Investing to Reduce Consumer Uncertainty

How does Consumer Homogeneity Matter?

CSEIS 25th Anniversary Symposium

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Managers want to know when to reduce consumers' uncertainty

… because they can, and because they must

Because they can

New technology options

- Video instructions
  - how is the product used?
- Virtual samples, virtual try-ons
  - how does it feel to own the product?
- Online product demos
  - how does the product perform?
- Snippets of digital content
  - will I like it?
- Augmented reality
  - how will the product look like in reality?

Because they must

More demanding customers

- More 67% of consumers explores features online
- From 2007 to 2008, importance of:
  - *"product comparison features"* 67%➔70%
  - *"guides & how-to information"* 38%➔42%
  - *"product videos"* 25%➔31%
- Wide range of products
  - 90% of millionaires research luxury

Sources: McKinsey Global Institute, Accenture, E-Tailing Group

Taste-related product attributes are becoming more important

… as social commerce and recommendation technologies are perfectly suited for the communication of taste-related attributes

Social commerce

- Social platforms (e.g, Facebook, Pinterest, Instagram, LivingSocial) connect like-minded shoppers and encourage consumers to explore their idiosyncratic preferences
  - e.g., consumers can choose to “follow” the design-based handbag recommendations of a like-minded shopper in Pinterest

Recommendation Tech

- Web 1.0 allowed people to sort products based on quality attributes, but could not make intelligent recommendations when consumers' personal tastes were involved
- Collaborative filtering (and other techniques) allow people to focus on subjective performance measures
  - e.g., restaurant recommendations when visiting a new country, based on your favorite restaurants back home

Recent interest in non-quality attributes

… but the question 'how should non-quality attributes be disclosed' remains

Article	Explores	Managerial Implication (other things equal)
Jovanovic 1982	Quality	Higher quality products should invest more
Chevalier & Mayzlin 2006	Quality (avg. review)	Higher quality products should invest more
Dellarocas et al. 2007	Quality (avg. review)	Higher quality products should invest more
Clemons et al. 2005	Hyperdifferentiation (product space distances)	Information investments mostly affect buyers for whom the product is "close to ideal"
Clemons et al. 2006	Differentiation (review variance)	Hyperdifferentiated products benefit more from the reduced need to invest in informational campaigns
Duan et al. 2008	Quality (avg. review)	Higher quality products should invest more
Brynjolfsson 2011	Long-tail (sales rank)	Long-tail products should invest more
Sun 2012	Differentiation (review variance)	High variance products should invest more iff their quality is low
Anderson & Magruder 2012	Quality (avg. review)	Higher quality products should invest more
Current article	Consumer homogeneity (review variance)	Low variance products invest more

Our answer is empirically supported and translates to practical managerial advice

Problem Statement

- *When should firms invest to reduce buyers' uncertainty about the taste-related attributes of their products?*

Main finding & contribution

- Firms should disclose more taste-related information when the customer segment that they directly target represents a larger share of the overall market
- Empirically supported with a unique data set of more than 1,400 PC-games
- Turned into practical and actionable advice by showing that the variance of consumer reviews can guide such decisions

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In the initial model the firm cannot observe *s* and buyers cannot observe exact firm position

Basics

- Circular market
- Monopoly
- Single purchase good
- 2 buyer populations, one concentrated, and one uniformly distributed

Model Parameters

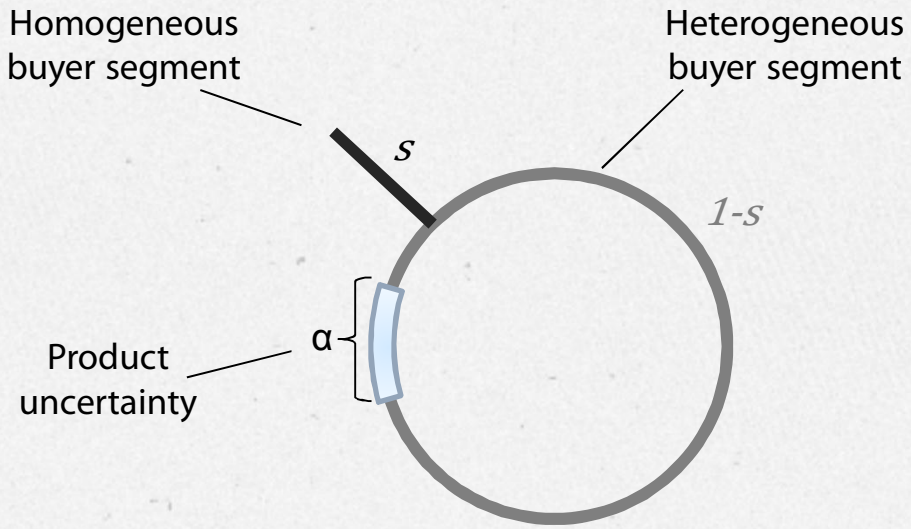
- Concentration of preferences *s*
- Uncertainty of firm position *α*
- Perceived quality *v*
- Demand parameter *K*: Probability that a buyer will purchase is *expected utility/K*
- Fit cost parameter *t = 1*
- Disclosure cost *c*

