Search and Obfuscation on the Internet

- Slides based mostly on

  "Search, Obfuscation, and Price Elasticities on the Internet," Ellison and Ellison, *EMA* 2009

- But also relevant:

  "A Model of Add-on Pricing," Ellison, *QJE* 2005

How do retailers respond to advent of low-cost price search?

- To study, researchers can chose an internet industry where price search had just become very cheap and easy through a price search engine.
- Firms should have a collective incentive to raise search costs.
- Effect of internet technologies on search frictions not unambiguous---firms can also use these technologies to frustrate search.
- Will focus on one particular obfuscation strategy: add-on pricing.

Pricewatch

est. 1995

A price search engine specializing in computer components and electronics

Find the lowest price, Holiday Sales.

Compare prices from the most trusted stores!

Like

Computers and Electronics

Hardware

Tablets / Notebooks
Desktops
Desktops (No OS)
Barebones PC
Point of Sale
Servers
Monitors
Printers

Components

Video Cards
Sound Cards
Controller Cards
CPUs / APUs
Motherboards
Motherboard + CPU Combos
Mboard Combos w/ Mem

Storage

Hard Drives
Tape Drives
Flash M
DVD/CD
Networl
Media

Click through, and you are given additional categories.

Memory

Computer / Laptop Memory
Flash Memory

Networking

Access Points
Routers / Switches
Cables
Network Adapters
All Networking

Electronics

Camcorders
Cameras
ware
Home Theater / Audio
GPS
Marine
MP3 Players
Phones
Projectors
Receivers
Scopes
Speakers
TV
Video Accessories

Tech Deals happening now

The Pricewatch Universe

Predifined category: 128mb PC 100 memory modules

Category is fairly narrowly defined, but not defined in terms of quality, warranty terms, etc.

BRAND	PRODUCT	DESCRIPTION	PRICE	SHIP	DATE/HR	DEALER/PHONE	ST	PART#
Generic	PRICE FOR ONLINE ORDERS ONLY - 128MB PC100 SDRAM DIMM - 8ns Gold leads	.- * LIMIT ONE - Easy installation - In stock	$ 68	$9.69 INSURED	10/12/00 12:40:05 AM CST	Computer Craft Inc. 800-487-4910 727-327-7559 Online Ordering	FL	MEM-128-100PCT
Generic	ONLINE ORDERS ONLY - 128MB SDRAM PC100 16x64 168pin	- * LIMIT ONE	$ 69	INSURED$9.95	10/11/00 10:59:56 PM CST	Connect Computers 888-277-6287 949-367-0703 Online Ordering	CA	-
Generic	PRICE FOR ONLINE ORDER - 128MB PC100 SDRAM DIMM	- * LIMIT ONE - InStock, 16x64 Gold Leads	$ 70	10.75	10/11/00 2:11:00 PM CST	1st Choice Memory 949-888-3810 -- P.O.'s accepted Online Ordering	CA	-
Generic	PRICE FOR ONLINE ORDER - 128mb True PC100 SDRAM EEPROM DIMM16x64 168pin 6ns/7ns/8ns Gold Leads	- * LIMIT ONE - In stock - with Lifetime Warranty	$ 72	9.85	10/10/00 11:30:39 AM CST	pcboost.com 800-382-6678 -- P.O.'s accepted Online Ordering	CA	-
Generic	IN STOCK, 128MB PC100 3.3volt unbuffered SDRAM Gold Lead 168 Pin, 7/8ns - with Lifetime warranty	- * LIMIT ONE Not compatible with Machine	$ 74	10.95- UPS INSURED	10/11/00 12:44:00 PM CST	Memplus.com 877-918-6767 626-918-6767	CA	- 880060
Generic	PRICE FOR ONLINE ORDERS ONLY - 128MB True PC100 SDRAM DIMM - 8ns Gold - warranty	- * LIMIT ONE	$ 74	10.25	10/9/00 6:53:25 PM CST	Portatech 800-487-1327 .	CA	-
House Brand	128MB PC100 3.3volt SDRAM 168 Pin, 7/8ns - with LIFITIME WARRANTY	- * LIMIT ONE	$ 74	10.50 FedEx	10/11/00 10:20:23 AM CST	1st Compu Choice 800-345-8880 800-345-8880	OH	-
Generic	128MB 168Pin TRUE PC100 SDRAM - OEM 16X64	DIMM16x64 168pin 6ns/7ns/8ns Gold Leads	$ 75	$10	10/11/00 2:37:00 PM CST	Sunset Marketing, Inc. 800-397-5050 410-626-0211 -- P.O.'s accepted	MD	-

Price prominently listed. Firms are ranked by price.

