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Entry and Concentration

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Market Concentration

- Stylized fact 1: Concentration varies….
  - Across markets: airplanes vs cars
  - Over time: mobile phone operators
- Stylized fact 2: …. but in a systematic way
  - Markets concentrated in Sweden, concentrated in UK (fixed vs mobile telecom networks)
  - Thus, market characteristics determine concentration
- What determines concentration?

Market Concentration

- Why interesting?
  - Concentration determinant of welfare
    - Good: Scale economies
    - Bad: Higher prices, less product variety
  - Market imperfections in entry process?

Market Concentration

- Model
  1. Firms enter the market
  2. Oligopolistic competition

Market Concentration

- Subgame perfect equilibrium
  - Price (and quantities) in stage 2 depend on the number of firms that enter in stage 1
  - Firms' entry decisions informed about their *expectations* about the price in stage 2

Market Concentration

- Stage 2: Oligopoly
  - Result: Determine outcome as function of the number of firms: $\pi(n)$
  - Assumption: Cournot

Market Concentration

- Stage 1: Entry model
  - Result: Determine the number of firms, n
  - Assumption:
    - Entry free, but costly
    - Entry until zero profit

Market Concentration

- NB: We disregard strategic issues in entry process
  - Example: Incumbent firms may fill product space to deter future entry

Stage 2: Oligopoly

How profit depends on concentration?

Assumptions

- Cournot competition
  1. Firms decide on quantities simultaneously
  2. Goods sold at market clearing price
- Concentration
  - n firms

Assumptions

- Production
  - Constant marginal cost + Fixed cost

$$cq_i + F$$

Assumptions

- Demand
  - Differentiated goods
  - m consumers
  - Individual demand linear

$$p_i(q_1,\ldots,q_n) = \alpha - \tfrac{1}{m} q_i - \sigma \tfrac{1}{m} \sum_{j \neq i} q_j$$

Assumptions

- How to derive the linear demand functions
  - Representative consumer
  - Product differentiation
  - Simplification: two products

Assumptions

Utility of representative consumer (quadratic, quasi-linear)

$$U = \alpha \cdot \left(x_1 + x_2\right) - \frac{1}{2} \cdot \left(x_1^2 + x_2^2\right) - \sigma \cdot x_1 \cdot x_2 + y$$

Budget constraint (y is numeraire)

$$I = p_1 \cdot x_1 + p_2 \cdot x_2 + y$$

Note: that σ is a measure of substitutability

- If σ = 0, products are not substitutes
- If σ = 1, products are perfect substitutes

Note:

- Quasi-linear => no income effects
- Quadratic => linear demand functions

Assumptions

Substitute (to avoid Lagrange)

$$\tilde{U} = \alpha \cdot (x_1 + x_2) - \frac{1}{2} \cdot (x_1^2 + x_2^2) - \sigma \cdot x_1 \cdot x_2 + (I - p_1 \cdot x_1 - p_2 \cdot x_2)$$

First order conditions

$$\frac{\partial \tilde{U}}{\partial x_1} = \alpha - x_1 - \sigma \cdot x_2 - p_1 = 0$$

$$\frac{\partial \tilde{U}}{\partial x_2} = \alpha - x_2 - \sigma \cdot x_1 - p_2 = 0$$

Note:

- To find market demand, we first need to derive direct demand of representative consumer

Inverse demand of representative consumer

$$p_1 = \alpha - x_1 - \sigma \cdot x_2$$

$$p_2 = \alpha - x_2 - \sigma \cdot x_1$$

Assumptions

Inverse demand of representative consumer

$$p_1 = \alpha - x_1 - \sigma \cdot x_2$$

$$p_2 = \alpha - x_2 - \sigma \cdot x_1$$

Rewrite

$$x_1 = \alpha - p_1 - \sigma \cdot x_2$$

$$x_2 = \alpha - p_2 - \sigma \cdot x_1$$

Substitute

$$x_1 = \alpha - p_1 - \sigma \cdot \left[\alpha - p_2 - \sigma \cdot x_1 \right]$$

$$x_1 = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_1 + \frac{\sigma}{1-\sigma^2} \cdot p_2$$

Demand of representative consumer

$$x_1 = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_1 + \frac{\sigma}{1-\sigma^2} \cdot p_2$$

$$x_2 = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_2 + \frac{\sigma}{1-\sigma^2} \cdot p_1$$

Assumptions

Demand of representative consumer

$$x_1 = \frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_1 + \frac{\sigma}{1-\sigma^2}\cdot p_2$$

$$x_2 = \frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_2 + \frac{\sigma}{1-\sigma^2}\cdot p_1$$

