Paid Placement Strategies in Internet Search Engines

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May 7, 2002
Figure 1: Paid placement in MetaCrawler.com
Paid Placement Strategies in Internet Search Engines

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

<table>
<thead>
<tr>
<th>Meta Search</th>
<th>Paid Links</th>
<th>Total Links</th>
<th>% Paid</th>
</tr>
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<tbody>
<tr>
<td>Dogpile</td>
<td>30</td>
<td>35</td>
<td>86</td>
</tr>
<tr>
<td>qBsearch</td>
<td>66</td>
<td>98</td>
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<td>MetaCrawler</td>
<td>13</td>
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<td>ProFusion</td>
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<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Ixquick</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Vivisimo</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

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
- $\gamma$: fee for paid placement
• Demand for search service

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

• \( L(q) = L \sqrt{q} \)

• 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 \( \pi \)

- Increase in \( L(q) \) allows search engine to increase paid placement links \( x^* \) and total profits \( \pi \)

Importance of good UI design: e.g., iLOR
Competition 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
Figure 2: iLOR’s first result page when searching “Canada”
Competition with Heterogeneous Qualities

• Quality levels $q_1, q_2$, $q_1 > q_2$
• 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

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

is lower than the monopoly bias level

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

$$
\Omega_1(x_2) = \sqrt{(sa + cL^2)^2 + 3a^2b^2\left(L^2q_1 - \frac{1}{2}L^2q_1 + \frac{1}{2}x_2^2\right)} - (sa + cL^2)
$$
Figure 4: When $L$ is small, higher quality search engine (1) has lower bias level.
Figure 5: When $L$ 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?