14.20 Cheat Sheet

Industrial Organization

- study of firms & markets under perfect competition
  - ↳ w/ focus on Market Power

Demand

$$\varepsilon_d = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q}$$

Costs

1. Sunk costs → Don't matter once incurred
2. Fixed cost (F) → independent of output
3. Variable Costs → Depend on output
4. Average cost → $C(q)/q$
5. Marginal cost → $\partial C(q)/\partial q$

Profit - Maximization

General: Max PDV(π) = V_t

One-period Profits:

$$\pi(q) = P(q) \cdot q - C(q)$$

$$\frac{\partial \pi(q)}{\partial q} = P + \frac{\partial P}{\partial q} \cdot q - \frac{\partial C(q)}{\partial q}$$

$$MR = MC$$

Mark-up Rule

$$P = MC/(1 + 1/\varepsilon_d)$$

Shutdown & Entry/Exit Decisions

⇒ Profit Maximization works so long as

$$\pi > -\text{Fixed cost}$$

Entry condition: $E[\pi | \text{entry}] > 0$

Exit Decisions: should take account of costs saved

Perfect competition

1. Large number Buyers & Sellers
2. Homogenous Product
3. complete info
4. No transaction costs
5. Free entry & Exit
6. No externalities

Firm Behavior under PC

- $P = MC$
- $P = AC$

$\pi = 0$ in long-run

shutdown condition:

- short-run: $P < AVC$
- long-run: $P < AC$

Monopolies & Dominant Firms

Monopoly → single supplier of a product

Dom. Firm → One "large" seller, many fringe players

Monopolist: Firm Demand = Market Demand

Dom. firm d_f = Market − fringe supply

* Market power depends on Demand Elasticity & Fringe supply elasticity

How Monopolies Created

1. Invention / Innovation
2. Legal contract / Government
3. Merger of Cartel
4. exclusionary/predatory actions

How Monopoly Maintained

1. Economies of Scale → "natural monopoly"
2. Substantial sunk cost
3. Absolute cost Advantage not related to size
4. * Legal/strategic Barriers to entry

Dom. w/ fringe π Max

$$\max_{\{P\}} \pi_d = P(q_d + q_f)q_d - C_d(q_d)$$

FOC: $\frac{\partial \pi_d}{\partial P} = 0$

* see Derivation in Notes

$$\frac{P - MC_d}{P} = \frac{S_d}{-\varepsilon_m + \varepsilon_{s,f} \cdot S_f}$$

S_i = share of dominant firm

d = dom firm

f = fringe firm

ε_m = market demand elasticity

$\varepsilon_{s,f}$ = fringe supply elasticity

Cournot Static Oligopoly

Assumptions:

1. homogenous good
2. simultaneous decision
3. Price set to clear market

Timing:

1. firms choose q_i
2. Price adjusts
3. Profits realized

Cournot Static Equilibrium

- n equations of n individuals

→ Cournot Quantities are strategic substitutes $\frac{\partial q_i^*}{\partial q_j^*} < 0$

Bertrand Price Competition

→ homogenous good, 2 symettric firms

Bertrand: Asymmetric Firms

- costs: $c_1 < c_2$
- equilibrium $\begin{cases} p_2 = c_2 \\ p_1 = \begin{cases} c_2 - \varepsilon & \text{if } c_2 \le p_1^m \\ p_1^m & \text{if } c_2 > p_1^m \end{cases} \end{cases}$

$\boxed{\pi_1 \ge 0, \quad p > c_1}$

Bertrand: Increasing Returns

- costs $\{ C(q_i) = F + c(q)$

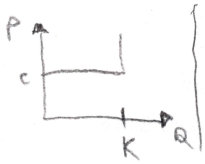
$\Rightarrow$ unstable for more than 1 firm

$P = MC \Rightarrow \pi < 0$; exit

$P > MC \Rightarrow \pi > 0$; entry

Bertrand: capacity constraint

- production defined by CRS up to capacity constraint



$\begin{cases} MC = c, & q \le K \\ q > K, & \text{infinite} \end{cases}$

2 stage Bertrand w/ capacity $\equiv$ cournot quantity outcomes

Bertrand: Differentiated Products

★ work horse Model

Model

$D_1(P_1, P_2) \quad C_1(q_1) \quad \frac{\partial D_i}{\partial P_i} < 0$

$D_2(P_1, P_2) \quad C_2(q_2) \quad \frac{\partial P_i}{\partial P_{q_i}} > 0$

$\max \pi_1 = D_1(P_1, P_2) \cdot P_1 - C_1(D(P_1, P_2))$

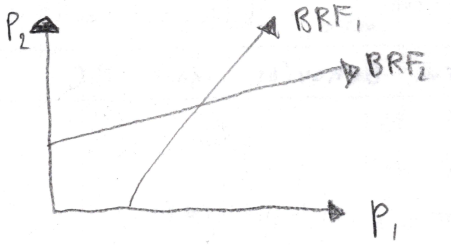
$$\frac{\partial \pi_1}{\partial P_1} = D_1(P_1, P_2) + P_1 \cdot \frac{\partial P_1}{\partial P_1} - \frac{\partial C_1}{\partial Q_1} \cdot \frac{\partial P_1}{\partial P_1} = 0$$