Horizontal summation

$$q_1 = m\cdot x_1 = m\cdot\left[\frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_1 + \frac{\sigma}{1-\sigma^2}\cdot p_2\right]$$

$$\frac{q_1}{m} = \frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_1 + \frac{\sigma}{1-\sigma^2}\cdot p_2$$

Market demand (per person)

$$\frac{q_1}{m} = \frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_1 + \frac{\sigma}{1-\sigma^2}\cdot p_2$$

$$\frac{q_2}{m} = \frac{1-\sigma}{1-\sigma^2}\cdot\alpha - \frac{1}{1-\sigma^2}\cdot p_2 + \frac{\sigma}{1-\sigma^2}\cdot p_1$$

Note:

- To find market inverse demand, we need to take the inverse again

Assumptions

Market demand

$$\frac{q_1}{m} = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_1 + \frac{\sigma}{1-\sigma^2} \cdot p_2$$

$$\frac{q_2}{m} = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_2 + \frac{\sigma}{1-\sigma^2} \cdot p_1$$

Market inverse demand

$$p_1 = \alpha - \frac{q_1}{m} - \sigma \cdot \frac{q_2}{m}$$

$$p_2 = \alpha - \frac{q_2}{m} - \sigma \cdot \frac{q_1}{m}$$

With many goods

$$p_i = \alpha - \frac{1}{m} \cdot q_i - \sigma \cdot \frac{1}{m} \cdot \sum_{j \neq i} q_j$$

Recall

$$x_1 = \frac{1-\sigma}{1-\sigma^2} \cdot \alpha - \frac{1}{1-\sigma^2} \cdot p_1 + \frac{\sigma}{1-\sigma^2} \cdot p_2$$

Profits

Firm profit

$$\pi_i(q_1,\ldots,q_n) = p_i(q_1,\ldots,q_n)\cdot q_i - [c_i \cdot q_i + F]$$

Insert (inverse) demand

$$\pi_i(q_1,\ldots,q_n) = \left(\alpha - \tfrac{1}{m} q_i - \sigma \tfrac{1}{m} \sum_{j\neq i} q_j\right)\cdot q_i - [c_i \cdot q_i + F]$$

Equilibrium

- Cournot game
  - Players: All the firms, $i = 1, 2, 3, \ldots, n$
  - Strategies: Production levels, q_i
  - Payoffs: Profit functions, $\pi_i(q_1, \ldots, q_n)$
- Q: How solve?

Best reply

First order condition

$$\frac{\partial \pi_i}{\partial q_i} = \left(\alpha - \tfrac{1}{m} q_i - \sigma \tfrac{1}{m} \sum_{j \neq i} q_j - c \right) - \tfrac{1}{m} q_i = 0$$

Best reply

$$q_i = m \frac{\alpha - c}{2} - \frac{\sigma}{2} \sum_{j \neq i} q_j$$

Equilibrium

- Equilibrium
  - n linear equations (best replies)
  - n unknowns (quantities)

– Q: How solve?

$$q_i = m\frac{\alpha - c}{2} - \frac{\sigma}{2}\sum_{j \neq i} q_j \qquad i = 1,\ldots n$$

Equilibrium

- Simple way
  - All firms are identical
  - *Assume:* that all firms produce the same quantity

Equilibrium

- Simple way
  - All firms are identical
  - *Assume:* that all firms produce the same quantity
  - Then:

$$q_i = q$$

$$q_i = m\frac{\alpha - c}{2} - \frac{\sigma}{2}\sum_{j \neq i} q_j$$

$$q = m\frac{\alpha - c}{2} - \frac{\sigma}{2}(n-1)q$$

$$q\left[1 + \frac{\sigma}{2}(n-1)\right] = m\frac{\alpha - c}{2}$$

$$q = m\frac{\alpha - c}{2 + \sigma(n-1)}$$

Equilibrium

- A “trick”:
  - Sum all best replies
  - Solve for total output Q

Equilibrium

Rewrite best replies

$$q_i = m\frac{\alpha - c}{2} - \frac{\sigma}{2}\sum_{j \neq i} q_j$$

$$\left(1 - \frac{\sigma}{2}\right) q_i = m\frac{\alpha - c}{2} - \frac{\sigma}{2}\sum_{j=1}^{n} q_j$$

$$q_i = m\frac{\alpha - c}{2 - \sigma} - \frac{\sigma}{2 - \sigma} Q$$

Equilibrium

$$\sum_{i=1}^{n} q_i = \sum_{i=1}^{n}\left[m\frac{\alpha - c}{2 - \sigma} - \frac{\sigma}{2 - \sigma} Q\right]$$

$$Q = n\left[m\frac{\alpha - c}{2 - \sigma} - \frac{\sigma}{2 - \sigma} Q\right]$$

$$Q = m\frac{\alpha - c}{2 + (n-1)\sigma} n$$

$$\Rightarrow \qquad q_i = q = \frac{Q}{n} = m\frac{\alpha - c}{2 + (n-1)\sigma}$$