Decision Variables

- Firm position
- Product price *p*
- Disclosure investment, either 0 or *c*

Mechanics

- Utility = *v-p-t·δd*
- Seller observes *s* imperfectly
- Buyers observe firm position imperfectly



Additional Assumptions

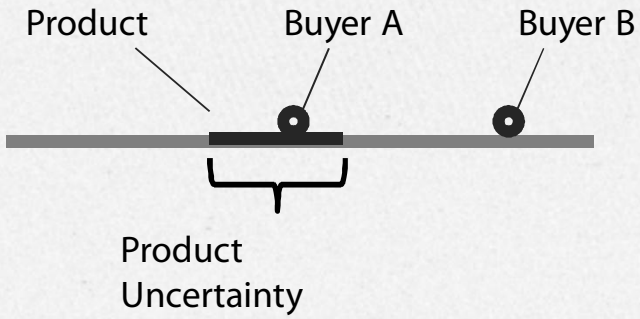
- Homogenous segment buys according to demand function: *(expected utility) / K*
- Heterogeneous segment buys if expected utility is positive

Timing

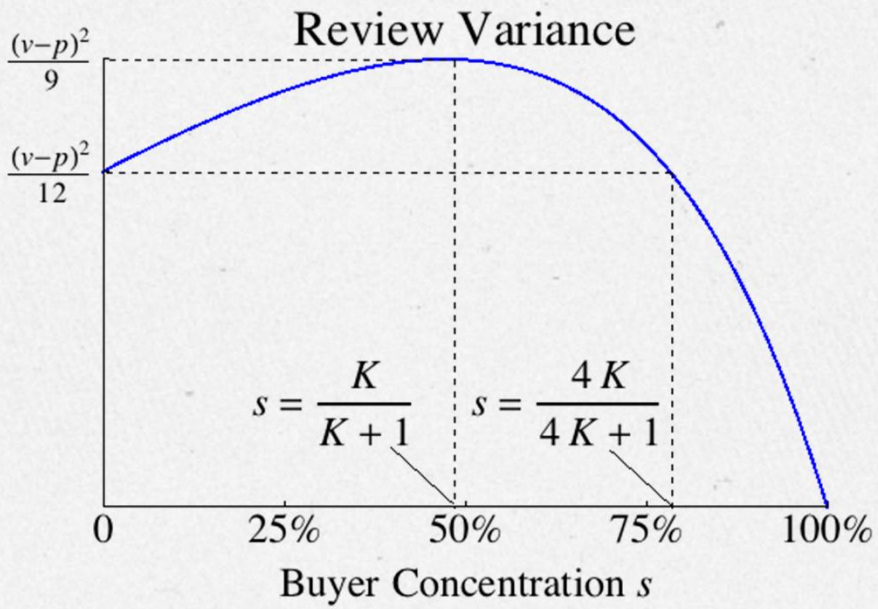
- Firm chooses location & price
- Firm receives signal *s'* for
- Firm decides on disclosure
- Buyers enter market and those who buy, publish rating

