Paid Placement Strategies in Internet Search Engines

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Figure 1: Paid placement in MetaCrawler.com

Outline

- Search Engines as Information Gatekeepers
- Paid Placement and Bias
- Optimal Bias in Monopoly Setting
- Competition between Gatekeepers: Optimal Bias and Effects
- Conclusion

Search Engines as Information Gatekeepers

- Huge amount of information on the internet and Web: Over 800 million pages, 6 terabytes of text data, on 2.8 million servers
  Lawrence & Giles (1999)
- Need for guided search: search engines are crucial entry points
  100 million queries are made on US search engines each weekday
- More generally, need for information, advice and recommendations with regard to decisions and alternatives

Information gatekeeper: able to influence decision making using

- vast repository of information
- expertise on the topic
- algorithms for matching alternatives to requirements

Other examples: comparison shopping engines, recommender systems, bestseller lists, ...

Evolution of Search Engines

- Begin as independent, free service, later supported by advertising revenues
- Revenue problem is critical
- Paid placement: content provider pays gatekeeper in return for prominent placement
  - Deliberate perturbation of result to benefit paid provider
  - Provider: Increase clickthroughs or conversion rate
  - User: Negative impact on perceived quality and credibility

Analogy: *pay-for-play* in radio industry

Paid Placement in Search Engines

Meta Search	Paid Links	Total Links	% Paid
Dogpile	30	35	86
qbsearch	66	98	67
MetaCrawler	13	25	52
Mamma	6	15	40
Search.com	10	29	34
ProFusion	2	14	14
Ixquick	1	10	10
Vivisimo	0	20	0

Table 1: Percentage of paid links on first page of results

Research Questions

- Tradeoff between placement and user-based revenues: What is the optimal bias strategy?
- Impact of gatekeeper quality and other factors on optimal bias?
- How does competition influence bias levels and user welfare?
- Longer-term prospects for gatekeeper market structure?

Literature Review

- Bhargava-Choudhary (2001b)
- Corbett-Karmarkar (1999)
- Baye-Morgan (2001)
- Dewan-etal (2001)

Model of Paid Placement

- Gatekeeper quality as perceived by user
  - x: Paid links
  - q: other measures (e.g., database size; user interface; retrieval algorithm, response time)
  - $L(q)$: Size of consideration set, $L_q(q) > 0$
    limited by cognitive and cost constraints
  - $\frac{x}{L(q)}$: Relative bias level
- $M(q, x) \equiv M(x)$: User demand for search service at bias x
  $M_q(q, x) > 0, M_x(q, x) < 0$,
- s: value per user
- γ: fee for paid placement

- Demand for search service

$$M(x) = aq(1 - \left(\frac{x}{L(q)}\right)^2)$$

- $L(q) = L\sqrt{q}$
- Quality-adjusted demand function for paid placement

$$\gamma = bM - cx$$

- Gatekeeper's revenues

$$sM(x) + \gamma x$$

Optimal Bias Level for Single Gatekeeper

Tradeoff between User-based revenues and Placement Revenues

- Optimal Bias

$$x^* = \frac{\sqrt{(sa + cL^2)^2 + 3a^2b^2L^2q} - (sa + cL^2)}{3ab}$$

- Increase in q allows search engine to increase paid placement links and total profits
- Increase in per user profit, s, decreases paid placements, increases market coverage M, and improves total profits π
- Increase in $L(q)$ allows search engine to increase paid placement links x^* and total profits π

  Importance of good UI design: e.g., iLOR

Cometition between Identical Gatekeepers

- Identical quality level q
- Bias levels x_1, x_2
- User demand

$$M(x_i; x_j) = \begin{cases} M(x_i) - \frac{1}{2}M(x_j) & \text{if } x_1 \leq x_2 \\ \frac{1}{2}M(x_i) & \text{if } x_1 > x_2 \end{cases}$$

Optimal Bias Levels

- If $x_1 > x_2$ then

$$\Omega_1(x_2) = \frac{\sqrt{(sa + 2cL^2)^2 + 3a^2b^2L^2q} - (sa + 2cL^2)}{3ab}$$

  is lower than the monopoly bias level

- If $x_1 \leq x_2$ then optimal response to search engine 2's bias level is

$$\Omega_1(x_2) = \frac{\sqrt{(sa + cL^2)^2 + \frac{3}{2}a^2b^2L^2q + \frac{3}{2}abx_2^2L^2} - (sa + cL^2)}{3ab}$$