$\Rightarrow \boxed{P_1^*(P_2) \mid BRF_1(P_2)}$

$\frac{\partial \pi_2}{\partial P_2} = 0 \Rightarrow P_2^*(P_1) \quad BRF_2(P_1)$

Key Result of Bertrand Differentiated Products

★ → Both firms on a BRF



Note: Upwards Sloping

Formalizing Games

Describing Game:

(1) Players → $\{1, \ldots, n\}$

(2) Rules:

- Allowable Actions / strategies $\boxed{S_i}$
- information
- Timing

(3) outcomes / payoffs

$\pi_i(S_i, S_{-i})$

$S_i \in S_i$

$S_{-i} = \{$strategy set of all other players$\}$

Usual Game Assumptions

i) Rationality

ii) Common Knowledge about structure of game

★★ Solving Games ★★

→ What is the expected outcome of a game

(1) Iterated Elimination of Dominated Strategies

→ Strategies $\boxed{S_i}$ are strictly dominated if

$\pi_i(S_i', S_{-i}) > \pi_i(S_i, S_{-i}) \ \forall$ possible S_{-i}

(2) Rationalizable Strategies

$\boxed{S_i}$ is a best response to S_{-i} if

$$\pi_i(S_i, S_{-i}) \ge \pi_i(S_i', S_{-i})$$

∴ iterate through opponents' S_{-i}, and eliminate s_i that are never Best Response

(3) Nash Equilibrium

→ strategy Profile s.t each player is playing their BRF to strategies of all other players

$\boxed{S^*}$ is Nash if

$$\pi_i(S_i^*, S_{-i}^*) \ge \pi_i(S_i', S_{-i}^*)$$

→ for $\forall S_i' \in S_i$, all players i

Notes on Solution Concepts

(1) Nash equilibrium is stronger solution concept than others

(2) can be multiple Nash Equilibria in game

(3) ★★ if no pure strategy Nash equilibria, in finite game there exists at least one mixed Nash Equilibria

Mixed Strategy Equilibria

→ Nash equilibria might involve probabilistic mixing of pure strategies

Extensive forms of games

1) Players
2) Timing
3) Strategies/Actions
4) Information
5) Payoffs

Sequential Move game solutions

1) Backwards Induction
2) Sub-Game Perfection

Example: Stackelberg competition

⇒ cournot competition where firm 1 commits to $\boxed{q_1}$ before firm 2 moves

Timing

- Firm 1 commits to q_1
- Firm 2 chooses q_2 after observing q_1
- Price clears ($P(q_1+q_2)$)

Key Result: Firm 1 chooses point on BRF_2 that maximizes $\boxed{\pi_1}$

Edge worth Cycles

→ if firm select non-cournot quantities, markets develop edge worth cycles

Reminder of Timing:

① Firms build capacities
② Firms then set Prices

Suppose

$\boxed{K_1 > q_i^*(K_2)}$ exceeds BRF to firm 2 quantity

$\boxed{K_2 < D(c)}$ Firm can't satisfy full Demand at Price=MC=c

Possible Equilibria

① $P_1 = P_2 = c$ { NO, Firm 1 will be tempted to price just higher to capture residual demand

② $P_1 > P_2 > c$ { firm 2 sets price $P_1 - \varepsilon$, to capture highest price possible

③ $P_1 = P_2 > c$ { No, firms want to undercut o Not full capacity utilization

No Pure strategy equilibria, But Mixed exist

Repeated Games

→ take airline example, & repeat game T=100 times

(The sub-game perfect Nash equilibrium of one shot is solution of super game

Chain Store Paradox

→ use backwards induction

1) Go to last period, Solve, then move one period back

BUT what relaxations might deliver a different result

Infinite Repeated Games

Folk Theorem → If games repeatedly, any set of feasible payoffs can be sustained as equilibrium for some set of beliefs

Example: { upper: joint collusive payoff
Lower: Bertrand competete

Bertrand Trigger strategy

- Homogenous Products
→ constant MC, No capacity constraint
→ n symettric firms

Propose

1) Strategy: Play $P = P_m$
2) if anyone cheats revert to ($P = MC$) forever

Payoffs: cooperate vs. cheat

$P = P_m$ (cooperate)

$P = P_m - \varepsilon$ (cheating)

cooperate if

$$\frac{\pi^m}{n(1-\delta)} \geq \pi^m$$

	Payoff (Today)	Future Payoff
cooperate	π^m / n	$\delta\pi^m/n + \delta^2\pi^m/n \cdots$
cheat	π^m	0

critical value δ^* { $\boxed{\delta^* \geq \frac{n-1}{n}}$

consider:

1) is "punishment" equilibrium?
2) How long should punishment last?
3) Impervious to renegotiation

Collusion

- Collusion more sustainable w/ the following attributes

1) Higher δ (more patience)
2) Smaller # of firms
3) Shorter Detection Lags
4) Growing market over time
5) Severe Punishment
6) Greater contact across across heterogenous multi-market. Enable slack to subsidize cooperation