Equilibrium

Equilibrium quantity

$$q = m \cdot \frac{\alpha - c}{2 + (n-1)\sigma} = m \cdot (\alpha - c) \cdot \lambda$$

$$\lambda(n,\sigma) \equiv \frac{1}{2 + (n-1)\sigma}$$

Equilibrium Price

Equilibrium price

$$p = \alpha - \tfrac{1}{m} q - \sigma \tfrac{1}{m} (n-1) q$$

$$p = \lambda \cdot \alpha + (1-\lambda) \cdot c$$

$$\lambda(n,\sigma) \equiv \frac{1}{2+(n-1)\sigma}$$

Equilibrium Price

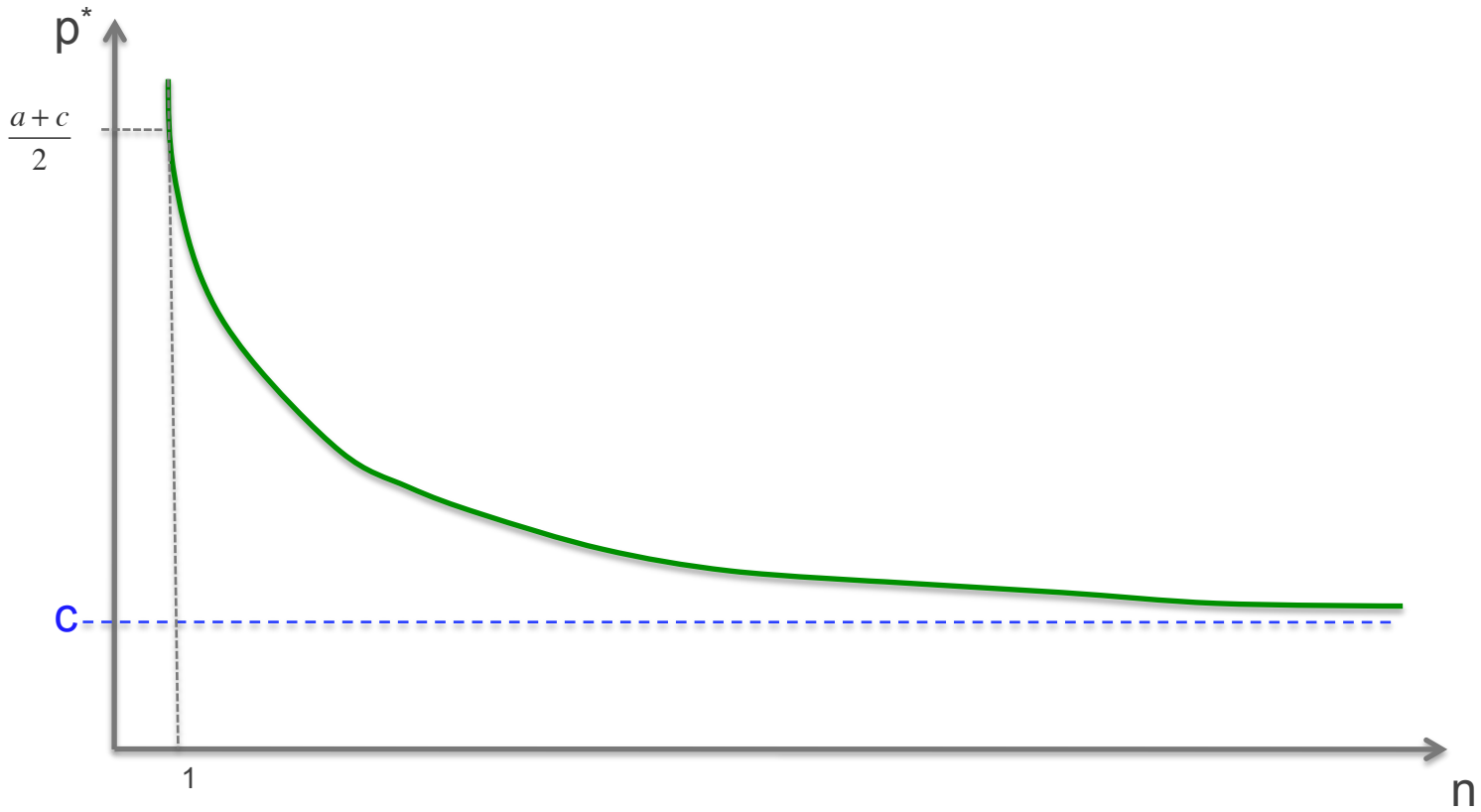
What happens to price if more firms enter the market?

