A Model of Product Design & Information Disclosure Investments

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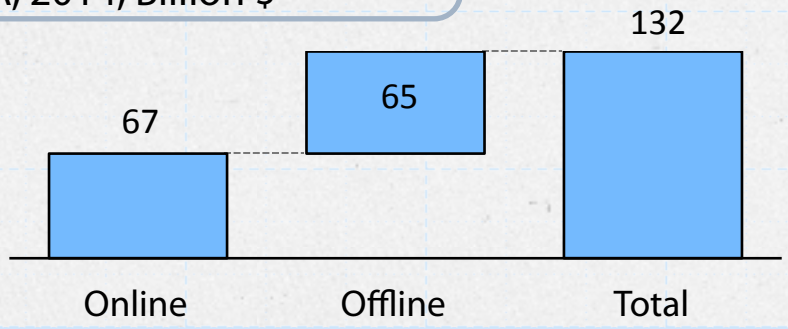
ICIS-2013 : December 2013, Milan, Italy

CURRENT ECOMMERCE TRENDS

Trends:	Examples & Evidence
⌘ New ways to invest to reduce consumer uncertainty about product characteristics	 Warby Parker offers virtual try-ons of prescription eyeglasses
	 IKEA uses augmented reality technology to let prospective customers see how the company's products fit in a room
⌘ Increasing importance of infomediaries as an independent source of product information	Pinterest Social commerce site became top 50 web destination while in beta
	cnet Expert reviews site is top 90 destination
	Digital Photography Review dpreview.com Top 1000 destination by including only camera reviews
⌘ Increasing importance of reducing consumer uncertainty about one's product	Sales involving active online buyer search for product info USA, 2014, Billion $



Source: "The impact of Internet technologies: Search", McKinsey Report, July 2011
Projection assumes 16% ecommerce CAGR

OUR RESEARCH QUESTION

Problem Statement

- *How does product quality influence investments that reduce consumer uncertainty, and vice versa?*
- *How to account for third party information availability when investing to reduce consumer uncertainty?*

Example

Printer Manufacturer:

The firm released one high-end and one budget model. It invests heavily to educate buyers on print longevity & color fidelity and explain the printers' performance on those dimensions

- What are optimal information investment levels for the two models?
- A prominent infomediary released a thorough (and fair) expert review. Should the firm adjust investment for the 2 models and how?
- How should the firm account for future information investments when designing new a printer?

KEY MESSAGE & CONTRIBUTION

Key Message

- "*Firms should view* ***product design*** *and* ***investments in reducing consumer uncertainty*** *as* ***an integrated process****…"*
- "*… that is in turn* ***heavily influenced by the operation of 3rd party infomediaries***"

Contribution

- Product quality decisions influence future disclosure costs
- Firms should take this dependence into account to avoid over-investing in quality
- Firms (especially lower quality) can free ride on infomediaries' investments and reduce their own disclosure costs