What could firms do to obfuscate?

- Have complicated (and unattractive) return policies and warranty terms
- List shipping and handling separately (and potentially charge a lot). (Pricewatch used to not list S&H on the same page & didn't have limits. Some firms charge $1 +$100 S&H.)
- Make the prices on the websites hard to find (Pricewatch added a "buy it now" button.
- Offer add-ons, upgraded products, etc.
- Pricewatch tries to fight against these strategies.

The Pricewatch Universe

Memory Spec. Chart - PC3200 DDR 512MB (Select Your Memory Module)

○ Samsung/Micron or Major 512MB PC3200 [ADD $25]	○ Industry Standard 512MB PC3200 [ADD $15]	◉ OEM 512MB PC3200
• CAS 2.5 Latency • Hand Picked 5ns • 6 Layer Low Noise Shielded PCB Board • 32x8 DRAM Type • Samsung/Micron or Major Brands • Return Shipping Paid • No Restocking Fee • Satisfaction & Compatibility Guaranteed • Lifetime Warranty • 15 Days Full Refund • Memory Tested Before Ship Out • Copper Heat Sink - Cool Down the Memory up to 40%	• CAS 2.5 Latency • Hand Picked 5ns • 6 Layer Low Noise Shielded PCB Board • 32x8 DRAM Type • Industry Standard DRAM Chips • 7 Days No Restocking Fee • Return Shipping not Paid • Improved Compatibility • Lifetime Warranty • Aluminum Heat Sink - Cool Down the Memory up to 35%	• CAS 3 Latency • 4 Layer Module Board • 64x4 DRAM Type • OEM DRAM Downgrade Chips • 20% Restocking Fee According to the Market Valu • Verify Compatibility with Memory Configurator • Return Shipping not Paid • 9 Months Warranty

"Add-on pricing".

British term "drip pricing"

More upgrade, high quality

Somewhat upgrade, Medium quality

Advertised, low quality

Can't search for these!!! Must visit each website.

Our Data

TABLE I

SUMMARY STATISTICS FOR MEMORY MODULE DATA (128MB PC100 MEMORY MODULES; 683 WEBSITE DAY OBSERVATIONS)

Variable	Mean	Stdev	Min	Max
LowestPrice	62.98	33.31	21.00	120.85
Range 1–12	6.76	2.52	1.00	13.53
*P*Low	66.88	34.51	21.00	123.49
*P*Mid	90.71	40.10	35.49	149.49
*P*Hi	115.19	46.37	48.50	185.50
log(1 + *P*LowRank)	1.86	0.53	0.69	3.26
*Q*Low	12.80	17.03	0	163
*Q*Mid	2.44	3.33	0	25
*Q*Hi	2.02	3.46	0	47

Rank of low quality product

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- Scraped price & product information for a year
- Got sales information from market participant

Demand Estimates

TABLE II

DEMAND FOR 128MB PC100 MEMORY MODULES[a]

Independent Variables	Dep. Var.: Quantities of Each Quality Level		
	Low q	Mid q	High q
$\log(1 + P\text{LowRank})$	−1.29*	−0.77*	−0.51*
	(10.9)	(4.6)	(2.9)
$\log(P\text{Low})$	−3.03	−0.59	1.49
	(2.3)	(0.4)	(0.9)
$\log(P\text{Mid})$	0.68	−6.74*	2.38
	(0.8)	(5.9)	(1.7)
$\log(P\text{Hi})$	0.17	2.72	−4.76*
	(0.2)	(1.8)	(3.3)
SiteB	−0.25*	−0.31*	−0.59*
	(3.5)	(2.9)	(5.6)
Weekend	−0.49*	−0.94*	−0.72*
	(8.4)	(8.3)	(5.8)
log(LowestPrice)	1.20	0.83	−0.14
	(1.1)	(0.6)	(0.1)
Number of obs.	683	683	683

[a] Absolute value of t-statistics in parentheses. Asterisks (*) denote significance at the 5% level.

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Demand Estimates

Sales of all quality levels respond to rank of lowest.

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All seems pretty standard

We can estimate characteristics of demand and also calculate own & x-price elasticities.