$$p = \lambda(n)\alpha + (1 - \lambda(n))c$$

$$\lambda(n) = \frac{1}{2 + (n-1)\sigma}$$

$$\frac{\partial p}{\partial n} = \frac{\partial \lambda}{\partial n}\alpha - \frac{\partial \lambda}{\partial n}c = \frac{\partial \lambda}{\partial n}(\alpha - c) = -\frac{\sigma}{(2 + (n-1)\sigma)^2}(\alpha - c) < 0$$

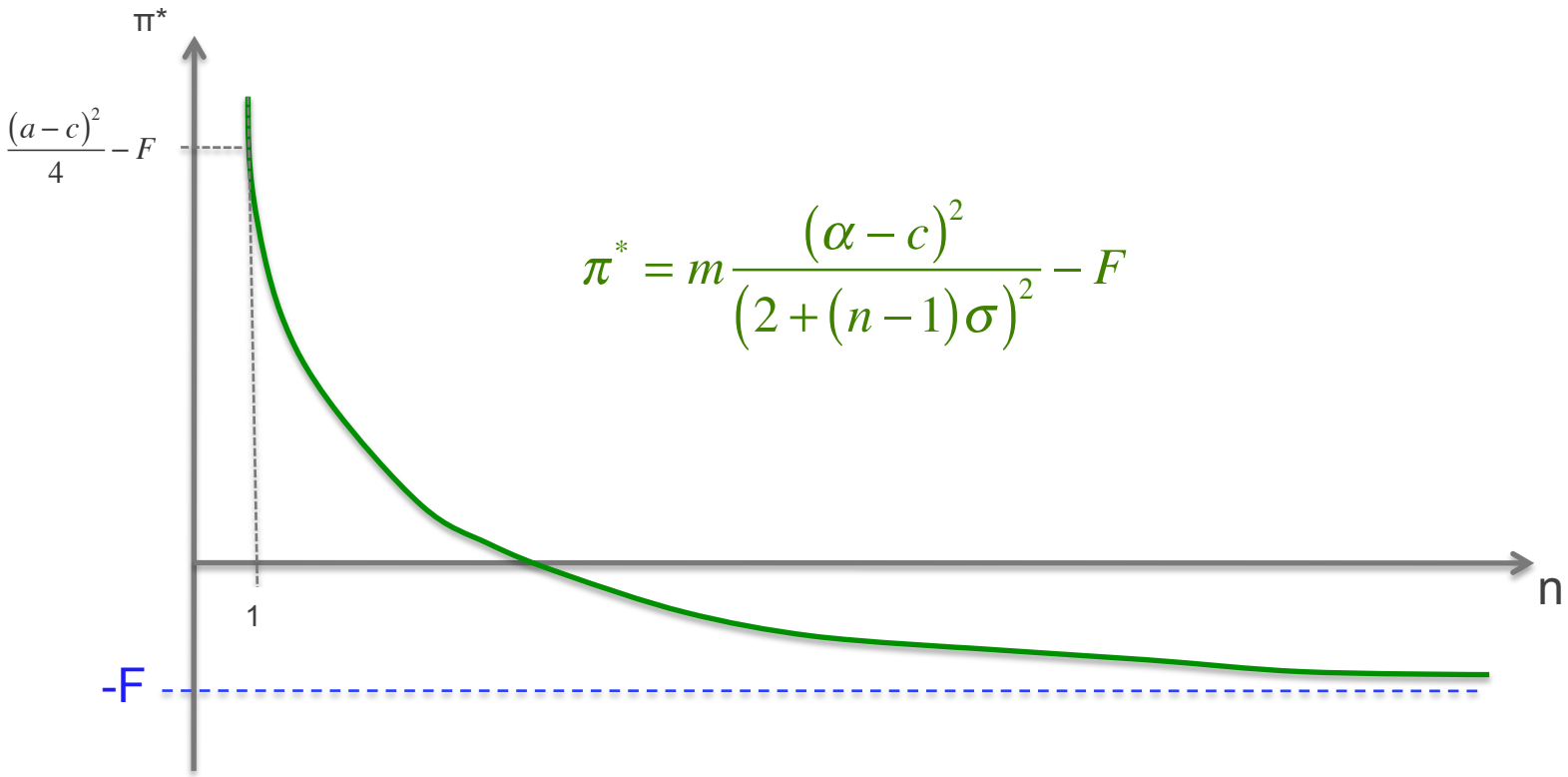
Equilibrium Price



Equilibrium Profit

$$\pi^* = \left(p^* - c\right)q^* - F = m\frac{\left(\alpha - c\right)^2}{\left(2 + \left(n-1\right)\sigma\right)^2} - F$$