Mechanisms for Tacit Collusion

→ successful coordination behavior deepends on

1. Reaching Agreement
2. Achieving coordination
3. Maintaining agreement → (Detection & enforcement)

A tl w/o direct communication

Difficulty Factors

1. Many Firms
2. Non-Identical factors of Demand
3. Differentiated Products
4. Differentiated Pricing
5. Dynamic uncertainty
6. Info Disparity

Facilitating Practices

1) Information exchange

- reduce uncertainty about rivals' actions
- increase effective detection

2) "Incentive Management"

- change incentives to reduce cheating

Facilitating Device Examples

1) Most favoured nation Clause

- "if I offer a lower P to another buyer, I give you that P"

Explicit Collusion: Cartels

- Group of firms that explicitly agree to collude

what constitutes agreement?

- Who participates?
- What's coordinated → P, Q, territory, advertising
- Objectives?
- Who doesn't participate?

Factors of cartel Sucess

1. N(firms)
2. Demand
3. Ease of entry
4. Dimensions of competition
5. info
6. firm Symmetry
7. enforcement within cartel
8. ** Government Policy towards cartel

Cartel Take aways

→ Result is equivalent to Multiplant Monopoly w/ Different Costs

- Marginal costs equalized across firms w/ positive q
- Costs differs, $q_i \neq q_j$
- Some firms might be shut down

Key: To incentivize high-price firms to cooperate, side payments are made

Horizontal competition Policy

Objectives

- Consumer/Social welfare
- Promote competition
- Limit "Bigness"

Price-Fixing Policy

→ naked "Price-Fixing" highly criminalized

1) Define Legal Standard

- Per-s → Did Firms agree?
- Rule of Reason → More flexible, balanced

2) Enforcement

Trade off (E[Price Fixing gains] vs. E(punishment | caught) * pr(caught)

- Optimal Punishment

→ low probability of detection must mean consequences are high

Notes: US Treatment of Collusion

* Parallelism ALONE DOES Illegality

Rule of Reason: firms can defend by demonstrating "legitimate business function" of agreement / restraint

Merger Theory

1) Market Power

Horizontal: take out competitor
Vertical: foreclose competitors

2) Efficiencies

- "synergies" in costs
- Align Management incentive w/ shareholder interest

3) Tax advantages

4) info advantage

HHI as Measure of Concentration

$$HHI = \sum(Share_i)^2$$

↳ where Share $[0, 100]$

For Differentiated Products:

- "effects" analysis & upwards Price Pressure more valuable

How DOJ Analyzes Merger

- Economists propose theory of competitive harm

1) What are relevant Product & Geographic Markets

2) Develop Economic Models of competition to test market definition

3) Predict competitive effect on merger

4) Consider Mitigating factors

→ efficiencies
→ low entry barrier
→ possible Divestiture?

Strategies in Oligopoly Markets

→ idea of charging multiple prices for same object

Price Dispersion Explanations

1) costs differ across product types or customers

2) Producers discriminate across customers based on willingness to pay

3) Consumers pay different prices b/c of information differences

Price Discrimination

→ Present when Price Markues over Marginal cost vary across customers for near-identical products

Firm must have

① Market Power

② Mechanism for sorting customers

③ Ability to prevent re-sale or arbitrage

First Degree Price Discrimination

- charge each their reservation price
- sell until reservation = MC!

* Firm captures all consumer surplus

→ every consumer faces a different price

Third Degree Price Discrimination

- Group Pricing on exogenous characteristics

→ verifiable to firm
→ correlated w/ willingness to pay

implication

- Different prices across markets or products

Second Degree Price Discrim

- Induce customers to self-select into product/price targeted at their type

→ Firm sets menu of product/sales characteristics

- consumers reveal their willingness to pay by choice

2nd Degree PD: Self-Selection

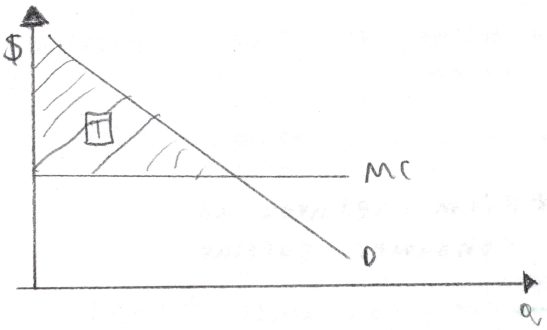
→ Firm may be able to charge different prices if they induce to self-select

- Quantity-Based Pricing
- Offer multiple products, where characteristics

Two-Part Tariff

Access Fee = T

Per-use fee = p (maybe 0)



optimal 2-part tariff

$p = MC$

$T = CS|_{p=mc}$

General Solutionconcepts

1) Extract all surplus from Low-value users

$$T_L = V_m(P_L)$$

2) Leave some surplus for high-value users in high-end package (so they dont switch to low-end)

$$T_H = V_H(P_H) - [V_H(P_L) - T_L]$$

3) often advantageous to charge $P_L > MC$, but keep

$$P_H = MC$$

Modelling Entry

- If no barriers to entry, expect positive profits to lead to increased entry

→ can re-allocate to lower cost incumbents

- entry shifts Firm Demand in
- exit shifts firm demand out

Optimal n firms: Public vs. Private

Privately optimal number: $\Pi_n(n) \geq 0$

Socially efficient number: $\left.\frac{\partial(CS(n) + \sum \Pi_n(n))}{\partial n}\right|_{n^*} = 0$

