Consumer Reviews and Dynamic Price Signaling

Stepan Aleksenko
UCLA

Jacob Kohlhepp
UNC Chapel Hill

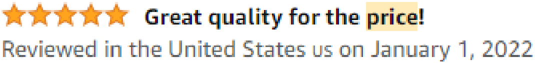
1/22/2024

Question

Great quality for the price!

Reviewed in the United States us on January 1, 2022

Question



Research Question: How do reputational incentives affect prices?

Motivation

(1) Lower prices ! better reviews

"...price increase of 1% leads to a decrease of 3%–5% in the average rating." Luca and Reshef (2021)

Motivation

(1) Lower prices ! better reviews

"...price increase of 1% leads to a decrease of 3%–5% in the average rating." Luca and Reshef (2021)

(2) Better reviews ! higher demand & revenue

"...a one-star increase in Yelp rating leads to a 5-9 % increase in revenue." Luca (2011)

Motivation

(1) Lower prices ! better reviews

"...price increase of 1% leads to a decrease of 3%–5% in the average rating." Luca and Reshef (2021)

(2) Better reviews ! higher demand & revenue

"...a one-star increase in Yelp rating leads to a 5-9 % increase in revenue." Luca (2011)

Firm's tradeo□

- Lowering price improves reputation and increases future profits
- Lowering price decreases current profit

Motivation

(1) Lower prices $\rightarrow$ better reviews

"...price increase of 1% leads to a decrease of 3%–5% in the average rating." Luca and Reshef (2021)

(2) Better reviews $\rightarrow$ higher demand & revenue

"...a one-star increase in Yelp rating leads to a 5-9 % increase in revenue." Luca (2011)

Firm's tradeoff

- Lowering price improves reputation and increases future profits
- Lowering price decreases current profit

When do firms underprice their product below the myopic optimum?

Model Overview

Single long-lived firm

- Firm strategically prices its product
- Exogenous product quality privately observed by the firm

Model Overview

Single long-lived firm

- Firm strategically prices its product
- Exogenous product quality privately observed by the firm

Multiple short-lived consumers

- Rational consumers observe past reviews and the current price
  - Past prices are unobserved
- Reviews depend on the utility of consumption of experience good:
  - Price
  - Product quality (vertical differentiation)
  - IID taste shock (horizontal differentiation)

Results Preview

Main results

(1) Underpricing occurs iff ratio of $\underbrace{\textit{marginal}}_{\text{review if underpriced}}$ to $\underbrace{\textit{inframarginal}}_{\text{review w/o underpricing}}$ reviewers is high.

Does not occur if consumer's tastes are too diverse (uniform case)

Occurs if vertical quality differentiation > horizontal taste differentiation

Results Preview

Main results

(1) Underpricing occurs iff ratio of $\underbrace{\textit{marginal}}_{\text{review if underpriced}}$ to $\underbrace{\textit{inframarginal}}_{\text{review w/o underpricing}}$ reviewers is high.

Does not occur if consumer's tastes are too diverse (uniform case)

Occurs if vertical quality differentiation > horizontal taste differentiation

(2) Underpricing can only happen at low current "reputation".

The high-quality firm prices lower than the low-quality firm.

Results Preview

Main results

(1) Underpricing occurs iff ratio of $\underbrace{\textit{marginal}}_{\text{review if underpriced}}$ to $\underbrace{\textit{inframarginal}}_{\text{review w/o underpricing}}$ reviewers is high.

Does not occur if consumer's tastes are too diverse (uniform case)

Occurs if vertical quality differentiation > horizontal taste differentiation

(2) Underpricing can only happen at low current "reputation".

The high-quality firm prices lower than the low-quality firm.

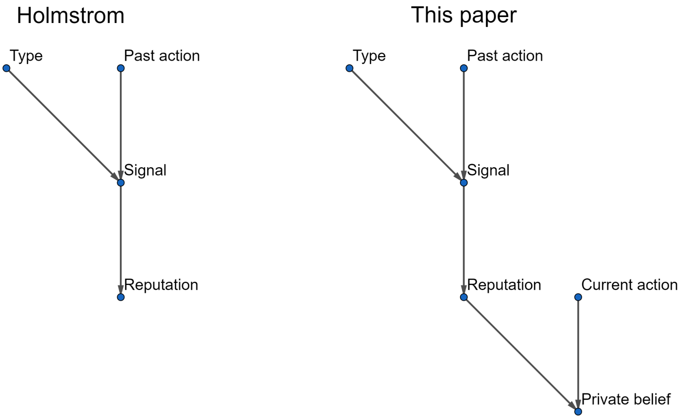
(3) Underpricing increases consumer surplus and speeds up learning.