Demand Estimates

TABLE III

PRICE ELASTICITIES FOR MEMORY MODULES: THREE QUALITIES IN EACH OF FOUR PRODUCT CLASSES[a]

	128MB PC100 Modules			128MB PC133 Modules		
	Low	Mid	Hi	Low	Mid	Hi
*P*Low	−24.9*	−12.5*	−7.2*	−33.1*	−11.2*	−4.9*
*P*Mid	0.7	−6.7*	2.4	0.8	−3.6*	0.5
*P*Hi	0.2	2.7	−4.8*	0.2	−4.8*	−4.8*
	256MB PC100 Modules			256MB PC133 Modules		
	Low	Mid	Hi	Low	Mid	Hi
*P*Low	−17.4*	−8.1*	−4.1	−24.8*	−12.5	−6.6
*P*Mid	5.7	−7.8	−4.1	0.3	3.3	3.9*
*P*Hi	0.7	6.4	−3.8	−0.9	−7.2	−0.8

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Demand Estimates

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PRICE ELASTICITIES FOR MEMORY MODULES: THREE QUALITIES IN EACH OF FOUR PRODUCT CLASSES[a]

Enormously elastic demand for easily searchable low quality

	128MB PC100 Modules			128MB PC133 Modules		
	Low	Mid	Hi	Low	Mid	Hi
*P*Low	−24.9*	−12.5*	−7.2*	−33.1*	−11.2*	−4.9*
*P*Mid	0.7	−6.7*	2.4	0.8	−3.6*	0.5
*P*Hi	0.2	2.7	−4.8*	0.2	−4.8*	−4.8*
	256MB PC100 Modules			256MB PC133 Modules		
	Low	Mid	Hi	Low	Mid	Hi
*P*Low	−17.4*	−8.1*	−4.1	−24.8*	−12.5	−6.6
*P*Mid	5.7	−7.8	−4.1	0.3	3.3	3.9*
*P*Hi	0.7	6.4	−3.8	−0.9	−7.2	−0.8

Not nearly as elastic

[a] Asterisks (*) denote significance at the 5% level.

Demand Estimates

- When calculating these elasticities, effect of rank subsumed in price effect.
- What do we expect an elasticity matrix for close substitutes to look like?
- X-price, pos, not sig., with two exceptions:
  - Demand for med & high quality ↑ as p of low quality, despite the fact that they're close subs.
  - Evidence of effectiveness of add-on pricing: Consumers find these products through low-quality one.

Observations on Demand

- Bertrand suggests paradox
  - Own-price elasticity -25 (low quality)
- Add-on pricing
  - Reduction in rank of low quality increases sales of higher quality. (Neg x-price elasticities in first row.)
- Search frictions
  - Less elastic demand for medium and high quality. Low q demand more price sensitive.
- Adverse selection problem
  - Reduction in rank of low quality increases sales of higher quality less than it increases sales of low quality. X-price elasticities in first row not as large as own-price mix of consumers' changes as your rank changes.
- Why don't all firms just charge well below cost to attract customers and then get them to upgrade?

Evidence on Markups

TABLE VI

MEAN PERCENTAGE MARKUP IN SIX PRODUCT CLASSES[a]

	Product Category			
	128MB Memory		256MB Memory	
	PC100	PC133	PC100	PC133
Actual low markup	−0.7%	−2.5%	4.3%	2.9%
Actual mid markup	17.3%	15.6%	16.2%	19.9%
Actual hi markup	27.3%	26.9%	24.3%	24.9%
Overall markup	7.7%	11.5%	12.7%	15.8%
Overall elasticity ε	−23.9	−27.7	−16.0	−21.2
$1/\varepsilon$	4.2%	3.6%	6.3%	4.7%
Adverse selection multiplier	2.0	3.5	1.7	2.4
Predicted markup	8.3%	12.8%	10.9%	11.4%

[a]The table presents revenue-weighted mean percentage markups for products sold by websites A and B in each of four product categories along with predicted markups as described in Sections 2.2 and 7.

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- Compare actual markups w/ those implied by 1) estimated elasticities; 2) estimate elasticities & adverse selection term.
- Confirms that profits from add-on strategy do not just get competed away

Comments on Markups

- Low quality markups very low
- Medium and high quality substantially higher
- Overall markups higher than naïve expectation based on price elasticity

Conclusions

- Price search can lead to super elastic demand and potential for Bertrand paradox.
- In addition to facilitating price search, the internet can also facilitate sales strategies that frustrate price search (like add-on pricing).
- Add-on pricing leads to higher prices through equilibrium effects of adverse selection.

14.27 Economics and E-Commerce

Fall 2014