Consumer Search and Pricing Behavior in Internet Markets

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Introduction (1)

- Development of technology gives a substantial impact on consumers’ searching behaviors in the market
  - The use of faster means of transportation
    - Reduction in transportation costs and time
    - Consumers to search for products in markets that were previously beyond their horizon
  - Increased use of Internet technology
    - Reduces consumers’ search costs and intensify price competition
    - Allows consumers to become more active in markets
      - Reducing commodity price and promoting economic efficiency
Introduction (2)

Bakos (1997)

“...electronic marketplaces are likely to move commodity markets closer to the classical ideal of a Walrasian auctioneer where buyers are costlessly and fully informed about seller prices. ... we expect that electronic marketplaces typically will sway equilibria in commodity markets to favor the buyers, will promote price competition among sellers, and will reduce sellers’ market power.”

Jeff Bezos, Founder of Amazon.com (1999)

“We on the Internet should be terrified of customers because they are loyal to us right up to the point that someone else offers a better service. The power shifts to the consumer online.”

2
This paper provides,

- Overview of the relevant empirical literature about the effectiveness of online markets in lowering prices to competitive levels

- An theoretical search model which identifies basic conditions that explain empirical evidence related to the price level and price dispersion
Basics concepts in the paper (1)

- **Price dispersion**
  - Variation in prices across sellers of the same item
  - Occurs when different sellers offer different prices for the same good in a given market
  - It differs from price discrimination under which a single seller offers different prices to different groups of buyers

- **Informed consumers**
  - Has perfect information about the price and incurs no search cost
  - They can buy a good from the lowest price

- **Less informed consumer**
  - Examines several price quotations before a purchase with positive search cost

- **Search engine**
  - A special site which provides the service of the search of products and prices

- **Rate of adoption of search engine**
  - A measure for how much Internet search matured in a market
  - The percentage of informed consumer in a market can be used as a proxy
Basics concepts in the paper (2)

- Price level
  - Average price of a homogeneous good charged by the sellers

- Relative size of the purchase
  - Can be understood as an intention to purchase a good
  - \( \frac{(v - r)}{c} \)
  - Where, \( v \): willingness to pay, \( r \): unit cost of a product, \( c \): search cost
Overview of relevant literature (1)

- **Price levels in online market**
  - Seemed to be that it is easier for consumers to compare firms’ offerings
    - It may lead to lower prices and less price dispersion
  
  - **Lee (1998)**: The first study of the impact of the Internet on price levels
    - Prices in online auction vs. in conventional auction for second-hand cars
    - Found higher prices in online auction than conventional auction
      - Second-hand cars are not a homogeneous good
      - The good is sold to the highest bidder in auction

  - **Bailey (1998)**: Study on books and CDs which are entirely homogeneous
    - Found higher prices in online market than in conventional market
      - Due to the low rate of adoption of search engine at that time
Overview of relevant literature (2)

- Price levels in online market
    - Found that prices in online market and physical stores are quite similar
    - The shipping and handling fees are charged in online purchase
      - Thus, online prices are lower if not taking these additional fees
  
  - Brynjolfsson and Smith (2000): The study on the price of books and CDs
    - Found that prices in online market is lower even when taking into account the additional online fees
Overview of relevant literature (3)

- **Price dispersion in online market**
  - Price dispersion is typically explained in the literature as,
    - Price dispersion may arise as some consumers do not search more than once while others search more often
    - Thus, price dispersion becomes less frequent as Internet lowers search cost for the products and hence reduce the price dispersion
  
    - Found that price dispersion for books and CDs is not lower in online than in traditional outlet
    - Some other studies showed that online price dispersion exhibit substantial price dispersion (Baye and Morgan (2001), Brown and Goolsbee (2002))

  - Eric Johnson (2004): The study on how many times people search before buying
    - Travel shoppers search substantially more than CD and Book shoppers
    - Higher search activity for the products with higher value such as travel than for the product like CDs or Books
Overview of relevant literature (4)