Rational consumers are not mislead by UP & they pay less.

Literature

- Consumer Reviews Depending on Prices
  - Static models: Feng, Li, and Zhang (2019); Martin and Shelegia (2021); Huang, Li, and Zuo (2022);
  - Boundedly-rational consumers: He and Chen (2018); Carnehl, Stenzel, and Schmidt (2021);
- Reputation
  - Reputation for quality: Holmström (1999); Mailath and Samuelson (2001); Board and Meyer-ter-Vehn (2013);
  - Dynamic signaling: Fudenberg and Levine (1989); Pei (2020); Ekmekci et al. (2022);
- Signaling by Choosing Info Structure
  - Degan et al. (2021); Rodríguez Barraquer and Tan (2022);

Literature



Reputation model with strategic pricing:

1. Prices affect reviews *(signal jamming)*
2. Price signals quality today *(repeated static signaling)*

Table of Contents

Model

Firm

- Long-lived Firm sells a single product
  - Chooses $p_t \in [0,1]$ over $t \in \mathbb{R}_+$
- Product quality is exogenous: $\in \{L, H\};\ 0 < L < H = 1$
  - $= H$, w/p q_0
  - In the paper, $_t$ is redrawn at rate 0

Model

Firm

- Long-lived Firm sells a single product
  - Chooses $p_t \in [0,1]$ over $t \in \mathbb{R}_+$
- Product quality is exogenous: $\in \{L, H\};\ 0 < L < H = 1$
  - $= H$, w/p q_0
  - In the paper, $_t$ is redrawn at rate 0

Consumers

- Short-lived Consumers arrive at rate
  - Unit demand
- Utility of consumption

$$u_t = \quad p_t + \varepsilon_t$$

  - ε_t is IID ex-post taste shock, w/ $f_\varepsilon(x) = f_\varepsilon(\ x)$
  - Outside option is 0

Model

Reviews: Perfect Good News

- A consumer leaves a review iff $= H$ AND $u_t > u$ $(u \quad 1)$

  $_g(p_t) := \quad \Pr(H \quad p_t + "_t > u)$

Model

Reviews: Perfect Good News

- A consumer leaves a review iff = H AND $u_t > u$ (u 1)

  $_g(p_t) :=$ $\Pr(H$ $p_t + "_t > u)$

Information

- h^t = $ht; f$ $_1; :::;$ $_n gi$ is a public history of past reviews
- Firm observes and h^t

  $p_t = p(;h^t)$

- Consumer observes p_t and h^t

  Expectations about firm's quality $\tilde{}(p_t; h^t) \; 2 \; [L; H]$ (buy iff $\tilde{}$ p_t 0)

Model

Reviews: Perfect Good News

- A consumer leaves a review iff $= H$ AND $u_t > u$ $(u \quad 1)$

  $_g(p_t) :=$ $\Pr(H \quad p_t + "_t > u)$

Information

- $h^t \quad = ht; f \ _1; :::; \ _n gi$ is a public history of past reviews
- Firm observes and h^t

  $p_t = p(\ ; h^t \ )$
- Consumer observes p_t and h^t

  Expectations about firm's quality $\tilde{}(p_t; h^t \ ) \ 2 \ [L; H]$ (buy iff $\tilde{} \quad p_t \quad 0$)

Firm's Problem

- Production is costless and payoffs are discounted at rate r

$$\max_{p_t} \mathrm{E} \left" \int_0^1 e^{\ rt} \mathbf{1}_{f\tilde{}(p_t;h^t \ ) \ p_t g} p_t \ dt \right\#$$

Table of Contents

Markov Perfect Bayesian Equilibrium

Markov State and Beliefs

Firm's Reputation is the public belief that the quality is high:

$$q(h^t) := (\tilde{\ }(h^t) - L)/(H - L) \in [0,1]$$

Markov Perfect Bayesian Equilibrium

Markov State and Beliefs

Firm's Reputation is the public belief that the quality is high:

$$q(h^t) := (\tilde{\ }(h^t) - L)/(H - L) \in [0, 1]$$

Strategies, beliefs, and values depend on history only via $q(h^t)$

- *Firm's prices* $p(\cdot\,; q)$
- *Consumers' beliefs about prices* $\tilde{p}(\cdot\,; q)$
- *Consumers' expectations about firm's quality* $\tilde{\ }(p; q) \in [L; H]$
- *Firm's value function* $V(\cdot\,; q) \in \mathbb{R}_+$

Markov Perfect Bayesian Equilibrium

Equilibrium

MPBE is $\{p(\cdot;q),\ V(\cdot;q),\ \bar{p}(\cdot;q),\ \tilde{\ }(p;q)\}$, s.t.