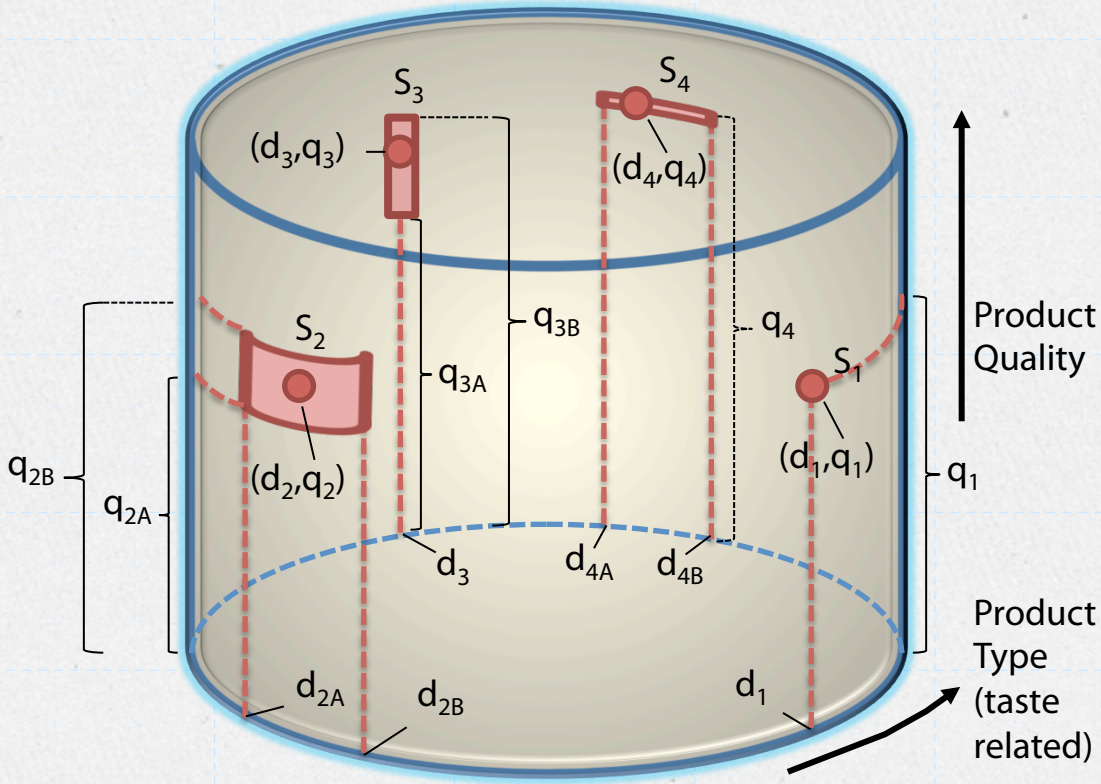
MODEL DEFINITION 1/2

Model Parameters

- N sellers
- Product value v
- Fit cost parameter t
- Quality preference θ
- Quality production cost $kq_i^2/2$
- Quality uncertainty $[q_{iA},q_{iB}]$, $a_q=q_{iB}-q_{iA}$
- Type uncertainty $[d_{iA},d_{iB}]$, $a_d=d_{iB}-d_{iA}$
- Quality disclosure investment cost c_q
- Type disclosure investment cost c_d

Decision Variables

- Types (taste-related): d_i
- Qualities: q_i
- Type (taste) disclosure investment: Id_i
- Quality disclosure investment: Iq_i
- Prices: p_i



Buyer behavior

- Uniformly distributed preferences
- Utility = $v+\theta\cdot q-t\cdot\delta d$

Additional Assumptions

- Infomediaries provide info so that a seller's true location is equiprobable inside the uncertainty interval
- There is always enough type information by infomediaries, so that sellers' type uncertainty intervals do not overlap

Connection to classic literature

- Model reduces to Economides (1993) for $a_q=a_d=0$

MODEL DEFINITION 2/2

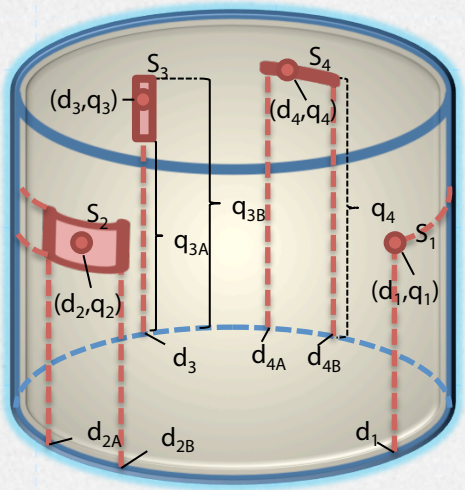
Firms' objective function (Profit)

Demand | Expected value of type | Expected value of quality

$$D_i = \frac{E(\overline{d_{i+1}}) - E(\overline{d_{i-1}})}{2} + \frac{p_{i+1} + p_{i-1} - 2p_i}{2t} + \frac{\theta(2E(\overline{q_i}) - E(\overline{q_{i+1}}) - E(\overline{q_{i-1}}))}{2t}$$

$$\Pi_i(\mathbf{p}, \mathbf{q}, \mathbf{d}) = p_i \cdot D_i(\mathbf{p}, \mathbf{q}, \mathbf{d}) - C(q_i) - Iq_i - Id_i, \qquad d\Pi_i/dp_i = 0$$

$$\Pi_i^*(p_i^*, \mathbf{q}, \mathbf{d}) = {p_i^*}^2/t - C(q_i) - Iq_i - Id_i$$



Game stages & timing

Stages 1&2: All sellers choose their types and qualities

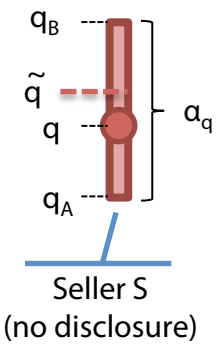
Sellers learn how their own products are perceived by early users in pre-market trials. They thus learn the uncertainty intervals (chosen by nature) that will be associated with their products if they do not invest in information disclosure