Equilibrium Profit



$$\pi^* = m\frac{(\alpha - c)^2}{(2+(n-1)\sigma)^2} - F$$

Conclusion

- Effect of entry

  More firms

  => Lower price & sales

  => Lower profit

Stage 1: Entry

Entry

- Before
  - Number of firms taken as given
- Now
  - Determine number of firms endogenously
- How
  - Assume entry until profit is zero
  - Cost of entry: K

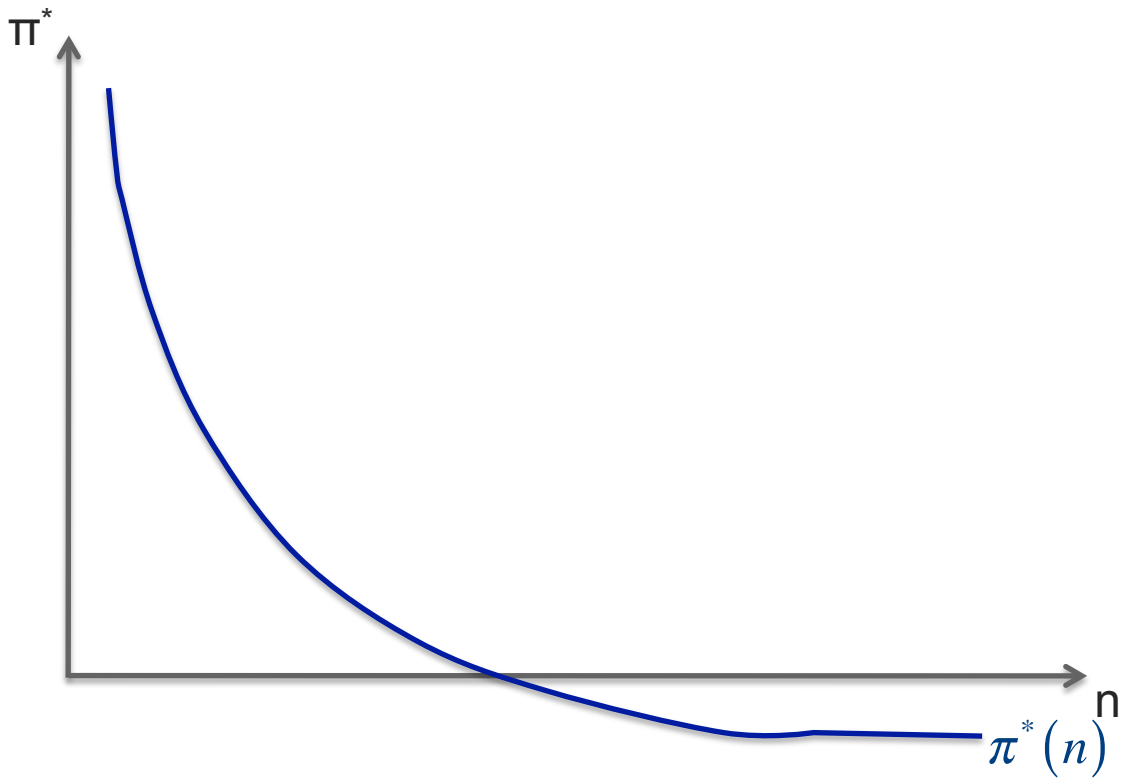
Entry

- K is *sunk* (= Cannot be recouped)
  - May only be part of initial investment
  - May include future expenditures (eg: disposing of waste)