- Price dispersion in online market
  - Even though it is easy to visit an Internet site
    - Still takes some time to find a particular book or CD and to order it
    - For a few dollars purchase, it doesn’t seem to be worthwhile to search many times
  - Higher search activity is associated with lower price level and lower price dispersion, Clay et al. (2001)
    - Search is more intense in the market for bestseller books as buyers value them more
    - Bestseller books in online markets are generally more discounted than other books
Search model in Internet market

- Model assumptions (1)
  - Two firms selling a homogeneous good with unit cost $r$
  - Consumers who wish to purchase at most a single unit of the good
    - A fraction of $\lambda$ of the consumer ($0 < \lambda < 1$)
      - Proportion of informed buyers with no search cost,
      - Used as a proxy for the rate of adoption of search engines
    - The other customers ($1 - \lambda$)
      - Proportion of less informed buyers with search cost $c$, $c > 0$
      - Less informed buyers decide to obtain several price quotations, $n$
    - Informed consumers buy a good from the lowest priced store, while less informed buy it from the store with the sampled lowest price
  - All consumers have the same willingness to pay ($v$) for a good
    - $v > c + r$
    - The maximum price
    - $(v - r) / c$ : the relative size of the purchase
Search model in Internet market

- Model assumptions (2)
  - $F(p)$: the firms’ price distribution function
  - $\mu_n$: the probability that a less informed buyer searches $n$ times
  - $\pi(p)$: the profits attained by a firm with price $p$

- Equilibrium is a pair $\left\{F(p), \{\mu_n\}_{n=0}^N\right\}$ such that,
  - $\pi(p) = \bar{\pi}$ for all $p$ in the support of $F(p)$
  - $\pi(p) \leq \bar{\pi}$ for all $p$
  - $\{\mu_n\}_{n=0}^N$ is optimal search behavior of less informed buyers given that their conjectures about the price distribution are correct
  - $\Rightarrow$ Any price in equilibrium yields the same profit

- Three search intensities based on less informed buyers’ search behaviors
  - Low/Moderate/High
Case 1: Low search intensity (1)

Less informed buyers randomize between searching for one price and not searching at all,
- \( \mu_0 > 0 \), \( \mu_0 + \mu_1 = 1 \)
- \( F(p_i) \): the probability that a firm charges a price that is smaller than \( p_i \)

Expected payoff to firm \( i \) of charging \( p_i \) when the rival chooses a random pricing strategy according to the \( F(.) \) is

\[
\pi_i(p_i, F(.)) = (p_i - r) \left[ \frac{(1 - \lambda)\mu_1}{2} + \lambda(1 - F(p_i)) \right]
\]

A per consumer profit

Less informed buyers (1-l) actively search for one price and particularly when they visit its store (\( m_1/2 \))

Portion of fully informed buyers (\( \lambda \)) when it charges a lower price than the rival, which happens with probability 1-F(\( p_i \))
Case 1: Low search intensity (2)

In equilibrium,
- A firm must be indifferent between charging any price in the support of F
- The maximum price a firm will ever charge is \( v \) (WTP)
- The upper bound of the price distribution cannot be lower than \( v \)
- Thus, \( F(v) = 1 \), \( F(p) < 1 \) for all \( p < v \)

Any price in the support of F must then satisfy \( \pi_i(p_i, F(\cdot)) = \pi_i(v) \), which yields,

\[
F(p) = \frac{2\lambda + (1 - \lambda)\mu_1}{2\lambda} - \frac{(1 - \lambda)\mu_1}{2\lambda} \frac{v - r}{p - r}
\]

- Because any price in equilibrium yields the same profit

Equilibrium in low search intensity if less informed consumers are indeed indifferent between searching for one price and not searching at all
- \( v - E[p] - c = 0 \), where \( E[p] \) is expectation of \( p \)
Search model in Internet market

- Case 1: Low search intensity (3)
  - In equilibrium the following condition must be satisfied,

\[
1 - \frac{(1 - \lambda)\mu_1}{2\lambda} \ln \left( \frac{2\lambda + (1 - \lambda)\mu_1}{(1 - \lambda)\mu_1} \right) = \frac{c}{v - r}
\]

The additional gains to a consumer from searching once given that he does not search at all ($\Phi$)
Case 2: High search intensity (1)

- Less informed buyers randomize between searching for one price and searching for two prices,
  - \( \mu_1 + \mu_2 = 1 \)