2 reasons the two Differ

1) Non-Appropriability of surplus

→ results in private understating socially optimal

2) Business Stealing

→ firms dont consider externality imposed on market,

General Consequences

- too little variety/few firms where differentiation is strong & Scale economies weak
- too much variety/entry where little differentiation

Structural Barriers to entry

1) Fixed costs: minimum efficient Scale large relative to market size

2) Operating cost advantage

R&D, learning, capital advantage

3) Demand advantage:

First mover, market niche, brand loyalty

4) Capital

Strategic BTE

1) Blockaded entry → incumbents behave as if no entry threat

2) Deterred entry → incumbents modify behavior to deter entry

3) "Accomodated" entry → modify behavior to increase expected profits, following anticipated entry

Analyzing choice in entry Game

objective: Max $E[PDV(\pi_{i,t})]$

Entrant: Chooses whether or not to enter

Max $E[\pi \mid$ Incumbent pre-entry strategy & anticipated post entry response$]$

Incumbent:

compares $\{E[PDV_H \mid$ Deterrance$]$ $E[PDV_H \mid$ Accomodation$\}$

Deterrence: can they? should they?

- what is cost of doing so
- likely success?

Post-Entry Behavior

Important to make distinction

① "Profitable" short term price wars

$E(PDV\ \pi_I) \geq 0$ if entrant remains or expands

→ predatory behavior, is sacrificing current profit now, for higher profits late, contingent on changing behavior of rivals

General idea: War of Attrition

- Incumbent can sustain losses longer, and forces exit. Losses recouped in monopolist period

Product Location Models

- How do firms decide
  - what products to produce
  - characteristics of products

Characteristics in 2 dimensions

1. Horizontal → Consumers have different tastes for characteristics (Location Models)

2. Vertical → Consumers agree on ordinal ranking of product, but disagree on value attached (quality)

Assumptions:

1) Consumers have heterogeneous preference over product location

2) each firm enters at most one location

3) Costless relocation of products in space

Model: Fix Location. what prices are charged?

→ consumers have reservation value v

→ uniformly distributed w/ density L

→ disutility of travel td^2

Firms

- 2 firms, fix locations $0, 1$

$\Rightarrow C(q) = F + cq$

- Bertand Price competition
- Homogenous apart from location

consumer indifferent at x^*

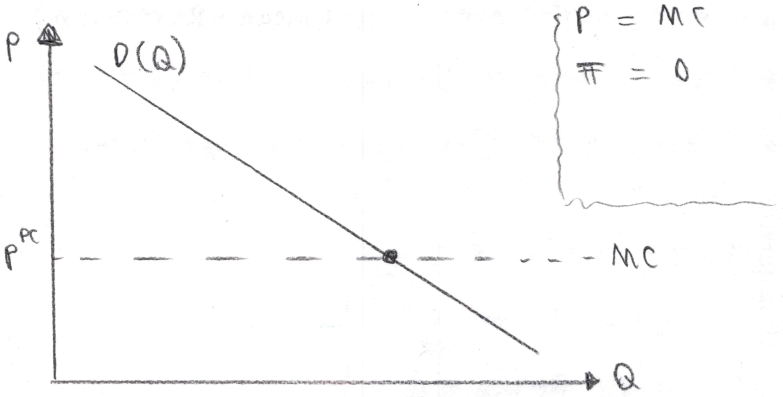
Model for vertical: Quality

1. Demand increases in Quality $\left\{ \begin{array}{l} \frac{\partial P}{\partial q} < 0 \\ \frac{\partial P}{\partial s} > 0 \end{array} \right.$

2. Cost increases in Quality, s $\left\{ \begin{array}{l} \frac{\partial C}{\partial q} > 0 \\ \frac{\partial C}{\partial s} \geq 0 \end{array} \right.$