Entry

Equilibrium profit as function of concentration

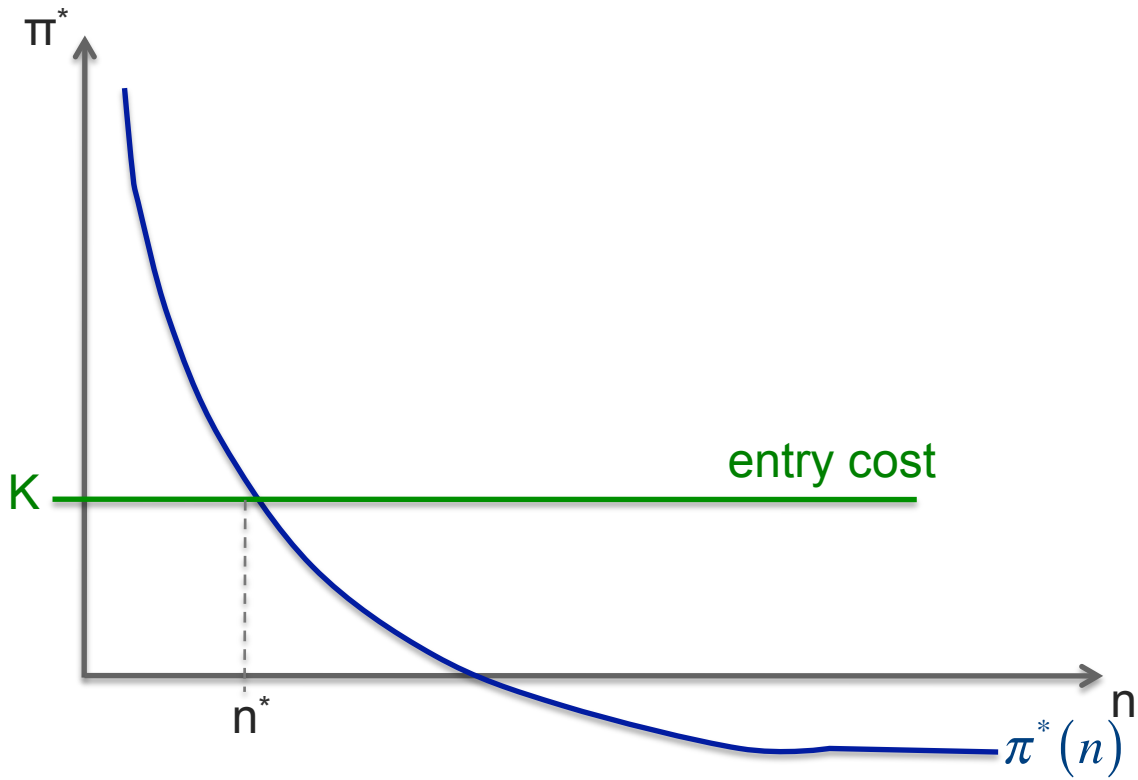
$$\pi^* = m\frac{(\alpha - c)^2}{(2+(n-1)\sigma)^2} - F$$