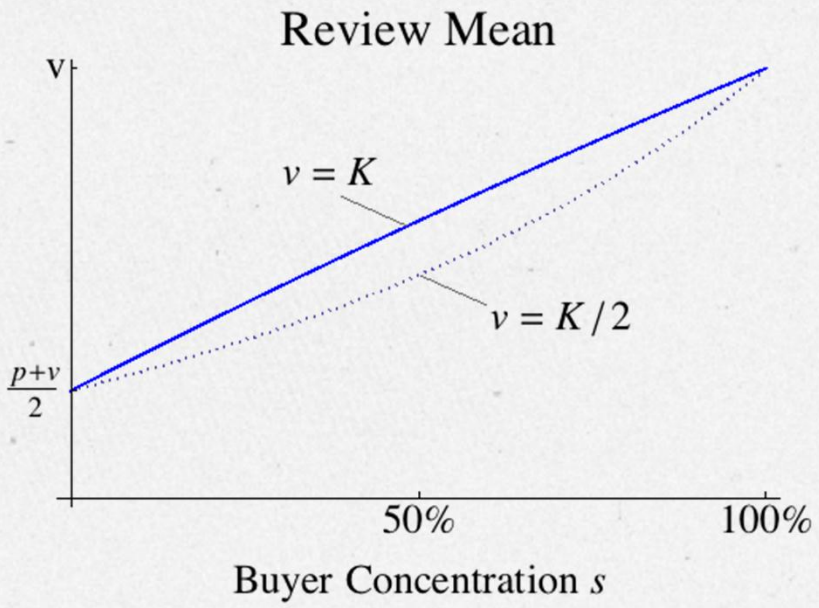
Main finding is that disclosure incentive is higher when preferences are more concentrated

	Prelim	Main
Result	▪ Firm locates where consumers are concentrated	▪ Disclosure incentive increases with the signal s' about the true size of s
Intuition	▪ Allows firm to raise price, as it minimizes expected fit costs	▪ Reducing uncertainty for Buyer B does not make the product more attractive ▪ Reducing uncertainty for Buyer A, does



We can use the buyers' reviews to generate testable hypotheses





Hypothesis A

- Across a wide range of review means, disclosure is negatively correlated with review variance

Hypothesis B

- Disclosure is positively correlated with review variance when review mean (buyer concentration) is low

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An excellent market to test our hypotheses is the PC-game market

PC-Games

- Market of a single-purchase product that buyers care about
- Investments in reducing consumer uncertainty, easily observable (playable demo version)
- Includes information about the structure of the product space

Methodology

- Initial data on 2196 games from gamespot.com, 1997-2005
- Collected demo info, mean and variance of reviews on different gaming web-sites
- Also collected professional reviewers' score on graphics, sound, gameplay, and longevity

n=1438

			review mean		review variance		avg Euclidean distance	
genre	# games	% demos	mean	std. dev.	mean	std. dev.	mean	std. dev.
Action	351	68%	7.05	1.40	1.61	1.49	4.43	1.07
Adventure	157	43%	6.94	1.21	2.16	1.68	4.14	0.88
Driving	129	67%	7.13	1.37	1.70	1.46	4.11	1.27
Puzzle	49	41%	6.99	1.27	2.20	1.93	4.11	1.35
Role-Playing	82	51%	7.52	1.28	1.29	1.16	4.11	1.25
Simulation	107	61%	7.48	1.13	1.38	1.24	3.68	0.86
Sports	126	61%	7.47	1.29	1.42	1.21	4.47	1.16
Strategy	437	65%	7.32	1.15	1.45	1.24	4.04	1.01

Model confirms the overall negative relationship between variance and disclosure

… i.e., that firms should disclose taste-related information when their product targets a "sweet spot"

$$Probit\left[Demo_{ij}\right] = \boldsymbol{\beta}^{T}\mathrm{x}_{ij} + \varepsilon_{ij}$$

	(1)	(2)	(3)	(4)	
Mean^2	0.017***	0.011***	-0.017		
	(0.002)	(0.002)	(0.013)		
Variance		-0.043***	-0.620***	0.084	
		(0.016)	(0.198)	(0.057)	
Mean				0.171***	
				(0.028)	
Mean × Variance				-0.019**	
				(0.008)	
Year control	Yes	Yes	Yes	Yes	No
Genre control	Yes	Yes	Yes	Yes	Yes
Instrument			Yes		
Wald for exogeneity	N/A	N/A	**	N/A	
Pseudo-R*	0.046	0.051		0.053	

* relative log likelihood improvement from the model that includes only genre intercepts

**p<0.05; ***p<0.01

- Hypothesis A supported
- Hypothesis B not supported (just)
- Instrument points to "*concentration* ➔ *demo*" causality

Contents

- Introduction
- Simple model: when to disclose taste-related information?
- Evidence from the PC-Game market
- **Extended model: How to use consumer reviews?**

We learned that review variance can be used to gauge the concentration of buyer preferences

How can we turn this into practical and actionable advice ?

