The Attention Economy of Search and Web Advertisement

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People *Surf* the Web

1. Search Engine Results Page

2. Content Website
Typical Complement Sellers’ Problem:

Double Marginalization: $P_H + P_S > P^*$

- Cournot 1838, ch. IX
Typical Solutions: One Price Setter

With advertisement, however, there are two effects at play

- Different websites have different advertising technologies
The Model: Simple Example

Search Engine Profits: \( a_s \times [\# \text{ of users}] \)

Content Website Profits: \( a_w \times [\# \text{ of users}] \)

User utility:

\[
u_i = \begin{cases} 
  v_i - a_s^2 - \left(\frac{a_w}{\gamma}\right)^2, & \text{if searches and visits website} \\
  0, & \text{otherwise}
\end{cases}
\]

\( v_i \sim U[0, \bar{v}] \)
Compare Two Scenarios

Case 1
• One Search Engine
• One Content Website

Case 2
• One Search Engine
• Perfectly Competitive Content Websites
Case 1: One SE, One CW

Timing
1. SE and CW set advertising levels
2. Users decide whether to search and visit content site

Choosing Advertising Levels—SE and CW solve:

\[
\max_{a_s} a_s \left[ 1 - \frac{a_s^2 + \left( \frac{a_w}{\gamma} \right)^2}{\bar{v}} \right] \quad \max_{a_w} a_w \left[ 1 - \frac{a_s^2 + \left( \frac{a_w}{\gamma} \right)^2}{\bar{v}} \right]
\]

(Same Users)
Case 2: One SE, Competitive CWs

Here, only search engine sets positive advertising

Choosing Advertising Levels—SE solves:

\[
\max_{a_s} \left[ a_s^2 + \left( \frac{0}{\gamma} \right)^2 \right]
\]

\[
1 - \frac{1}{\bar{v}}
\]
Tradeoff:
Double Marginalization versus Mis-marginalization

Total Profits

<table>
<thead>
<tr>
<th>Competitive Content Websites</th>
<th>One Content Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>• With one SE, one CW,</td>
<td>• With competitive CWs,</td>
</tr>
<tr>
<td>total advertising level</td>
<td>only SE’s advertising</td>
</tr>
<tr>
<td>unprofitably high</td>
<td>technology is utilized</td>
</tr>
</tbody>
</table>

\( \gamma \)
Tradeoff: Double Marginalization versus Mis-marginalization

Total Welfare

<table>
<thead>
<tr>
<th>Competitive Content Websites</th>
<th>One Content Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{v} \text{ large} )</td>
<td></td>
</tr>
<tr>
<td>( \bar{v} \text{ small} )</td>
<td></td>
</tr>
</tbody>
</table>

\( \gamma \)
General, price theoretic treatment of the problem

• Start off with one site, examine different advertising technologies

\[ U_i = \begin{cases} 
  v_i - \delta(a, \gamma), & \text{if visits site} \\
  \chi, & \text{if not} 
\end{cases} \]

\[ \Pi = (a - c)D(\delta(a, \gamma) + \chi) \]
In the Paper

General, price theoretic treatment of the problem

- Start off with one site, examine different advertising technologies
In the Paper

General, price theoretic treatment of the problem

• Start off with one site, examine different advertising technologies
In the Paper

General, price theoretic treatment of the problem

- Start off with one site, examine different advertising technologies
- Analyze problem with arbitrary number of sites
  - Two fundamental distortions
    - Double marginalization
    - Mis-marginalization
Two Fundamental Distortions

Industry Optimum:

\[ \bar{a}^\Pi - \bar{c} = h(\delta(a^\Pi)) \frac{1}{\partial \delta / \partial a_j}, \quad \text{for all } j \]

Equilibrium:

\[ \bar{a}^* - \bar{c} = h(\delta(a^*)) \left( \frac{1}{\partial \delta / \partial a_1} + \ldots + \frac{1}{\partial \delta / \partial a_n} \right) \]
In the Paper

General, price theoretic treatment of the problem

• Start off with one site, examine different advertising technologies
• Analyze problem with arbitrary number of sites
  • Two fundamental distortions
    • Double marginalization
    • Mis-marginalization
• Salop model: 1 search engine, n content websites
  • Study effects of differentiation, incentives for entry
    • Surprising result: In equilibrium, users benefit from more differentiation / less entry by content websites
Future Work

• Relate to ongoing work on general framework of platform competition (with Glen Weyl)
• Integrate constraints on transferability of utility between platforms and consumers

• Better understand relation to Cournot with asymmetric costs
Searcher benefit direct visitors, and direct visitors harm searchers
Unreliable Content Sites

\[ \lambda v_i - a_s^2 - a_w^2 \]

2. Fan Fare » Blog Archive » Critics say “whatever” to Woody Allen’s... It is Allen’s first movie set in his native New York since the 2005... he “didn’t want to be the guy to screw up Woody Allen’s movie. ... blogs.reuters.com/.../critics-say-whatever-to-woody-alls-latest-caper/ - Cached - Similar

\[ (1 - \lambda) \lambda v_i - a_s^2 - a_w^2 - a_{w,1} - a_{w,2} \]
Related Literature

• Search and the Greater Web:
  • Evans (RNE ’08), Survey—“The Economics of Online Advertising”
  • Katona & Sarvary (Marketing Science ‘08)
  • Dellarocas & Rand
• Search Engine as a Platform
  • Athey-Ellison, Gomes
  • White
• Advertising on Platforms:
  • Anderson & Coate (RES ’05), Anderson & De Palma
  • Choi (IEP ’06)
  • Crampes, Hartichbalet & Jullien (JIE ’09)
• Competition Among Complement Producers:
  • Casadesus-Masanell, Nalebuff & Yoffie
  • Cheng & Nahm (RJE ‘07)
  • Weyl-Fabinger
Conclusion

1. Multiple websites are often complements
2. They use very different methods to turn user attention into revenue

Each of these leads to a separate coordination problem

1. Double Marginalization: too much nuisance
2. Mis-marginalization: inefficient nuisance

*For websites, there is a tradeoff between solving one and solving the other*