Price Discrimination with Boundedly Rational Consumers: When Do Dominated Offers Pay Off?

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Motivating example

- **Mobile phone plans** (O2, Czech Republic):

	Bronz	Silver	Gold
fixed fee, CZK	180	555	890
free minutes	30	100	200
extra unit price, CZK:			
- to own operator	3.1	2.7	2.5
- to other operators	5.2	4.4	4

- **What is the best plan**: lowest expected cost of consumption
  - expected cost has to be computed = search

Existing Search Models

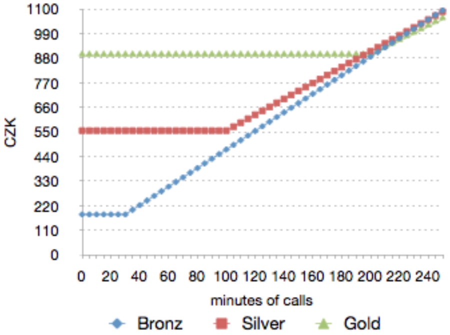
- **Rational search** (Stigler 1961):
  - consumers know distribution of choice alternatives
  - they can compute expected benefit of search
  - search cost is known
  - they search as long as benefit is higher than cost
- **Satisficing** (Simon 1955):
  - consumers have aspiration level
  - they search as long as aspiration level is not achieved
- **Question not answered**:
  - what is the first considered choice alternative?

Key Idea

- **Search sequence is correlated with consumer type**
  - consumers with higher willingness to pay for quality consider high-quality alternatives first
  - consumers with higher demand for calls consider mobile plans with more included minutes first
- **Implication of search models**
  - different consumer types biased to different choice alternatives

Back to Motivating Example

- **Q: How can firms exploit consumers' limited search?**
- A: By offering dominated choice alternatives - those that consumers who fully search never choose



Consumers

- **Consumer i chooses bundle j to maximize net surplus:**

$$\max_j V_{ij} = u(\theta_i, q_j) - t_j, \text{ for } i = L, H. \quad (1)$$

  - θ_i ... taste parameter $\theta_H > \theta_L$
  - $T_j = (q_j, t_j)$ ... consumption-price bundle j
  - $u(.)$ ... satisfies all standard properties

Monopolist

- **Profit function when consumers fully search:**

$$\pi = \sum_{j=1}^{N}(t_j - cq_j)[\lambda f(V_{Lj}, V_{L\bar{j}}) + (1-\lambda) f(V_{Hj}, V_{H\bar{j}})] \qquad (2)$$

  - λ ... probability of θ_L-type
  - $f(V_{ij}, V_{i\bar{j}}) = 1$ if θ_i-type chooses T_j, 0 otherwise
  - N ... number of offered bundles
  - c ... constant unit cost

First-Best Outcome

- Monopolist observes consumer type
- Monopolist offers T_l to θ_L-type and T_h to θ_H-type
  - choice rule: $f(V_{ij}, V_{i\bar{j}}) = 1$ if $V_{ij} \geq 0$ (PC_i)
- Profit function:

$$\pi^{FB} = \lambda p_l + (1-\lambda) p_h, \quad (3)$$

$$\text{where } p_l = u(\theta_L, q_l) - cq_l,$$

$$p_h = u(\theta_H, q_h) - cq_h.$$

- First-best outcome ($j = l$ for $i = L$, $j = h$ for $i = H$):

$$q_j^* = \arg\max_q \left[u(\theta_i, q) - cq \right], \quad (4)$$

$$t_j^* = u\left(\theta_i, q_j^*\right).$$

Second-Best Outcome

- Monopolist does not observe consumer type
- Monopolist offers T_l and T_h, consumer chooses
  - choice rule: $f(V_{ij}, V_{i\bar{j}}) = 1$ if $V_{ij} \geq 0$ (PC_i) and $V_{ij} \geq V_{i\bar{j}}$ (ICC_i)
- Profit function:

$$\pi^{SB} = \lambda p_l + (1-\lambda)[p_h - V_{Hl}]. \tag{5}$$

  - assumption: θ_L-type self-selects T_l, θ_H-type self-selects T_h
- Second-best outcome:

$$q_l^{SB} < q_l^*, q_h^{SB} = q_h^*, \\ t_l^{SB} < t_l^*, t_h^{SB} < t_h^*. \tag{6}$$