Models

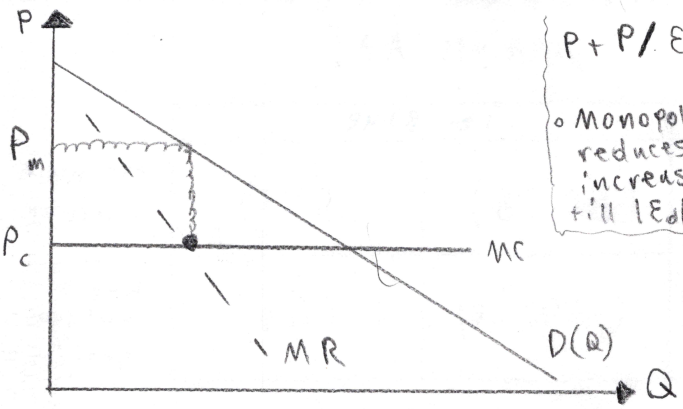
Perfect Competition



$P = MC$

$\pi = 0$

Monopoly

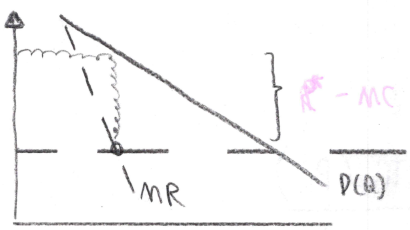


$P + P/\varepsilon_d = MC$

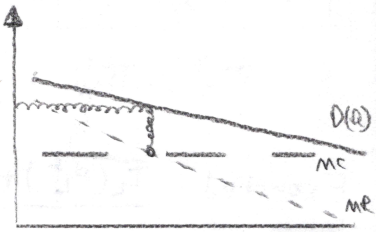
- Monopolist reduces Q_i, increase P till $|\varepsilon_d| > 1$

Elasticity of Demand & Mark-up Power

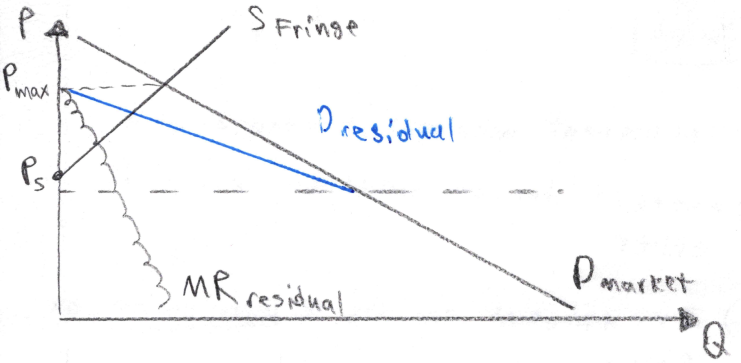
Low Elasticity



High Elasticity



Residual Demand faced by Dom. firm w/ fringe



Cournot static Oligopoly

1) Strategy: Best Response of firm i to q_{-i}

→ take q_{-i} as given

where q_{-i} = {set of competitor's quantities}

A $\max_{q_i} \pi_i = P(\sum q_j) \cdot q_i - C(q_i)$

$\frac{\partial \pi_i}{\partial q_i} = 0 =$ implicitly implied Best Response Function (BRF)

$$q_i^* = q_i\left(\sum q_{-i}\right)$$

⇒ n equations for n players, allows for solving all BRF

Properties:

- Mark-ups dependent only on decision q_i, not Market Q

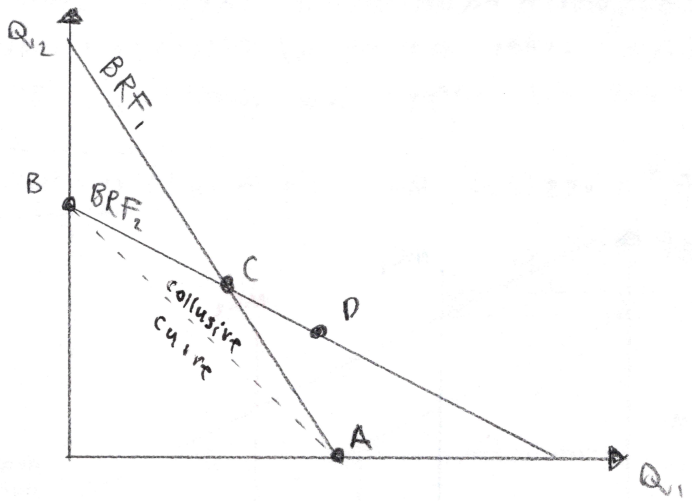
→ Decrease w/ number of firms, and Demand Elasticity

Bertrand Static Price Competition

Game:

1) Firms choose P simultaneously
2) Consumers purchase $D(P_{min})$ from lowest price firm
3) Profits realized from sale

Duopoly BRF under different conditions



A - Firm 1 Monopoly
B - Firm 2 Monopoly
C - Cournot
D - Stackelberg (Firm 1 moves first)

Sequential Move Games : Air lines

Question: Should JetBlue enter route against AA?

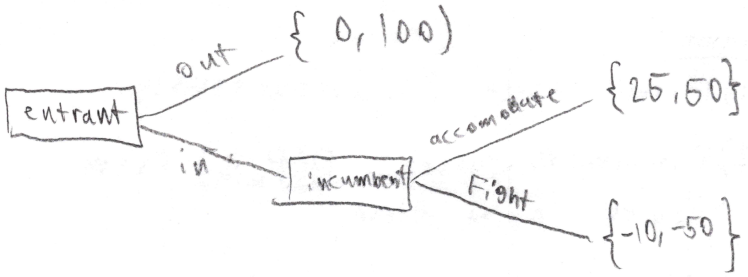
American \ Jet Blue	(enter)	(stay out)
maintain service	(50, 25)	(100, 0)
match entrant service	(-50, -10)	(100, 0)

