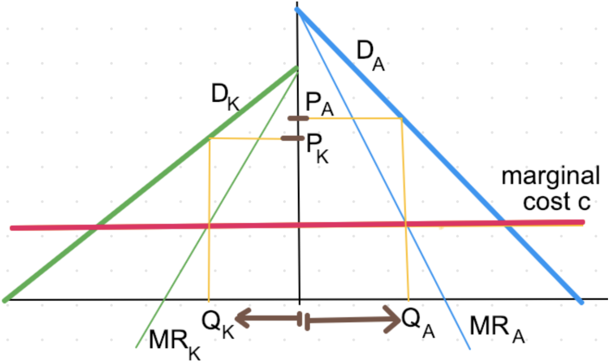
Third Degree Price Discrimination

- **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: not allowed to charge different prices for men and women except for life insurance

Third Degree Price Discrimination: Movie Ticket Pricing

- For example, imagine a constant marginal cost $c > 0$, and demand curves $P_A(Q)$ and $P_K(Q)$ for adults A and kids K.
- With no interaction between these groups, separately apply our inverse elasticity rule for each group
- The more inelastic group is charged a higher price:

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



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!