- Expected payoff to firm \( i \) of charging \( p_i \) when the rival chooses a random pricing strategy according to the \( F(.) \) is

\[
\pi_i(p_i, F(p)) = (p_i - r) \left[ \frac{(1 - \lambda)\mu_1}{2} + (\lambda + (1 - \lambda)(1 - \mu_1))(1 - F(p_i)) \right]
\]
Case 2: High search intensity (2)

In equilibrium,
- A firm must be indifferent between charging any price in the support of F
- Same arguments employed with case 1

Any price in the support of F must then satisfy \( \pi_i(p_i, F(\cdot)) = \pi_i(v) \), which yields,

\[
F(p) = \frac{2 - (1 - \lambda)\mu_1}{2(1 - (1 - \lambda)\mu_1)} - \frac{(1 - \lambda)\mu_1}{2(1 - (1 - \lambda)\mu_1)} \frac{v - r}{p - r}
\]

- Because any price in equilibrium yields the same profit

Equilibrium in high search intensity if less informed consumers are indeed indifferent between searching for only one price and searching for two prices
- \( v - E[p] - c = v - E[\min(p_1, p_2)] - 2c \)
Search model in Internet market

- Case 2: High search intensity (3)
  - In equilibrium the following condition must be satisfied,

\[
\frac{(1 - \lambda)\mu_1}{2(1 - (1 - \lambda)\mu_1)} \left[ \frac{1}{1 - (1 - \lambda)\mu_1} \ln \left( \frac{2 - (1 - \lambda)\mu_1}{(1 - \lambda)\mu_1} \right) - 2 \right] \frac{c}{v - r}
\]

The additional gains to a consumer from searching one search more given that he already searched once (\(\Gamma\))

The relative cost of an additional search

![Graphs showing the relationship between \(\Gamma\) and \(\mu_1\) for different values of \(\lambda\).](image-url)
Search model in Internet market

- **Case 3: Moderate search intensity**
  - Less informed buyers should search the price only once
    - $\mu_1 = 1$
  - Derivations and computations are the same and omitted
  - Equilibrium in moderate search intensity if less informed consumers are indeed find it optimal to search only once
    - $v - E[p] - c \geq 0$
    - $v - E[p] - c \geq v - E[\min\{p_1, p_2\}] - 2c$
Search model in Internet market

- Three possible equilibrium

Moderate intensity equilibrium

(a) High search engine rate of adoption ($\lambda = 0.8$)
Search model in Internet market

- Three possible equilibrium

(b) Low search engine rate of adoption ($\lambda = 0.2$)

Moderate intensity equilibrium
Search model in Internet market

- Key observations from the search models
  - Whether the economy is in a low, moderate, or high search intensity equilibrium depends on two critical parameters
    - The search cost (c)
    - The rate of adoption of search engine (λ)
Comparative statics

- Impact of changes in the parameters of the model
  - Development in the search technology
    - Decline in a search cost (c) or an increase in the rate of adoption of search engine (λ)
  - The influence of the parameters depends on intensity with which less informed buyers search in equilibrium

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$p^e$</td>
<td>$p^d$</td>
<td>$\pi$</td>
</tr>
<tr>
<td>$c$ down</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>$\lambda$ up</td>
<td>-</td>
<td>-</td>
<td>↑</td>
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</tbody>
</table>

Table 1: Summary of comparative statics results

- $p^e$: Expected price
- $p^d$: Price dispersion
- $\pi$: Expected price
- $W$: Welfare
Comparative statics

- The effects of a reduction in search cost $c$ on expected price, $p^e$ (E[p])
  - Less informed consumers with low search intensity
    - Since $v - E[p] - c = 0$, $E[p]$ ($p^e$) increases as $c$ falls
    - The search intensity of buyers rises as $c$ falls, however they are those who do not exercise price comparisons (more price-insensitive buyers)
    - Sellers have then an incentives to charge higher prices ($E[p]$ increases)
  
  - Less informed consumers with moderate search intensity
    - $v - E[p] - c \geq 0$
    - $v - E[p] - c \geq v - E[\min\{p_1, p_2\}] - 2c$
    - Small change in $c$ leaves less informed buyers’ behavior unchanged ($E[p]$ is unchanged)

