Product Differentiation Outline

Product Differentiation

- Entry
  - Chamberlin Monopolistic Competition
  - Non-Entry
  - Salop Free-Entry
- Differentiation
  - Hotelling Fixed Locations
  - Hotelling Fixed Prices
  - Hotelling Continuous Two-Stage
  - Hotelling Discrete Two-Stage
  - Schmalensee Product Proliferation
  - Shaked and Sutton Vertical Differentiation

Chamberlin Monopolistic Competition

- Parameters: A large number of firms produce mutual substitutes with decreasing average cost and compete in prices. Each firm's price has negligible effect on each other firm's demand. Entry and exit are costless.
- Analysis: Argue that firms produce at minimum average cost since costless entry and exit imply zero profit at equilibrium.
- Result: Apparent over-provision of product diversity.
  - Analytically, each firm fails to exhaust minimum efficient scale. Chamberlin concludes that product diversity is over-provisioned since $\downarrow n^a \Rightarrow \uparrow$ productive efficiency.
- Evaluation: Unrealistic assumption of monopolistic competition since firms tend to have a small number of close competitors.
- Discussion: Chamberlinian argument fails to consider the desirability of variety, which is modelled in Hotelling and Salop models as a reduction in total transport cost.

Non-Entry

- Parameters: Bertrand free entry model with $P(Q) = 1 - Q$.
- Analysis: Find monopoly profit and monopoly social surplus. Argue that for intermediate F entry does not occur but entry is socially optimal.
- Result: Under-provision of product diversity.
  - Intuitively, this is because of the non-appropriability of social surplus.
- Discussion: Non-appropriability of social surplus is due to the inability of firms to perfectly price discriminate.

Salop Free-Entry

- Parameters: Potential entrants choose whether to enter at cost F, firms choose price. Suppose that transport cost is linear.
- Analysis: Suppose $p_j = p$ for $j \neq i$, then for i, find indifferent consumer, hence demand function and profit function. Solve for subgame Nash equilibrium by taking FOC and imposing symmetry.
- Result: $\uparrow t \Rightarrow \uparrow p, \uparrow n$.
  - Intuitively, $\uparrow t \Rightarrow \uparrow$ product sensitivity $\Rightarrow \downarrow$ price-elasticity of demand $\Rightarrow \uparrow p \Rightarrow \uparrow \pi \Rightarrow \uparrow$ entry incentive.
- Result: $\uparrow F \Rightarrow \uparrow p, \downarrow n$.
  - Intuitively, $\uparrow F \Rightarrow \uparrow \pi \Rightarrow \downarrow n^a \Rightarrow \uparrow$ "distance" between firms $\Rightarrow \downarrow$ consumers' willingness to switch $\Rightarrow \downarrow$ price-elasticity of demand $\Rightarrow \uparrow p$
- Result: Excessive entry, over-provision of product diversity.
  - Analytically, $CS = \sum v - p - t$, $PS = \sum \pi - F$, $W = CS + PS$, W maximisation consists in $T + F$ minimisation, $n^O = \frac{\sqrt{tF}}{2} = \frac{n^e}{2}$.
  - Intuitively, excessive entry is due to the business-stealing effect since entry imposes negative externalities. Non-appropriability of social surplus is irrelevant since by supposition all consumers buy.

- Result: $\uparrow S \Rightarrow <\propto\uparrow q, <\propto\uparrow n^a$.
  - Intuitively, since market size uniformly scales demand, $p^* \perp\!\!\!\perp S, \uparrow S \Rightarrow\propto\uparrow \pi^* \Rightarrow\uparrow$ entry incentive. Entry occurs until $\downarrow \pi$ due to $\uparrow$ number of firms exactly offsets $\uparrow \pi$ due to $\uparrow$ market size.

Hotelling Fixed Locations

- Parameters: Standard Hotelling model with linear transport cost.
- Analysis: Find indifferent consumer, hence demand function and profit function. Solve by taking FOC and imposing symmetry.
- Result: Firms escape Bertrand trap.
  - Intuitively, only marginal consumers are alienated by a price increase, hence demand is not perfectly elastic, and each firm can increase profit by choosing price above marginal cost.
- Result: $\uparrow t \Rightarrow\uparrow p$.
  - Intuitively, $\uparrow t \Rightarrow\uparrow$ product sensitivity $\Rightarrow\downarrow$ price-elasticity of demand $\Rightarrow\uparrow p$.
- Discussion: Hotelling line describes heterogenous preferences along a continuum, where consumers incur disutility from consuming "distant" products.