Timing

0) incumbent monopolist earns profit

1) entrant decides whether or not to enter

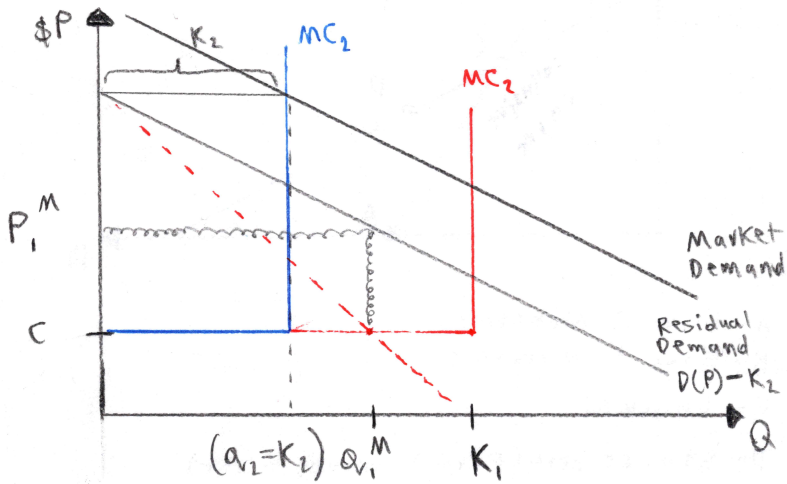
2) Incumbent decides to accomodate or fight



Edgeworth cycles (Illustrated)

- Edgeworth equilibrium involves smaller firm undercutting, w/ discrete probability that the larger firm jumps to high price

p_1^M = residual monopoly price given $q_2 = K_2$



Collusion, Time-Varying Demand, Full Information

- N firms
- Demand varies over time (Mean-Reversion)
- Firms observe Demand before prices set
- Firms play Bertrand Trigger Price Game

The States

Low Demand L

High Demand H

$$Pr(D_L(P)) = Pr(D_H(P)) = 1/2$$

& $\pi_H^M > \pi_M^L$

Expected Value of Cooperation $\left\{ \dfrac{\pi_L(P_L^*) + \pi_H(P_H^*)}{2N(1-\delta)} \right.$

→ Implication: Less likely to sustain collusion in high Demand states

Simple Cartel Model

compare

π_i^* = Profits for firm i as inside member of n-firm cartel

π_i^{dl} = profits for firm i as the cartel

Need to know game if some firms aren't

i) Cartel as Dominant firm

ii) Stackelberg leader

iii) Cournot (cartel as single firm

iv) variant of trigger game

defection incentive factors

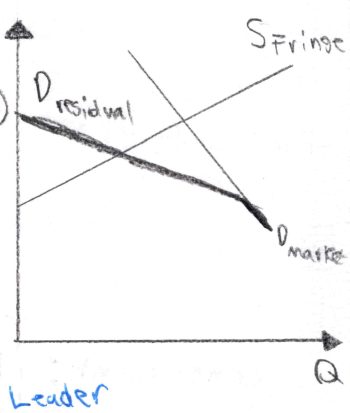
1. Number of firms
2. Nature of Game
3. Relative costs

Models (Page 2)

Simple Cartel Model (cont.)

Dominant Firm

- cartel acts as dominant firm
- Non-Members act as competitive fringe ($P=MC$)
- * Cartel MR derived from Residual demand curve



Cartel as Stackelberg Leader

→ cartel is Stackelberg leader that announces production in advance

⇒ must evaluate incentive of 1 or more firms to leave

N symmetric firm cartel

$$\max_{q_i} \sum_{i=1}^{N} \pi_i = P(\Sigma q_i)\cdot(\Sigma q_i) - \Sigma C(q_i)$$

$$\Sigma q_i^* = [Q^*, P^*, \pi^*]$$

Case of one defector

→ Cartel announces output Q_{n-1},

- firm 1 solves:

$$\max_{q_1} \Pi_1 = P(Q_{n-1} + q_1)\cdot q_1 - C_1(q_1)$$

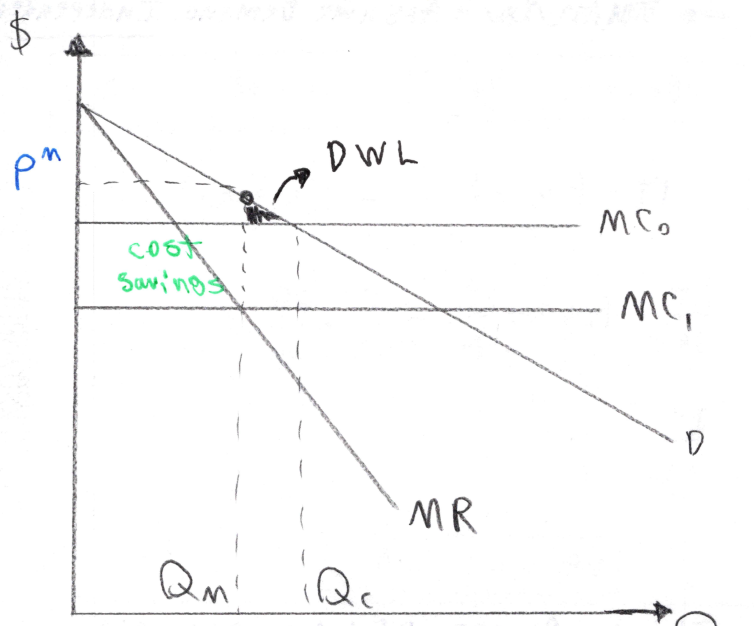
$$\frac{\partial \Pi_1}{\partial q_1} = 0 \qquad q_1^*(Q_{n-1}) \text{ BRF}$$