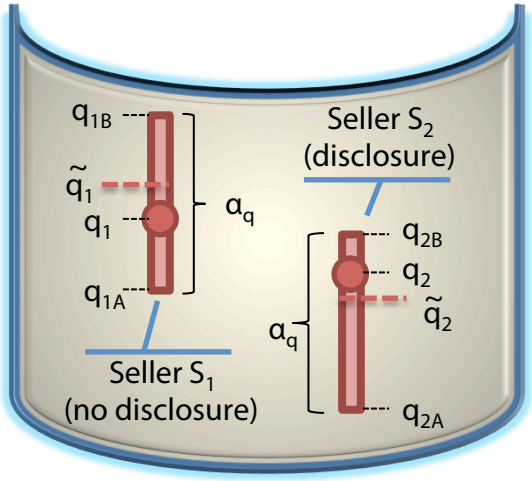
Stage 3: All seller decide on whether to invest in disclosing

All sellers and buyers learn the information of sellers who invested in disclosure and learn from infomediaries the uncertainty intervals of sellers who have not invested in disclosure.

Stage 4: All sellers choose their price

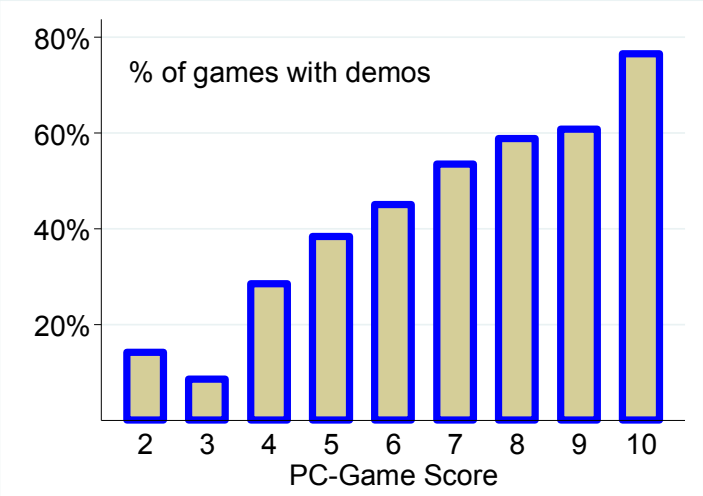
PRELIM RESULT: PROBABILITY OF A QUALITY DISCLOSURE INVESTMENT INCREASES WITH QUALITY





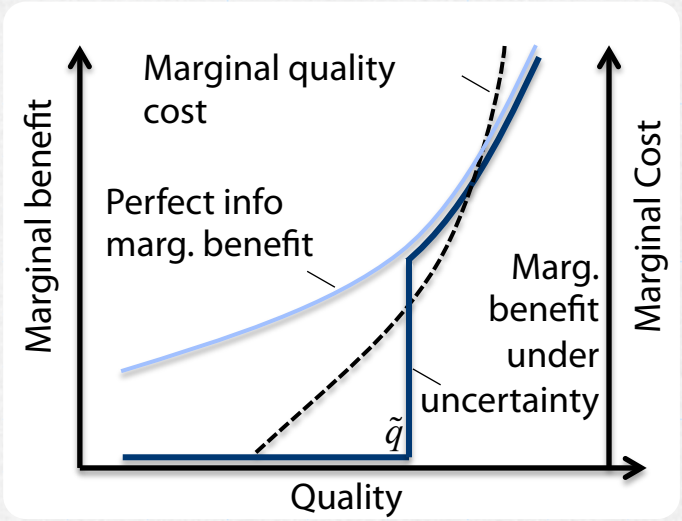
	Classic Literature	Current Model
⌘ **Mechanism**	The *unraveling* result states that there exists a threshold $\tilde{q}$ such that sellers disclose *iff* their quality exceeds $\tilde{q}$	A seller discloses *iff* his quality exceeds a quality threshold $\tilde{q}_i$ inside his uncertainty interval. This threshold decreases with higher quality
⌘ **Impact of quality to quality disclosure investments**	A quality increase does not increase the probability of disclosure	A quality increase increases the probability of disclosure