Limited Search

- Assume sufficiently large search cost, such that
  - consumer's consideration set consits of one bundle
- Consumer i accepts the first bundle j if $V_{ij} \geq 0$, no ICC_i
- Heterogenous search:

$$s_L^j \neq s_H^j,$$

  - s_i^j ... probability to have T_j in consideration set for θ_i-type
  - $\sum_{j=1}^N s_i^j = 1$ for $i = L, H$

Monopolist's New Problem

- **Profit function when consumers have limited search:**

$$\pi = \sum_{j=1}^{N}(t_j - cq_j)[\lambda s_L^j f(V_{Lj}) + (1-\lambda)s_H^j f(V_{Hj})] \qquad (7)$$

  - $f(V_{ij}) = 1$ if $V_{ij} \geq 0$
- Monopolist's gain:
  - no information rent to θ_H-type
- Monopolist's loss:
  - θ_L-type might be excluded if $s_L^j > 0$ and $V_{Lj} < 0$

Optimal Offers

- **Lemma 1**: Every bundle offered by monopolist is first-best for at least one consumer type.
- **Intuition**: no incentive compatibility constraint to be satisfied

Distinct Offers

- **Definition**
  - T_j, T_k both satisfy PC_H: they are distinct if $t_j \neq t_k$ or $q_j \neq q_k$
  - T_j, T_k both violate PC_H: they are always identical
  - T_j satisfies PC_H, T_k violates PC_H: they are always distinct
- Making two identical offers is equivalent to advertising them

Optimal Number of Distinct Offers

- **Lemma 2**: Optimal number of distinct offers never exceeds number of consumer types (two)
- **Intuition**:
  - Lemma 1: only first-best offers are optimal
  - there are two distinct first-best offers (one for each type)

Main Result

- **Proposition 1**: It is optimal for monopolist to offer two distinct bundles T_l and T_h **only if** $s_H^h > s_L^h$.
- i.e. θ_H-type is more likely to start search with T_h than θ_L-type

Proof of Main Result

- By Lemma 1 and 2, only three possible strategies:
  - pooling: $\pi_{T_l^*} = p_l^*$
  - excluding: $\pi_{T_h^*} = (1-\lambda)p_h^*$
  - two bundles: $\pi_{T_l^*,T_h^*} = (\lambda s_L^l + (1-\lambda)s_H^l)p_l^* + (1-\lambda)s_H^h p_h^*$
- $\pi_{T_l^*,T_h^*} > \pi_{T_l^*}$ and $\pi_{T_l^*,T_h^*} > \pi_{T_h^*}$ simultaneously when:

$$1-\lambda\frac{s_H^h - s_L^h}{s_H^h} < \frac{(1-\lambda)\,p_h^*}{p_l^*} < 1+\lambda\frac{s_H^h - s_L^h}{1-s_H^h}. \tag{8}$$

- **Necessary condition**: $s_H^h > s_L^h$
  - in special case $(1-\lambda)p_h^* = p_l^*$, necessary condition is sufficient

Summary

- **Market observation**:
  - presence of dominated choice alternatives
  - fully rational consumers never choose dominated alternatives
- **Assumption on consumer search behavior**:
  - only subset of offers are in consumers' consideration set
  - consumer always chooses the best from consideration set
  - heterogenous consumers have heterogenous consideration sets
- **Main result**:
  - monopolist can benefit from dominated offers **only if** consumers willing to pay more are more likely to consider them