How will cartel choose optimal: Q_{N-1}

$$\Pi = \sum_{i=1}^{N} \pi_j = P\left(\Sigma q_i + q_1\left(\Sigma Q_{ij}\right)\right)\cdot \Sigma q_j - C(\Sigma q_i)$$

$$Q_{N-1}^{dl}, q_1^{dl} = \{\pi_j^{dl}, \pi_1^{dl}\}$$ (test for every subg

Williamson Merger Total Welfare Trade off



Initial Equilibrium

$MC = MC_0$; $P^c = MC_0$

Merger!

$MC_0 \rightarrow MC_1$

$MR = MC_1$; $P = P^m$

Evaluation

- Losses: DWL
- Gains: cost savings
- Transfers: $(P^m - P^c)Q_m$ from consume to monopolist

Structural Estimates of Market Power

- we can derive estimates of Market Power from Econometric estimates of Demand

Demand Function

$$P_t = D(Q_t, Y_t, \delta, e_{dt})$$

P = Price

Q = Quantity

Y = Demand shifters

δ = Demand parameters

Cost Function

$$C_{it} = C_i(q_{it}, w_{it}, z_{it}, \Gamma)$$

i = Firm identifier

q = Firm quantity

w = input price

z = cost shifters

Γ = cost parameters

Modeling 3rd Degree Price Discrimination

- Consider 2 markets segmented
  - Assume Demand Independent

$$\text{Demand}_1 = P_1(q_1) \qquad \text{Demand}_2 = P_2(q_2)$$

$$\Pi = P_1 q_1 + P_2 q_2 - C(q_1 + q_2)$$

$$\frac{\partial \Pi}{\partial q_1} = P_1 + q_1 \frac{\partial P_1}{\partial q_1} - \frac{\partial C}{\partial Q} \cdot \frac{\partial Q}{\partial q_1} = 0$$

$$\frac{\partial \Pi}{\partial q_2} = \text{"} \quad \text{"}$$

$$MR_1 = MR_2 = MC$$

Third Degree PD: An example

- Suppose Nintendo produces video games, & faces different Demand curves in UK & EU

UK Demand	$P^{UK} = 20 - q^{UK}$
EU Demand	$P^E = 40 - q^E$
costs	$C(Q) = 50 + 5(q^{UK} + q^E)$
Total output	$Q = (20 - P^{UK}) + (40 - P^E)$

Case 1 : no price discrimination

$$\Pi = (60 - 2P)(P - 5) - 50$$

$$\frac{\partial \Pi}{\partial P} = 0 = 60 - 4P + 10$$

$P = 17.5$

$q^E = 22.5 \quad q^{UK} = 2.5$

$\Pi = 262.50$

Case 2 : Costless market segmentation, no arbitrage

$$\frac{\partial \Pi}{\partial P^{UK}} = 0 = 25 - 2P^{UK} \Rightarrow P^{UK} = 12.5 \quad q^{UK} = 7.5$$

$$\frac{\partial \Pi}{\partial P^E} = 0 = 45 - 2P^E \Rightarrow P^E = 22.5 \quad q^E = 17.5$$

Case 3 : Arbitrage Limits

(a) if firm set prices as in (2)

- European consumers will instead buy @ 17.5 = P_{UK} + \$5(shipping)

$P^{UK} = 12.5$ | $q^{UK} = 7.5$ | $q^E(17.5) = 22.5$

$\text{Profit} = (12.5 \cdot 30) - 5(30) - 5^2 = 175$

(b) How would firm optimally set price given shipping possibility

constraint: $P^E \le P^{UK} + 5$

2-part Tariff: Tennis Club Example

- 2 customer types: M = MIT, H = Harvard (1000 of each)

$q_M = 3 - 0.5P$ | $q_H = 6 - P$

weekly cost: $C(Q) = 5000$

- weekly demand for hours q of tennis as function of price/hr

(0) No Price Discrimination: Baseline

$$\Pi = P \cdot 1000 q_M + P \cdot 1000 q_H - 5000$$

$\frac{\partial \Pi}{\partial P} = 0 \rightarrow P^* = 3, \quad \Pi = 8500$

(1) Priced to capture serious players only

$$\Pi = T \cdot 1000 + P \cdot 1000 q_H - 5000$$

Models (Page 3)

Entry: Accomodation vs. Deterrence

- consider investment choice K_1 that the incumbent can make prior to entry
  - → Public tech: low fixed cost, high MC
  - → Private tech: high fixed, low MC