Problem Statement

- *Can firms use review variance to decide if they must invest in reducing buyer uncertainty?*
- If so, what is more important, the mean or the variance of the reviews?

Main finding & contribution

- Review variance can inform disclosure investments
- Review variance is more important than review mean for taste-related product attributes
- Review variance plays the same role for taste-related attributes, as review mean plays for quality-related attributes

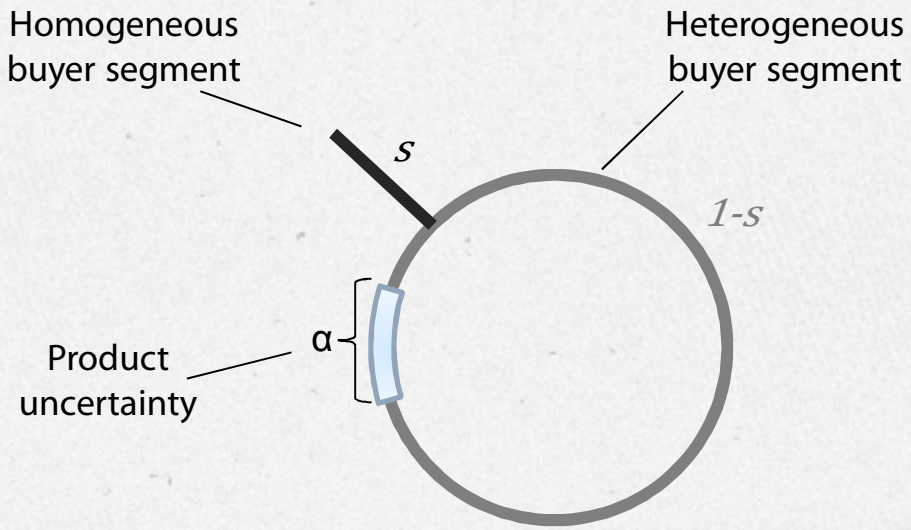
In the two period model, both buyers and sellers can use review information for their

More uncertainty

- The firm and the buyers are also initially uncertain about perceived quality v
- …this allows us to show that the mean of reviews primarily provides quality information

Two-period set-up

- We allow the firm to observe initial reviews before informing the rest of the buyers
- Buyers can also use initial reviews to decide if they should buy the product



Period 1

- Available information
  - s is uniform in $[s_1, s_2]$
  - v is uniform in $[v_1, v_2]$
  - product uncertainty interval
- Player moves
  1. The Firm chooses location and price and enters the market
  2. A fraction $r<<1$ of buyers enter the market and those who buy the product publish a rating

Period 2

- Available information
  - the mean and variance of reviews from Period 1
  - players' updated beliefs on v, s
- Player moves
  1. The firm decides whether to disclose its exact location
  2. The remaining r-1% of buyers enter the market and make their purchasing decisions

The reviews incorporate critical information about the product and the market

β is expected quality in Period 1

$$mean = \frac{K(1-s)(p+2v-\beta)+s\cdot v}{2K(1-s)+s}$$

The *mean* of reviews contains information *both* about quality (*v*) and buyer concentration (*s*)

$$var = \frac{K(K(1-s)+2s)(1-s)(p-\beta)^2}{3(2K(1-s)+s)^2}$$

The *variance* of reviews contains information *only* about buyer concentration (*s*)

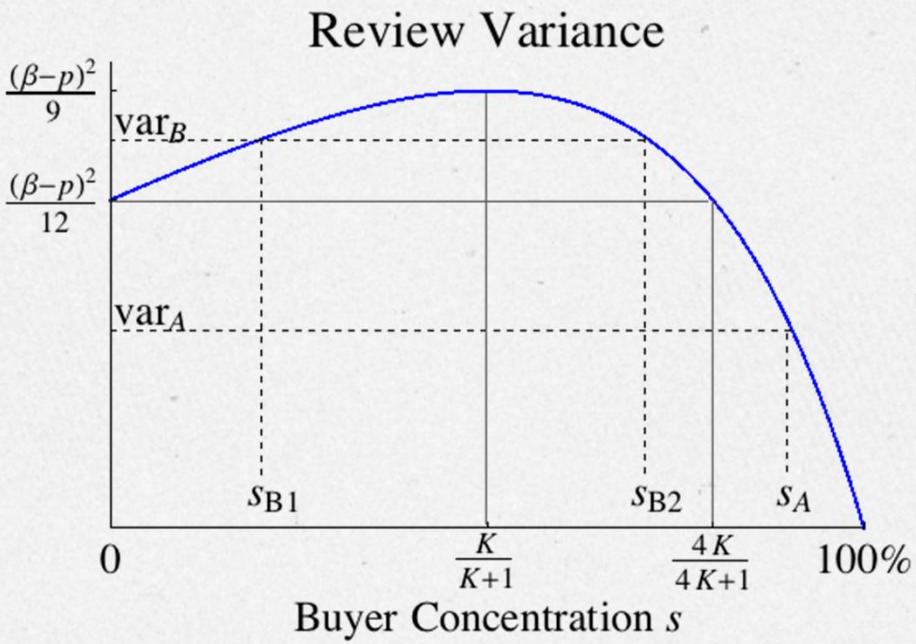
based on the above we can show:

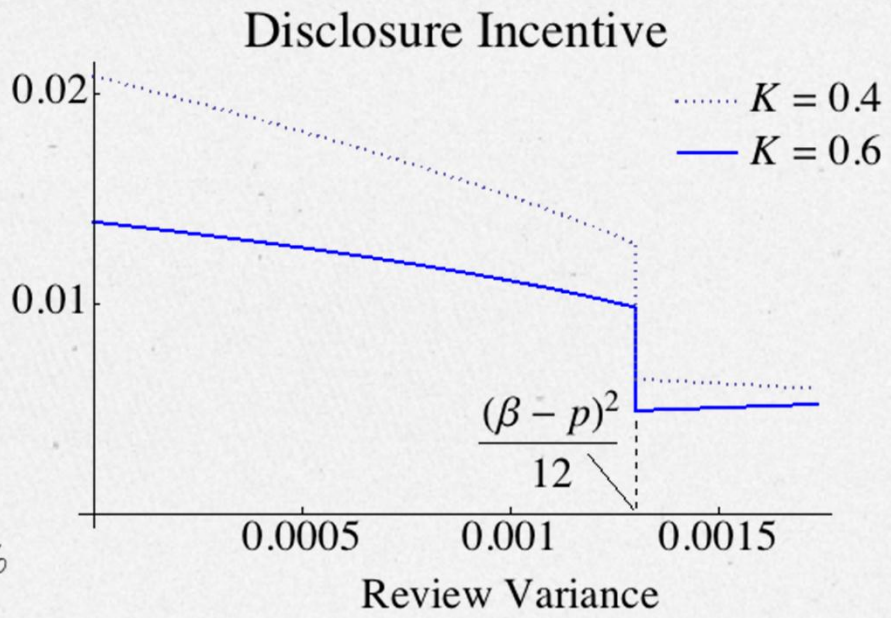
- Buyers care for both the mean and the variance of reviews, because they wish to determine product quality, prior to purchase
- Sellers care only about the variance of reviews, because they only need to know buyer concentration to decide whether or not to disclose their product location
- Sellers disclose as long as their cost is: $c < \frac{2p\cdot\sigma\cdot\alpha}{3K}$

σ is the expected value of *s*

Variance is to taste-related attributes, what the mean is to quality attributes

… an indicator of how useful informing buyers would be





- *Let the incentive for the firm to disclose be measured by the disclosure investment cost that the firm is willing to incur*
  - *The incentive for the firm to disclose taste-related information is independent of the mean of buyer reviews*
  - *If review variance is less than $(\beta\text{-}p)^2/12$, the incentive for the firm to disclose increases as review variance decreases*
  - *If review variance exceeds $(\beta\text{-}p)^2/12$, the incentive for the firm to disclose falls discontinuously and can increase or decrease as review variance decreases*

There are potential limitation in using the variance of reviews

Limitations	Explanation
Cannot neglect review mean	▪ disclosures may also reveal quality info. A very low mean warns us that disclosure may reveal product's shortcomings
"Too much" variance is uninformative	▪ a relatively high review variance, may not necessarily mean that buyer preferences are heterogeneous and may discourage investment when an investment is needed
Variance is sensitive to other factors	▪ in practice variance is only an imperfect measure of the concentration of buyer preferences

Recommendation

- Variance is a useful indicator when it is low and combined with a high review mean
- Firms should also study corroborating evidence about the good product fit with concentrated buyer preferences

thank you