DISCLOSURE RATES THAT INCREASE SMOOTHLY WITH QUALITY ARE MORE CONSISTENT WITH REAL WORLD MARKETS

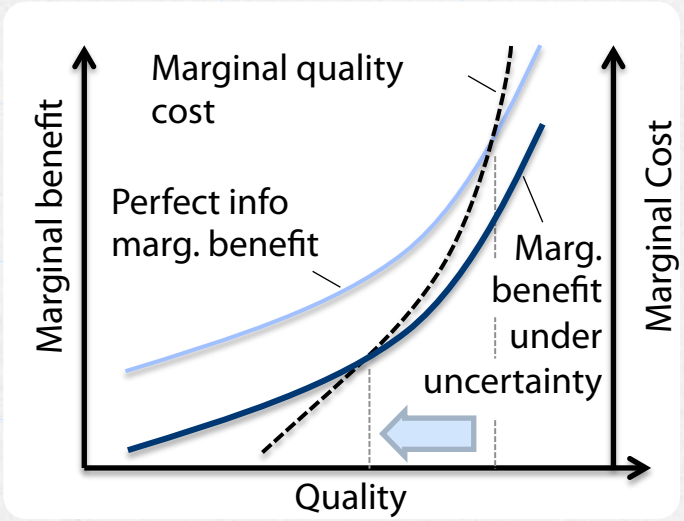


- Data on 1848 PC-Games released between 1993-2003, collected from Gamespot.com
- % of games that released a demo version, against the score that the game received from professional reviewers employed by Gamespot
- Similar results when corrected for game genre and year

FIRMS SHOULD MODERATE QUALITY INVESTMENTS UNDER UNCERTAINTY



Classic Quality Unraveling



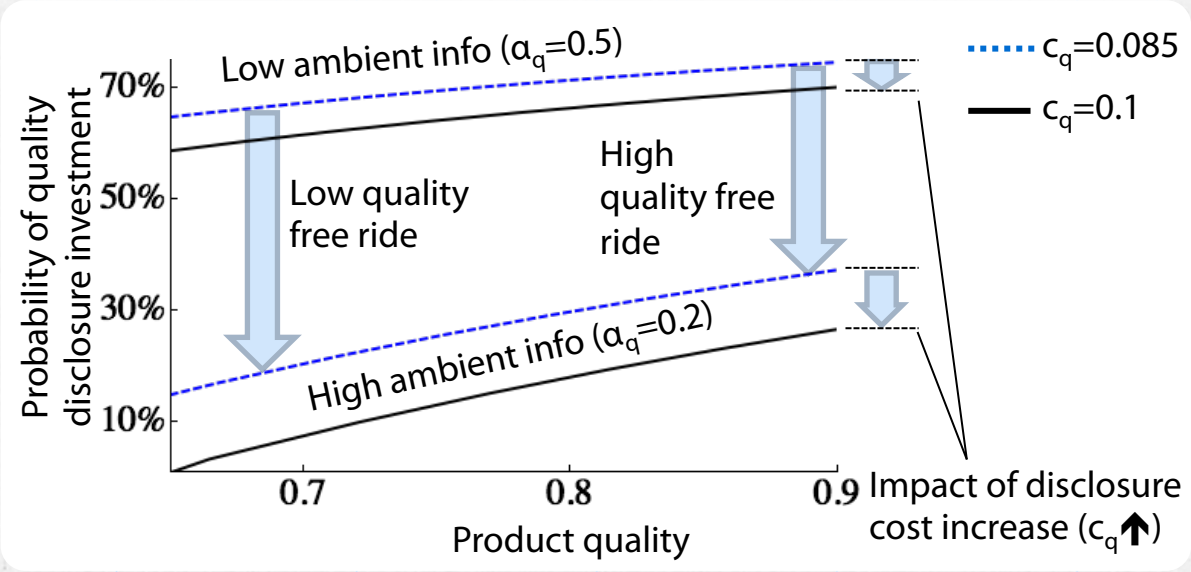
Current Model

- **Impact of uncertainty to optimal product quality**

- The mechanism implies that firms who face imperfectly informed consumers, should **either produce at the lowest possible quality, or they should ignore the impact of buyer uncertainty**, depending on quality production cost