→ without entry, would be chosen K_1^m

Scenarios

1) Blockaded entry

- if entry blockaded by K_1^m, no need

2) Entry Deterrence

- entrant only enters if,

$$\pi_2(K_1, x_1^*(K_2), x_2^*(K_1)) \geq 0$$

→ For some values $K_1 > K_1^m$, may be profitable for incumbent to deter entry

3) Entry Accomodation

→ $\pi_1(K_1, x_1^*(K_1), x_2^*(K_1)$ still varies w/ $x_2(K_1)$

- if investment makes firm 1 **tough**:

$\frac{d\pi_2}{dK_1} < 0$, they want to over-invest

- if investment makes firm 1 **soft**:

$\frac{d\pi_2}{dK_1} > 0$, they want to under-invest

⇒ chart of different strategies

Reputation Model of Rational Predation

Assumptions

1) 2 markets or potential entraints

2) π_i(Accomodate) > π_i(Fight) {i: incumbent, entraunt}

3) 2 possible incumbent types
   - i) Crazy → fight all entrants
   - ii) Sane → incumbents are rational

4) Uncertainty about Incumbent

Entry: Mathematics & Taxonomy

$$\frac{d\pi_2}{dK_1} = \frac{\partial \pi_2}{\partial K_2} + \frac{\partial \pi_2}{\partial x_1} \cdot \frac{dx_1^*}{dK_1} + \frac{\partial \pi_2}{\partial x_2} \cdot \frac{dx_2^*}{dK_1}$$

Competitive Strategy Game Notes cheat Sheet

What is it

- strategic interactions
  - → up to [8] companies
  - → compete in any or all of [4] markets

How each company Differs

- Different Companies have
  1. Different Efficiency
  2. Different Costs

How Markets differ

1. Market Demand curve of different form for each product
2. Different capital intensities
   - ↳ Greater Fixed Cost
   - ↳ Greater Marginal cost component?
3. Different Product Substitution Properties
   - ↳ Dictate Dynamics of competition

What's Expected of us

- Each team controls actions of [1] firm
  - → what markets to enter
  - → how much to invest in facilities
  - → when to invest
  - → when to exit
  - → what price to set

Complex set of Decisions

Mechanics of Game itself

- Game contain { 10, ρ=1/3 ; 11, ρ=1/3 ; 12, ρ=1/3 }
  - → Team strateg submitted 1pm EST on webpage

After 1st submission we learn

1. who entered which markets
2. what capacity each entered with

what you can update about decision

1. Change your price
2. change your capacity
3. Make additional entry to new markets

=> if no submission price assumption

Q: Is the exit a valid move/needs to be declared

Role of strategy

- Info Publicly available
  - → Others' Price
  - → others capacity
  - → substitution properties
  - → Info about Demand
- Info Known w/ noise
  - → Total sales in each market
  - → Range of other firms cost

CSG Production & Costs

- to produce & sell goods at market
  - → company must
    1. Enter Market
    2. Build Production Capacity
    3. Produce Goods
  - → each is costly

* Each Player issued unique cost profile which does not change (see table 1 for example)

Market Entry Fee

- One-time fee paid for entry
  - → Assessed upon 1st unit of capacity
  - → * Re-assessed if capacity allowed to drop to zero
- Firm can enter at most [1] market/period

* Drawn from Normal Distribution (see Appendix)

Cost of Capacity

→ Before company can use capacity, it must build in prior period

* For use in round [n], must announce at [n-1]

=> entry announcement [8] capacity expansion Known globally

- No Scale in capacity costs

$(C_{10.} = 10 * C_{1\,unit})$

* Distribution of capacity costs known (see appendix) by Market

Capacity Cost: Useful Life

- Productive Life = 4 periods
  - Afterwards we receive scrap value

* Depreciation dictated by Market & capacity age

Note: Value can be liquidated after production before end of capacity useful life.

Key: A reduction will cull newest capacity first

- At end of game all capacity cashed in

Marginal Costs

- Drawn from Distribution
- cost of producing each unit up to capacity

Price & Sales

- Firm Dictates Price for available capacity
- Quantity demanded Q_D for each firm determined

* MARKET Clearing * Procedure, (Important) *

1. if $Q_{D,firm} \leq K_{firm}$
   - Produce & sell $Q_{D,firm}$
2. if $Q_{D,firm} > K$
   - firm produces & sells K
   - allocates out randomly
3. consumers left unserved
   - will buy from another if they incur Positive surplus

Cost of Financing

- every firm starts with $1,000,000

$r_{lending} = 2\%$

- incurred on positive Balance between perids

$r_{Borrow} = 5\%$

- incurred on negative Balance between periods

Market Demands

- Market Profile general info

(1) Amount sold w/ variable Price & # of firms

- Quantity sold deepends by Prices charged by each firm & # of brands in market

- Holding Price Constant
  - More firms = More sales
  - effect differs between markets

* Greater degree of heterogenous products => increase in total quantity demanded

→ Though brands ar differentiated, no brand has quality advantage

(All else equal, same price <=> equal market share)

Strategy & Market Outcome

(1) Price
(2) Capacity Change

} submitted components of Strategy Profile

Once all strategies received:

1. every firm sells to every consumer wishing to buy that brand

The readout

1) Price charged by each firm

2) Δ capacity

Privately Known

3) quantity sold in each market

4) costs, Revenues, financial Balance

Logistics

* See Instructions *