(1) $V(\cdot;q)$ and $p(q)$ solve HJB (Static, Reputation)

$$rV(H;q) = \max_{p\in P_q} \left[p + {}_g(p)\,[V(H;1) \quad V(H;q)] + V_q(H;q)\,\frac{dq}{dt} \right]$$

$$rV(L;q) = \max_{p\in P_q} \left[p + V_q(L;q)\,\frac{dq}{dt} \right]$$

$\frac{dq}{dt} = \quad {}_g(\bar{p}(H;q)) \quad q(1 \quad q)$ (w/o good news)

$P_q := \{p \in [0,1] \mid \tilde{\ }(p;q) \quad p\}$ (*Acceptable Prices*)

Markov Perfect Bayesian Equilibrium

Equilibrium

MPBE is $\{p(\cdot;q),\ V(\cdot;q),\ \tilde{p}(\cdot;q),\ \tilde{\sigma}(p;q)\}$, s.t.

(1) $V(\cdot;q)$ and $p^*(q)$ solve HJB (Static, Reputation)

$$rV(H;q) = \max_{p \in P_q} \left[p + \lambda_g(p)\,[V(H;1) - V(H;q)] \right] + V_q(H;q)\,\frac{dq}{dt}$$

$$rV(L;q) = \max_{p \in P_q} \left[p \right] + V_q(L;q)\,\frac{dq}{dt}$$

$\frac{dq}{dt} = -\lambda_g(\tilde{p}(H;q))\,q(1-q)$ (w/o good news)

$P_q := \{p \in [0,1] \mid \tilde{\sigma}(p;q) \geq p\}$ (*Acceptable Prices*)

(2) Beliefs about prices are correct

$\tilde{p}(\cdot;q) = p(\cdot;q)$

Markov Perfect Bayesian Equilibrium

Equilibrium

MPBE is $\{p(\;;q);\; V(\;;q);\; \tilde{p}(\;;q);\; \tilde{\ }(p;q)\}$, s.t.

(1) $V(\;;q)$ and $p\ (q)$ solve HJB (Static, Reputation)

$$rV(H;q) = \max_{p \in P_q} \quad p + \quad {}_g(p) \quad [V(H;1) \quad V(H;q)] \quad + \backslash V_q(H;q) \quad \frac{dq}{dt}"$$

$$rV(L;q) = \max_{p \in P_q} \quad p \quad + \backslash V_q(L;q) \quad \frac{dq}{dt}"$$

$\frac{dq}{dt} = \quad {}_g(\tilde{p}(H;q)) \quad q(1 \quad q)$ (w/o good news)

$P_q := \{p \in [0;1] \,|\, \tilde{\ }(p;q) \quad p\}$ (*Acceptable Prices*)

(2) Beliefs about prices are correct

$\tilde{p}(\;;q) = p(\;;q)$

(3) Consumer expectations are Bayesian on path

$\tilde{\ }(p\ (q);q) = \mathrm{E}[\ |p\ (q);q]$

Continuity Refinement

Continuity Refinement

Belief function $\tilde{\mu}(p; q)$ is continuous in p.

Equilibrium is an MPBE that satisfies *continuity refinement*.

Table of Contents

No Underpricing & Underpricing

Equilibrium dichotomy:

(1) No UnderPricing (NUP) is pricing at the consumers' willingness to pay:

$$\tilde{\ }(q) := qH + (1 \quad q)L$$

(2) UnderPricing (UP) is pricing below the consumers' willingness to pay.

Remark: there is NUP in the myopic benchmark; $\tilde{\ }(q)$ is the standard price in reputation models.

Main Result

Theorem 1

An equilibrium exists.