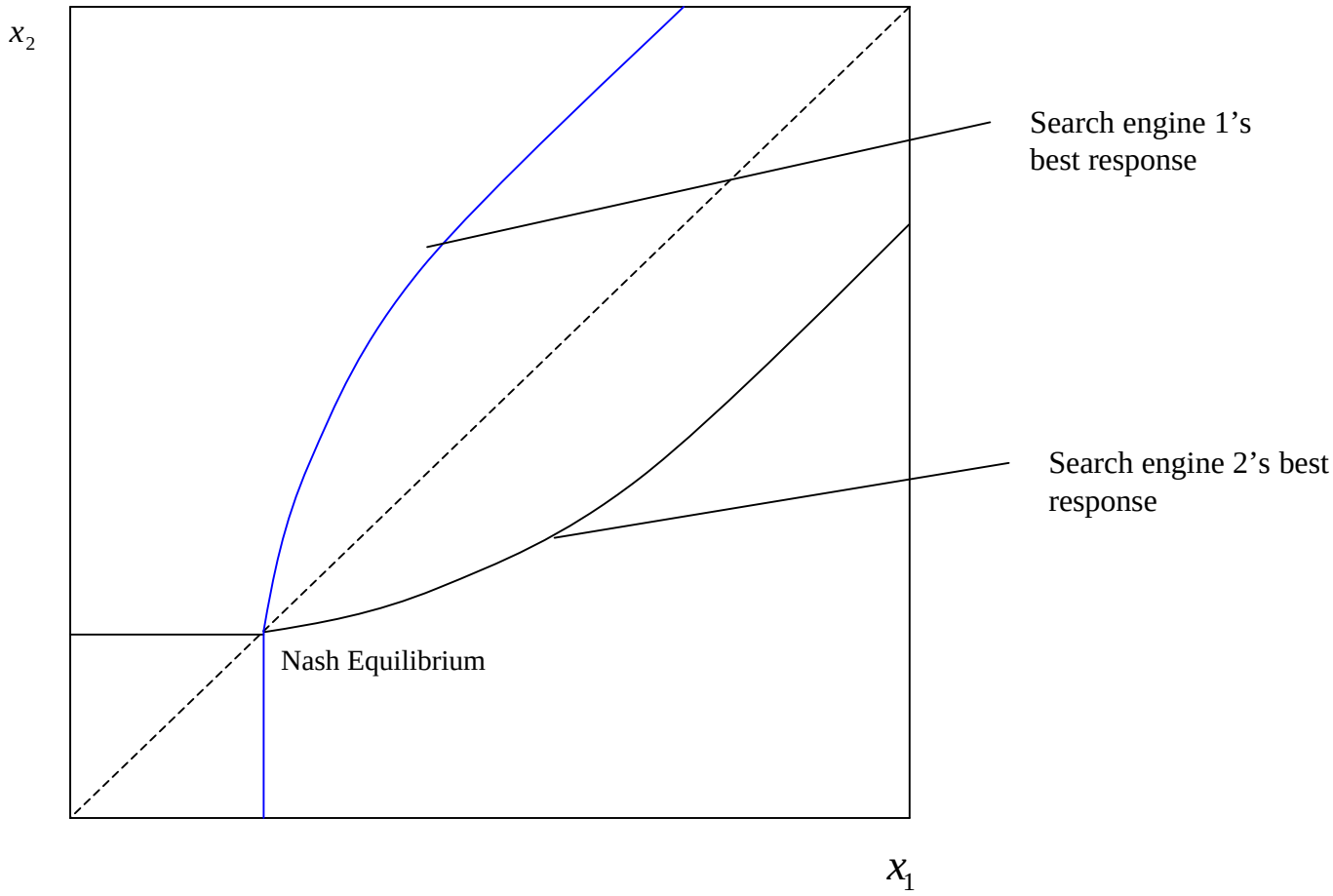

Figure 3: search engine's best response function when they have same qualities

- Unique Nash equilibrium

$$x_1^* = x_2^* = \frac{\sqrt{(sa + 2cL^2)^2 + 3a^2b^2L^2q} - (sa + 2cL^2)}{3ab}$$

  is below optimal monopoly bias level

- Competition causes increase in users' welfare; reduces surplus of content providers and search engines

Pop-up window where users store the list they choose

Pop-up window where user can perform the operation

Figure 2: iLOR's first result page when searching "Canada"

