Product Complexity and Search

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Overview

Aim of the Talk

- provide explanation for prevalence of complexity in competitive environments
- why do consumers not search for better deals?

Intuition for Results

- consumers rationally prefer complex products to bad products
- if all goods complex, no incentives to search
- making a good transparent only allows consumers to find out about bad matches

Related Literature

Search

- Anderson & Renault (1999, 2000), Wolinsky (1986)

Advertising/Product design: change taste variance of products

- Lewis & Sappington (1994), Bar-Isaac et al. (forthcoming), Johnson & Myatt (2006), Anderson & Renault (2009)

Product complexity

- Carlin (2009), Gabaix & Laibson (2003), Piccione & Spiegler (2012)
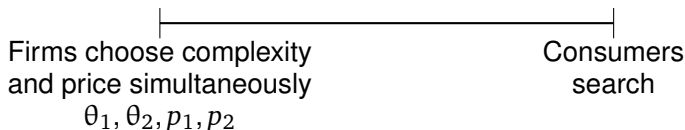
- two symmetric firms, denoted $j = 1, 2$
- offer one horizontally differentiated product each
- no fixed costs, marginal costs normalized to 0
- set price p_j and complexity $\theta_j \in \{0, 1\}$ for their product

The Model - Consumers

- total mass 1 of risk-neutral consumers, denoted i

$$U_{ij}(p_j) = v - p_j + \epsilon_{ij}$$

- $\epsilon_{ij} \sim F(\epsilon)$ over $[\underline{\epsilon}, \overline{\epsilon}]$ with log-concave density $f(\epsilon)$, iid across consumers and firms
- buy at most one product, outside option normalized to 0
- random, sequential search
- search cost c for second visit, costless recall
- upon sampling firm j, consumers see price p_j
- given complexity $\theta_j \in \{0, 1\}$
    - $\theta_j = 0$, learn their valuation ϵ_{ij}
    - $\theta_j = 1$, do not learn their valuation, keep belief that $\epsilon_{ij} = \mathbb{E}(\epsilon)$

Timing

Firms choose complexity
and price simultaneously
$\theta_1, \theta_2, p_1, p_2$

Consumers
search

- solution concept: Perfect Bayesian Equilibria with passive beliefs, focus on pure strategies
  - firms maximize profits given expected price and complexity of the rival and consumer search behavior
  - consumer behavior is utility maximizing given prices and product characteristics observed and anticipated
  - anticipated prices and complexities are consistent with equilibrium strategies and independent of those observed

Consumer Decision Full Transparency

Search Behavior
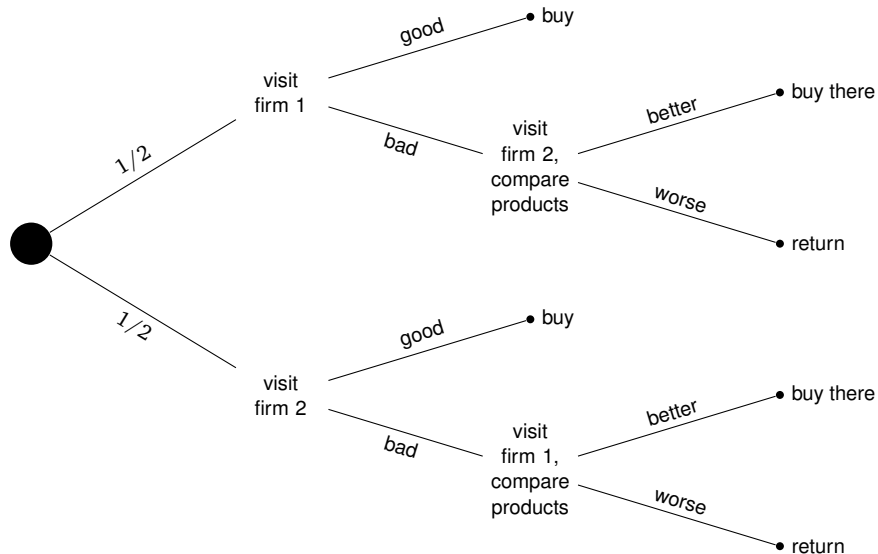
- prefer and buy second product if $\epsilon_2 - p_2 > \epsilon_1 - p_1$
- gains from searching transparent firm 2 after visiting firm 1
    - lower price
    - better match

- indifferent consumer $\hat{\epsilon}_1(p_1, \mathbb{E}(p_2))$: gains from search = search costs
    - $\epsilon_1 < \hat{\epsilon}_1$, search rival
    - $\epsilon_1 \geqslant \hat{\epsilon}_1$, do not search further
    - tie-breaking rule: indifferent consumer does not search

Full Transparency

- symmetric candidate equilibrium (p^*, p^*)
- deviation by firm 1 to complexity without changing price
- consumers starting at deviating firm see homogenous product
  $\Rightarrow$ all make the same decision whether to visit other firm or not

- if search costs s.t. $\hat{\epsilon} \leqslant \mathbb{E}(\epsilon)$: deviation strictly profitable
    - all first visitors stay at deviating firm
    - all second visitors must have learned $\epsilon_2 < \mathbb{E}(\epsilon)$

- no full transparency equilibrium exists if search costs are sufficiently high such that $\hat{\epsilon} \leqslant \mathbb{E}(\epsilon)$

Full Transparency contd

- $\hat{\epsilon} > \mathbb{E}(\epsilon) \Rightarrow$ sell to $F(\mathbb{E}(\epsilon))$ consumers
    - all first visitors search transparent rival $\Rightarrow$ all consumers see product 2
    - get *all* consumers with $\epsilon_2 < \mathbb{E}(\epsilon)$

- profitability depends on skewness of $F(\epsilon)$
    - right-skewed: mean $>$ median (more consumers with "low" valuation than with "high" valuation) deviation strictly profitable
    - symmetric: mean $=$ median, deviation rotates demand curve through point (p^*, p^*)
    - left-skewed: mean $<$ median

- no such equilibrium exists for any level of search costs if distribution $F(\epsilon)$ is skewed to the right or symmetric

Full Complexity

- both products perceived as homogenous ⇒ Diamond paradox, monopoly prices only candidate equilibrium

Deviation towards transparency

- only consumers visiting deviating firm see that firm has deviated
- without understanding its product, they all would have stayed
- profitable iff monopolist prefers transparent product

full complexity equilibrium with monopoly prices exists iff monopolist's choice is complexity (holds under mild conditions: product is a "good" for most realizations of ϵ)

Conclusion

- new approach to modeling complexity/obfuscation
- complex products prevent consumers from searching
- competition softened since consumers do not search