  - Less informed consumers with high search intensity
    - Decline in $c$ raises the probability with which the buyers search for two prices
      - $\mu_2 = 1 - \mu_1$ (since $\mu_1$ decreases, $\mu_2$ increases)
      - Price comparisons are more frequent and price competition is fostered ($E[p]$ falls)
Comparative statics

The effects of a reduction in search cost $c$ on price dispersion, $p^d$

- Less informed consumers with low search intensity
  - Price dispersion arises due to the existence of two groups of customers who are asymmetrically informed
    - Firms make substantial profits by expropriating the less informed buyers
    - Search cost reduction in a market with low search intensity brings more price-insensitive buyers to the market, which gives incentives to raise prices
      - $\Rightarrow$ Price dispersion rises as $c$ decreases

- Less informed consumers with moderate search intensity
  - Small change in $c$ leaves less informed buyers’ behavior unchanged
    - $\Rightarrow$ No change in price dispersion

- Less informed consumers with high search intensity
  - $\nu - \mathbb{E}[p] - c = \nu - \mathbb{E}[\min(p_1, p_2)] - 2c$
    - Since $\mathbb{E}[p] - \mathbb{E}[\min(p_1, p_2)] = c$, So, $\mathbb{E}[\max(p_1, p_2)] - \mathbb{E}[\min(p_1, p_2)] = 2c$
      - $\Rightarrow$ Price dispersion decreases as the search cost falls
Comparative statics

- The impact of lower search cost \( c \) on \( E[p] \) and \( p^d \)

\[
\begin{align*}
E[p] - r & \quad \text{Moderate} \\
0.3 & \quad 0.25 \\
0.25 & \quad 0.2 \\
0.2 & \quad 0.15 \\
0.15 & \quad 0.1 \\
0.1 & \quad 0.05 \\
1 & \quad 0.8 \\
0.8 & \quad 0.6 \\
0.6 & \quad 0.4 \\
0.4 & \quad 0.2 \\
0.2 & \quad 0.1 \\
0.1 & \quad 0.05 \\
1 & \quad 1 \\
\end{align*}
\]

(a) High search engine rate of adoption (\( \lambda = 0.8 \))

(b) Low search engine rate of adoption (\( \lambda = 0.2 \))

<table>
<thead>
<tr>
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<th>Moderate</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td>( p^e )</td>
<td>( p^d )</td>
<td>( \pi )</td>
</tr>
<tr>
<td>↓ ( c )</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>↑ ( \lambda )</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

Table 1: Summary of comparative statics results
Comparative statics

The effects of an increase in the rate of adoption of search engine λ on expected price, $p^e$ and price dispersion, $p^d$

- Less informed consumers with low search intensity
  - Since $v - E[p] - c = 0$, neither $v$ nor $c$ varies, $E[p]$ and $p^d$ must remain constant

- Less informed consumers with moderate search intensity
  - An increase in $\lambda$ does not alter the behavior of buyers
  - Since more consumers exercise price comparison ($\mu_1 = 1$), the market becomes more competitive and $E[p]$ falls
  - $P^d$ decreases when the number of informed buyers is large initially

- Less informed consumers with high search intensity
  - An increase in $\lambda$ less informed buyers search less intensively
    - Less price comparison
  - Compensation of companies incentives to charge lower price and thus no change in $E[p]$ and $p^d$
Comparative statics

- The impact of an increase in the rate of adoption of search engine $\lambda$ on $E[p]$ and $p^d$

![Diagram showing comparative statics results](image)

(a) Relative size of purchase is small ($\frac{c}{v-r} = 0.5$)  
(b) Relative size of purchase is large ($\frac{c}{v-r} = 0.05$)

<table>
<thead>
<tr>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p^e$</td>
<td>$p^d$</td>
<td>$\pi$</td>
</tr>
<tr>
<td>$\downarrow c$</td>
<td>$\uparrow$</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>$\uparrow \lambda$</td>
<td>$-$</td>
<td>$-$</td>
</tr>
</tbody>
</table>