Competition with Heterogeneous Qualities

- Quality levels q_1, q_2, $\quad q_1 > q_2$
- Bias levels x_1, x_2
- User demand

$$M(q_i, x_i; q_j, x_j) = \begin{cases} M(q_i, x_i) - \frac{1}{2} M(q_j, x_j) & \text{if } \tilde{x}_1 < \tilde{x}_2 \\ \frac{1}{2} M(q_i, x_i) & \text{otherwise} \end{cases}$$

$$\tilde{x}_i = q_i \left(1 - \frac{x_i}{L^2 q_i}\right)$$

Optimal Bias Levels

- If $\tilde{x}_1 \geq \tilde{x}_2$ then

$$\Omega_1(x_2) = \frac{\sqrt{(sa + 2cL^2)^2 + 3a^2b^2L^2q_1} - (sa + 2cL^2)}{3ab}$$

  is lower than the monopoly bias level

- If $\tilde{x}_1 < \tilde{x}_2$

$$\Omega_1(x_2) = \frac{\sqrt{(sa + cL^2)^2 + 3a^2b^2(L^2q_1 - \frac{1}{2}L^2q_1 + \frac{1}{2}x_2^2)} - (sa + cL^2)}{3ab}$$

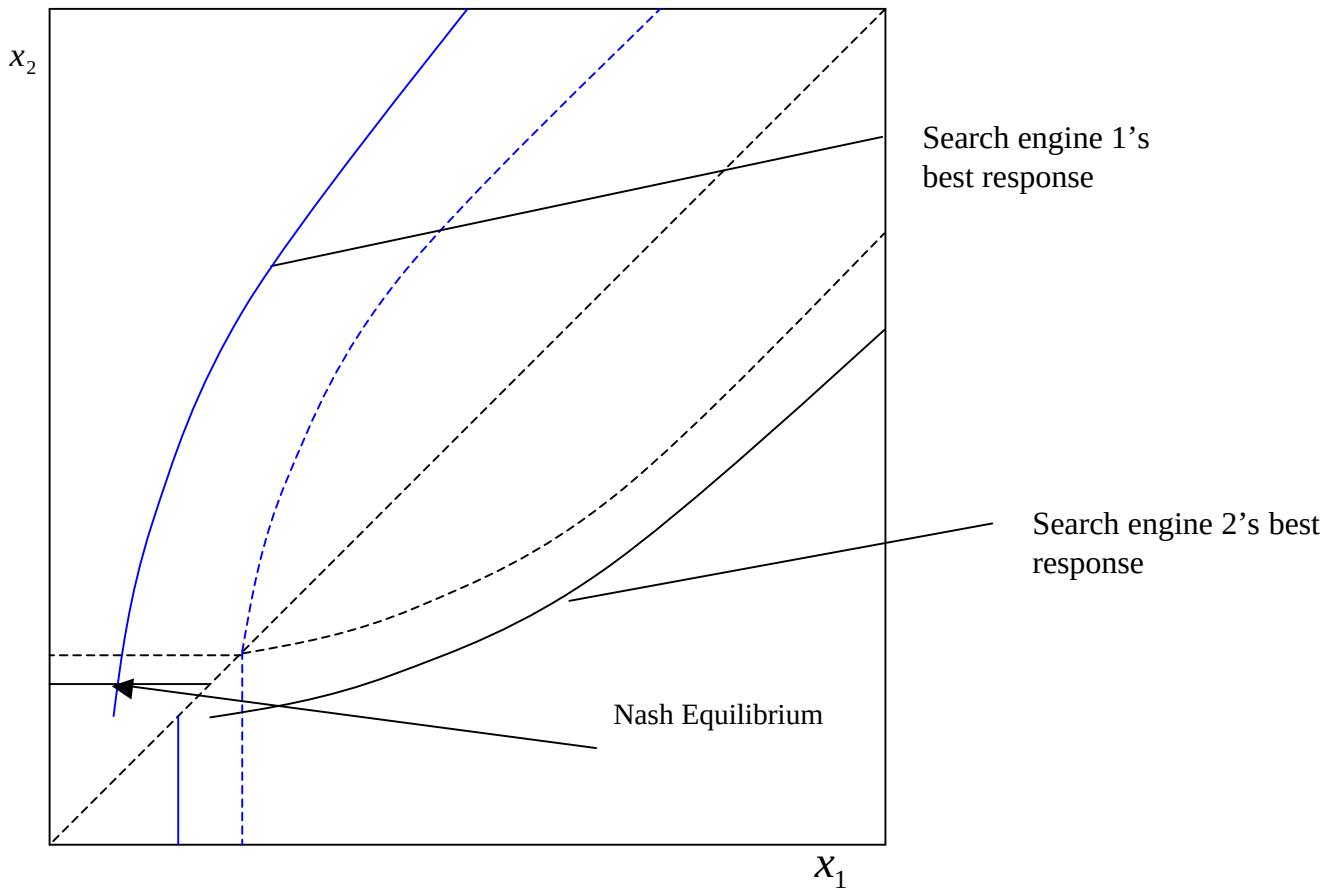

Figure 4: When L is small, higher quality search engine (1) has lower bias level.