Hotelling Fixed Prices

- Parameters: Standard Hotelling model with linear transport cost.
- Analysis: Argue that consumers buy from the nearest firm. Show no profitable deviation from $x_A = x_B = \frac{1}{2}$.
- Result: Under-provision of product diversity.
  - Analytically, $x_A^O = \frac{1}{4}, x_B^O = \frac{3}{4}$.
  - Intuitively, exogenous prices eliminate strategic incentive to differentiate. Firms have incentive to concentrate because of "market share" effect.

Hotelling Continuous Two-Stage

- Parameters: Standard Hotelling model with quadratic transport cost.
- Analysis: State equilibrium $x_A = 0, x_B = 1, p_A = p_B = c + t$. Analyse $\frac{d\pi_A}{dx_A} = \frac{\partial\pi_A}{\partial x_A} + \frac{\partial\pi_A}{\partial p_A}\frac{dp_A}{dx_A} + \frac{\partial\pi_A}{\partial x_B}\frac{dx_B}{dx_A} + \frac{\partial\pi_A}{\partial p_B}\frac{dp_B}{dx_A} = \frac{\partial\pi_A}{\partial x_A} + \frac{\partial\pi_A}{\partial p_B}\frac{dp_B}{dx_A}$.
- Result: Maximum differentiation, over-provision of product diversity.
  - Analytically, $x_A^O = \frac{1}{4}, x_B^O = \frac{3}{4}$.
  - Intuitively, the strategic effect dominates.
- Evaluation: Unrealistic result of maximum differentiation. In reality, firms tend to concentrate. This can be explained by concentrated demand, exogenous prices, and/or positive externalities.

Hotelling Discrete Two-Stage

- Parameters: Standard Hotelling model with quadratic transport cost.
- Analysis: State equilibrium $x_A = 0, x_B = 1, p_A = p_B = c + t$. Analyse subgame Nash equilibria where $x_A = x_B$ and where $x_A \neq x_B$.
- Result: Maximum differentiation, over-provision of product diversity.
  - Analytically, $x_A^O = \frac{1}{4}, x_B^O = \frac{3}{4}$.
  - Intuitively, firms differentiate to escape the Bertrand trap.

Schmalensee Product Proliferation

- Parameters: I chooses n_I at cost $n_I F$, I brands are distributed evenly on a Salop circle, E chooses whether to enter and where at cost F, $p_I = p_E = p$.
- Analysis: Argue that optimal entry is between I brands, find π_I and π_E. Argue that I can deter entry by product proliferation.
- Result: Product diversity not necessarily over-provisioned.
- Evaluation: Critical assumption of credible commitment to not re-positioning or withdrawing brands is plausible re-positioning and launching brands involves sunk costs.
- Case Study (Ready-to-Eat Cereal):

    - The ready-to-eat breakfast cereal market in the U.S. was heavily concentrated from 1950 to 1972, with a 4-firm concentration ratio of 85% and a 6-firm concentration ratio of 95%. Throughout this period, no new firm achieved a non-negligible market share. Incumbents enjoyed very high profits, that could not apparently be explained as compensation for risk-bearing, given limited fluctuation in sales and profits. Over this period the 6 leading incumbents introduced over 80 brands into distribution beyond test market. Minimum efficient scale in this industry is thought to be small, at $3-5\%$ market share, neither patents, ownership of raw material sources, production knowhow, advertising, nor capital costs seems to constitute a significant barrier to entry (by introducing a new brand) (especially for the potential entrants Pet and Colgate, which are large, diversified food processing firms).

Shaked and Sutton Vertical Differentiation

- Parameters: Two firms choose p_X given s_X where consumers maximise $v-p-\theta s$ and $\theta \sim U(0,1)$.
- Analysis: Find indifferent consumer, hence demand function and profit function for each firm. Take FOC and solve simultaneously.
- Result: $p_A > p_B, q_A > q_B, \pi_A > \pi_B$, hence there is a strong first-mover advantage.
- Result: Firms have incentive to maximally differentiate.
    - Analytically, $\frac{d\pi_A}{ds_A} = \frac{\partial \pi_A}{\partial s_A} + \frac{\partial \pi_A}{\partial p_A}\frac{dp_A}{ds_A} + \frac{\partial \pi_A}{\partial s_B}\frac{ds_B}{ds_A} + \frac{\partial \pi_A}{\partial p_B}\frac{dp_B}{ds_A} = \frac{\partial \pi_A}{\partial s_A} + \frac{\partial \pi_A}{\partial p_B}\frac{dp_B}{ds_A}$
    - Intuitively, the strategic effect dominates the direct effect.