Entry

Equilibrium profit as function of concentration

$$\pi^* = m\frac{(\alpha - c)^2}{(2+(n-1)\sigma)^2} - F$$



Entry

Entry condition

$$\pi^* = m\frac{(\alpha - c)^2}{\left(2 + (n-1)\sigma\right)^2} - F = K$$

Entry

Entry condition

$$\pi^* = m\frac{(\alpha - c)^2}{\left(2 + (n-1)\sigma\right)^2} - F = K$$

Solve for n

$$n = -\frac{2-\sigma}{\sigma} + \frac{\alpha - c}{\sigma}\sqrt{\frac{m}{K+F}}$$

Entry

Step by step

$$m\frac{(\alpha-c)^2}{\left(2+(n-1)\sigma\right)^2}-F=K$$

$$m\frac{(\alpha-c)^2}{\left(2+(n-1)\sigma\right)^2}=K+F$$

$$(\alpha-c)^2\frac{m}{K+F}=\left(2+(n-1)\sigma\right)^2$$

$$(\alpha-c)\sqrt{\frac{m}{K+F}}=2+(n-1)\sigma$$

$$\frac{(\alpha-c)}{\sigma}\sqrt{\frac{m}{K+F}}-\frac{2}{\sigma}=(n-1)$$

$$n=-\frac{2-\sigma}{\sigma}+\frac{\alpha-c}{\sigma}\sqrt{\frac{m}{K+F}}$$

Entry

Equilibrium number of firms

$$n = -\frac{2-\sigma}{\sigma} + \frac{\alpha - c}{\sigma}\sqrt{\frac{m}{K+F}}$$

m = market size

K = Entry cost

F = Fixed cost

σ = Degree of substitutability

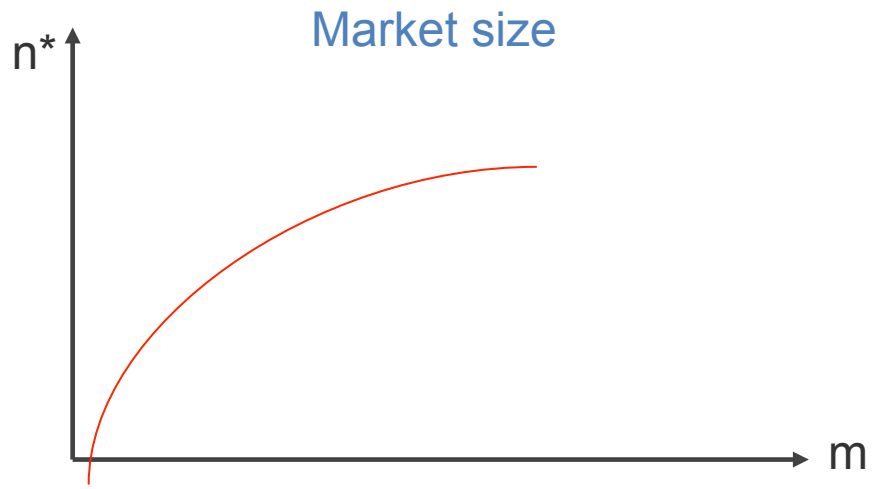
Conclusions

- Result 1: Determinants of concentration
  - Economies of scale (F)
  - Entry barriers (K)
  - Market size (m)
  - Product differentiation (σ)

Conclusions

- Result 2: effect of market size
  - *n* increases with m, but not in proportion to *m*
  - If the market doubles, the number of firms will not double

$$n^* = -\frac{2-\sigma}{\sigma} + \frac{\alpha - c}{\sigma}\sqrt{\frac{m}{K+F}}$$



Conclusions

- Result 2: effect of market size
  - *n* increases with m, but not in proportion to *m*
  - If the market doubles, the number of firms will not double

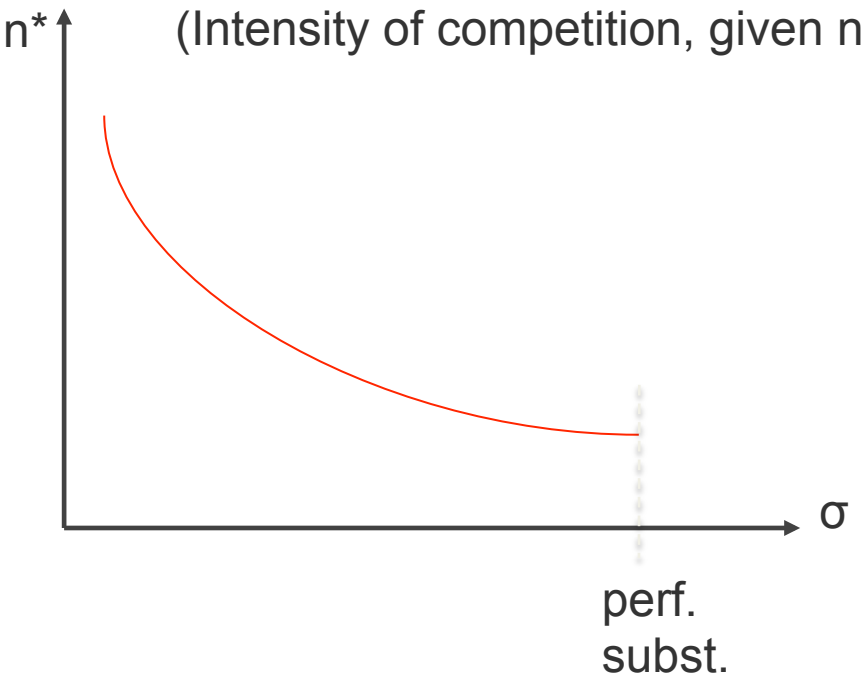
- Q: Why?
  - With more firms, there is more competition
  - Margins are lower (p – c)
  - Each firm needs more consumers to cover their fixed costs

  - But also countervailing force: If products are differentiated new entry leads to "market expansion"

Conclusions

Result 3: effect of product differentiation

(Intensity of competition, given n)



$$n^* = -\frac{2-\sigma}{\sigma} + \frac{\alpha - c}{\sigma}\sqrt{\frac{m}{K+F}}$$

Conclusions

- Result 3: effect of product differentiation
  - Attempts to increase competition by reducing product differentiation may reduce the number of firms
- Q: Why?
  - Reduced differentiation reduces profits (given n)
  - Has to reduce n to make $\pi(n, \sigma) = 0$

Entry & Welfare

How Measure Welfare?

- Social welfare = π + CS
- Q: Why measure welfare like this?
  - CS measures utility in monetary terms
  - We do not care about distribution of wealth

Effects of Entry

- Q: Positive effects of entry?
  - Increased product variety
  - Increased competition
- Q: Negative effects of entry?
  - Scale economies not exploited (Additional fixed costs)
  - Additional entry costs

Too Much or Too Little Entry?