Table 1: Summary of comparative statics results
Comparative statics

- Explaining the mixed empirical results
  - Bailey study (1998)
    - Higher price for books and CDs in online than offline
    - The relative size of the purchase is small compared with the search cost
    - The rate of adoption of search engines was probably low (in 1996)

  ➔ The model would expect a low or moderate search intensity equilibrium thus a decline in \( c \) produce higher expected price

- Brynjolfsson and Smith (2000)
  - Lower price for books and CDs in online than offline
  - Probably higher rate of adoption and lower search cost in 2000 than in 1998

  ➔ The model would expect a high search intensity equilibrium thus a decline in \( c \) produce lower expected prices and price dispersion
Comparative statics

- Summary of comparative statics

Table 1: Summary of comparative statics results
Discussion (1)

- Price search in real market
  - Two products
    - Book – “Steve Jobs (Official autobiography)”
    - Shoes – “Nike basketball shoes (The overplay 6)”
  - Compare the prices in online and offline market

<table>
<thead>
<tr>
<th>Online site</th>
<th>Price (Won)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpark</td>
<td>22,500</td>
</tr>
<tr>
<td>11st</td>
<td>22,500</td>
</tr>
<tr>
<td>Gmarket</td>
<td>22,500</td>
</tr>
<tr>
<td>Bandi&amp;Lunis</td>
<td>22,500</td>
</tr>
<tr>
<td>Amazon.com</td>
<td>$17.87 = 21,080</td>
</tr>
<tr>
<td>Kyobobook.co.kr</td>
<td>22,500</td>
</tr>
<tr>
<td>Homeplus (offline)</td>
<td>25,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Online site</th>
<th>Price (Won)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpark</td>
<td>58,660</td>
</tr>
<tr>
<td>11st</td>
<td>53,593</td>
</tr>
<tr>
<td>Gmarket</td>
<td>57,400</td>
</tr>
<tr>
<td>Lotte.com</td>
<td>59,000</td>
</tr>
<tr>
<td>AKMall</td>
<td>55,900</td>
</tr>
<tr>
<td>Nike Store (offline)</td>
<td>64,900</td>
</tr>
<tr>
<td>Galleria Department store (offline)</td>
<td>70,000</td>
</tr>
</tbody>
</table>
Discussion (2)

- Price dispersion exists and price level in online is lower than offline
  - Price dispersion of “Steve Jobs” is 3,920 and “Nike basketball shoes” is 16,407, respectively

- Why the price dispersion of “Steve jobs” is less than “Nike Basketball shoes” ?
  - “Steve jobs” is currently the dominant bestseller (Ranked No. 1) in all of book stores
  - Search is more intense in the book market for the bestseller book as buyers value them more
  - High search intensity (or search cost reduction) reduces the price dispersion

- Why the price of “Steve jobs” and “Nike Basketball shoes” in online market is much more less than those in offline ?
  - Increased rate of search engine adoption increases search propensity
  - With Internet, we can search 7 quotations within 5 minutes
  - Without Internet, we should visit every physical stores, it may takes several hours or days
  - The price in offline market is bit more expensive than in online market
Discussion (3)

Case 1: Search cost decreases dramatically with price-comparison service

- Several portal service provides price-comparison service
  - Shopping How (Daum), Knowledge Shopping (Naver), Airline Shopping (Whypaymore)
  - The reduction in search cost stimulates the search behavior of customers and decrease the price level near to the competitive level
  - However, price dispersion was not fully diminished
  - The relative size of purchase with products is positively related to searching behavior of customers
Case 2: Search cost decreases dramatically with price-comparison service

- OPINET (Oil Price Information Network) of Korean gasoline market
  - The effects of the reduction of consumers’ search cost using OPINET
  - By utilizing OPINET, both price dispersion and margin of gasoline price in the metropolitan areas
Conclusion

- Product’s values relative to search cost as well as the search engine rate of adoption are the determinants of consumers’ search engine.

- The comparative statics effects of improved search technology on commodity markets depend on lowering search cost and increasing search engine rate of adoption, which are influenced by the search intensity of customers.
References

[1] Consumer search and pricing behavior in Internet markets, Maarten C. V. Janssen, Jose L. Moraga-Gonzalez, Matthijs R. Wildenbeest, 2005


Thank you !!!