- All firms should **account for uncertainty** when they estimate the **ROI of an investment in quality** improvement
- Doing so, will lead firms to **moderate investments in product quality** (as shown by the arrow)

INFOMEDIARIES ENABLE FIRMS TO FREE RIDE AND ESPECIALLY AT LOWER QUALITY LEVELS



Intuition

- **A quality increase reduces** the firm's **disclosure threshold** (inside the uncertainty interval)
- When the **uncertainty interval is relatively small, even a small decrease in the position of the disclosure threshold can significantly affect the probability** that a firm's quality will be below (or above) the threshold.
- Thus, the **probability of a disclosure investment becomes more sensitive on quality when α_q is low** (bottom pair of lines in the graph is steeper)
- Thus, the two sets of **lines of the graph converge: low quality firms adjust their disclosure probability more prominently** than higher quality firms

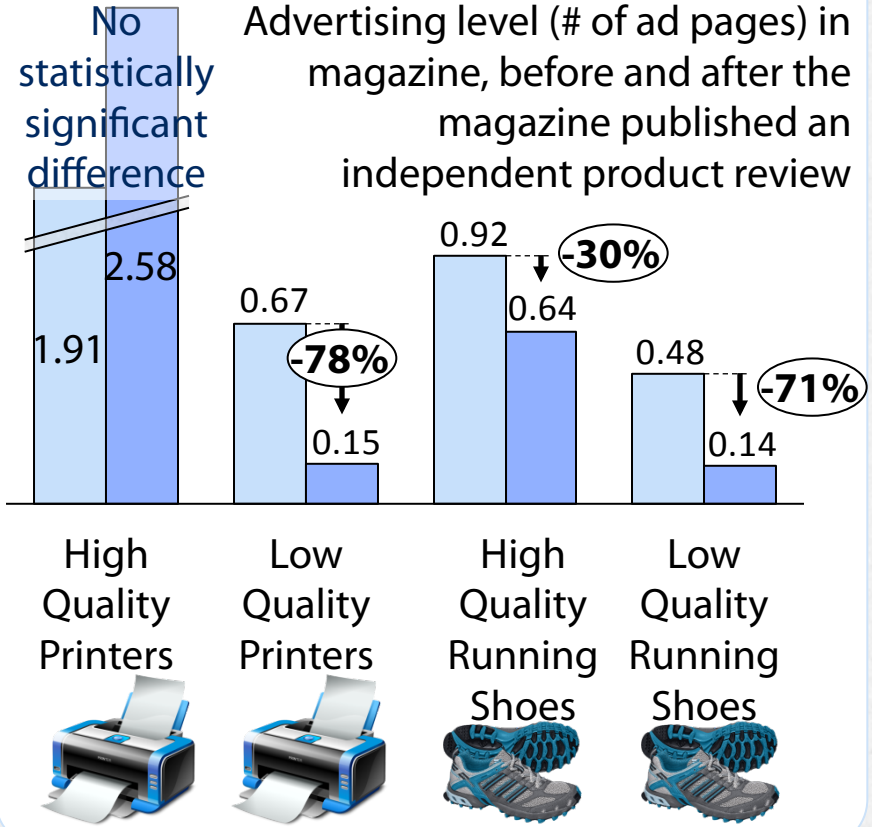
AN EXAMPLE OF LOWER QUALITY PRODUCTS FREE RIDING MORE THAN THEIR HIGH QUALITY COMPETITORS

Quality Information by Third Parties

- Chen & Xie (2005) looked at how firms adjust their advertising spend as a response to an independent product review published in a magazine

- 2 review formats:
  - **(Shown in graph):** A recommendation format that, in the end, either results on a recommendation or not. This is considered akin to quality disclosure
  - **(Not Shown in graph):** General description format, avoiding clear pronouncements on quality, considered akin to taste disclosure

Impact to Firms Own Info Investments



Source: Chen & Xie (2005) "3rd-Party Product Review & Firm Marketing Strategy" Marketing Science 24(2), pp.218-240

THE FULL MODEL

- The expected (ex-ante) **probability of quality disclosure increases smoothly with equilibrium quality**
- This is a refinement of the quality unraveling argument that argues that disclosures will only occur beyond a fixed quality level

- **Infomediaries enable firms to free ride** on the info that they provide and firms find that they can reduce their own disclosure investments. Free riding is **more attractive at lower product quality levels**