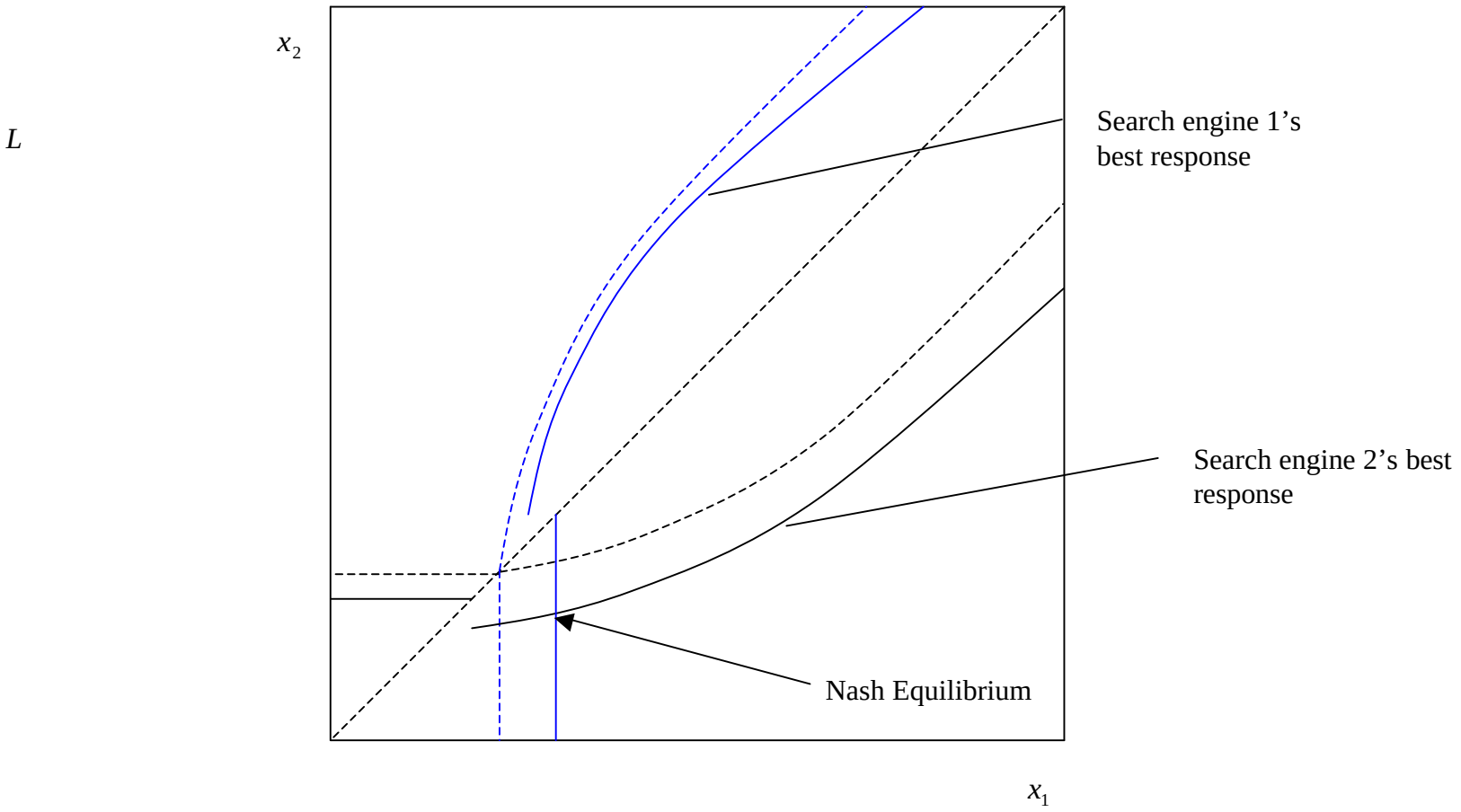

Figure 5: When is large, higher quality search engine (1) has higher bias level.

Equilibrium Bias Level

- Lower quality search engine (2) will decrease its bias level below monopoly case
- Higher quality search engine (1) will
  - Increase bias below monopoly level if users have "high" tolerance for paid links
  - Decrease bias level if user tolerance is "low"

  Increase in $L(q)$ gives increases search engine 1's ability to increase its bias level

Conclusions and Future Work

- Economic logic of paid placement
- Competition between search engines reduces bias level
- Long-term viability of *free* and *fair* search engines?
- Prospects for market segmentation and fee-based search engines?