- Q: What are the externalities? (disregard prod variety)
  - Increased competition = positive externality on consumers
  - Business stealing = negative externality on rivals
- Q: Which dominates?
  - Competition does not increase much in Cournot

Entry & Welfare

- Result
  - There is too much entry in Cournot markets
- Intuition
  - New firms mainly take over incumbents' sales
  - Small increase in competition
    (= small reduction in price and increase in output)

Entry & Welfare

- Note 1: Importance of welfare standard
  - Total welfare reduced when last firm enters
  - But consumer surplus is increased

Entry & Welfare

- Note 2: Importance of conduct
  - Cournot => too much entry
  - Bertrand => possibly too little entry
    - With homogenous goods, there can only be one firm if $F + K > 0$
    - Entry of second firm reduces dead weight loss
    - If entry cost and fixed cost small, reduction in dead weight loss more important
  - Cartel => too much entry (only business stealing)

Endogenous Entry Costs

Endogenous Entry Costs

- Stylized fact 1 ("A mystery")
  - In some markets, concentration is (almost) independent of market size
- Example: Beer industry
  - Portugal: Centralcer, Unicer
  - USA (50 times bigger): Anhauser Bush, Miller, Coors

Endogenous Entry Costs

- Possible explanation 1
  - Price competition =>
    n does not grow in proportion to m
- But…

Endogenous Entry Costs

- Stylized fact 2
  - Industries that tend to be concentrated, also in large markets, are R&D and advertising intensive
- Implication
  - R&D and advertising => (Perceived) product differentiation => Little price competition
  - Number of firms should increase fast in market size
  - Cournot: Number of firms should be √50 = 7 times larger in the US than in Portugal

Endogenous Entry Costs

- Stylized fact 3
  - R&D and Advertising costs increase with market size
  - Example: Advertising cost *as percentage of sale* is roughly the same in US and Portuguese beer industry

Endogenous Entry Costs

- Q: Why would costs increase with market size?
  - Endogenous - Firms choose themselves
  - Advertising and R&D more valuable in large markets

Endogenous Entry Costs

- Claim (Shaked & Sutton, 1987)
  - If firms compete in both prices and R&D/Advertising
  - Then there exists upper limit on #firms, as market grows bigger
  - (under reasonable conditions)

Endogenous Entry Costs

- Example
  - This example illustrates why firms' advertising costs increase in a larger market
  - How larger advertising costs limits the number of firms
- Simplification
  - No price competition

Endogenous Entry Costs

Example

Market

customers: m

firms: n

Value of one unit: v

Customer only have time to visit one store: $p^* = v$

Endogenous Entry Costs

Example

Bench mark: No advertising

Customer select shop at random

Firm profit: $\pi = (m / n)v - F$

Entry: $n^* = (m \cdot v) / F$

Number of firms proportional to size of market

Extreme - no price competition

Endogenous Entry Costs

Example

Advertising game

Customer select shop in proportion to advertising

Firm profit: $\pi_i = m\left(\frac{r_i}{R}\right)v - k \cdot r_i - F$ $\quad R = \sum_{j=1}^{n} r_j$

Endogenous Entry Costs

Example

Advertising game

Customer select shop in proportion to advertising

Firm profit: $\pi_i = m\left(\frac{r_i}{R}\right)v - k \cdot r_i - F$ $\qquad R = \sum_{j=1}^{n} r_j$

Equilibrium: $r_i^* = \frac{n-1}{n^2}\frac{m \cdot v}{k}$

Endogenous Entry Costs

Example

Advertising game

Customer select shop in proportion to advertising

Firm profit: $\pi_i = m\left(\frac{r_i}{R}\right)v - k \cdot r_i - F$ $\qquad R = \sum_{j=1}^{n} r_j$

Equilibrium: $r_i^* = \frac{n-1}{n^2}\frac{m \cdot v}{k}$

Advertising cost increasing in size of market: $K_i^* = k \cdot r_i^* = \left(\frac{n-1}{n^2} \cdot v\right) \cdot m$

Endogenous Entry Costs

Example

Entry

Profit: $\pi_i^* = \frac{m \cdot v}{n^2} - F$

Entry: $n^* = \sqrt{\frac{m \cdot v}{F}}$

Number of firms increases less than proportional to size of market

Quiz

Single Market Program

- European Internal Market Program
  - The European Internal Market Program aims at removing all trade barriers between the Member States
- Questions
  - What is the likely effect on the number of firms and market concentration in Europe?
  - What are the welfare gains?

Single Market Program

- Hint
  - You may attempt to analyze this question more formally, using the entry model discussed in the lecture notes.
  - To simplify the analysis, you may assume that Europe consists of two countries of equal size, that there is not trade before the reform and that there are barriers to trade (and no transportation costs) after the reform.

Answer

Single Market Program

Single Market Program

Single Market Program

Single Market Program