1. If $h_{"} < \frac{1}{1 \quad L}$, then no underpricing is the unique equilibrium ($8q\ p(\quad; q) = \tilde{\ }(q)$).

2. If $h_{"} > \frac{1}{1 \quad L}$, then $9\ 0 < q \quad < q \qquad 1$, s.t. in every equilibrium

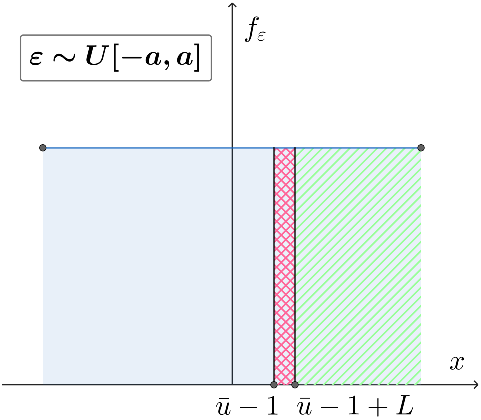
   (a) there is underpricing $8q \quad q \ : p(H; q) = 0;\ p(L; q) = L$

   (b) there is no underpricing $8q \quad q \quad$.

Adjusted hazard rate (of taste shock distribution) is

$$h_{"} := \frac{(F_{"}(u \quad 1 + L) \quad F_{"}(u \quad 1))=L}{1 \quad F_{"}(u \quad 1 + L) + r=}$$

Adjusted Hazard Rate



(a) Low adjusted hazard rate

(b) High adjusted hazard rate

Inframarginal reviewers (NUP: $p = L$) v.s. Marginal reviewers (from UP ! $p = 0$) at $q = 0$

Table of Contents

No-Underpricing Example: Uniform Case

Assumption

" U[a; a], for a maxf u; 1 ug

$$_g(p) = \quad \Pr(1 \quad p + " \quad u) = \quad \frac{\quad}{2a} \; p + \frac{(1 + a \quad u)}{2a}$$

No-Underpricing Example: Uniform Case

Assumption

$\varepsilon \sim U[-a, a]$, for $a \leq \max\{\mu, 1-\mu\}$

$$\rho_g(p) = \Pr(1 - p + \varepsilon \geq \mu) = -\frac{1}{2a} p + \frac{(1 + a - \mu)}{2a}$$

- Pricing incentives for H

$$\frac{\partial}{\partial p}\left[p + \rho_g(p)[V(H;1) - V(H;q)] \right] = \underbrace{1}_{\text{static incentives}} \underbrace{- \frac{1}{2a}[V(H;1) - V(H;q)]}_{\text{reputational incentives}}$$

No-Underpricing Example: Uniform Case

Assumption

$\varepsilon \sim U[-a, a]$, for $a \leq \max\{\mu, 1-\mu\}$

$$\Gamma_g(p) = \Pr(1 - p + \varepsilon \geq \mu) = -\frac{1}{2a} p + \frac{(1 + a - \mu)}{2a}$$

- Pricing incentives for H

$$\frac{\partial}{\partial p}\left[p + \Gamma_g(p)[V(H;1) - V(H;q)] \right] = \underbrace{1}_{\text{static incentives}} - \underbrace{\frac{1}{2a}[V(H;1) - V(H;q)]}_{\text{reputational incentives}}$$

- Optimal pricing

$$p_H(q) = 1_{\{1 - \frac{1}{2a}[V(H;1) - V(H;q)] > 0\}} \max P_q$$

$$p_L(q) = \max P_q$$

Uniform Case: Optimal Pricing

Lemma

The high-quality firm always prefers choosing the highest acceptable price, $\max P_q$.

Corollary: every equilibrium is pooling, $\forall q \; p(L;q) = p(H;q) = \max P_q$.

Uniform Case: Optimal Pricing

Lemma

The high-quality firm always prefers choosing the highest acceptable price, $\max P_q$.

Corollary: every equilibrium is pooling, $\forall q \; p(L;q) = p(H;q) = \max P_q$.

Proof intuition (by contradiction)

$$\frac{\partial}{\partial p} = \qquad \frac{}{2a}[V(H;1) \quad V(H;q)]$$

- Want to show: static incentives $>$ reputation incentives $(\forall q)$

Uniform Case: Optimal Pricing

Lemma

The high-quality rm always prefers choosing the highest acceptable price, $\max P_q$.

Corollary: every equilibrium is pooling, $8q$ $p(L;q) = p(H;q) = \max P_q$.

Proof intuition (by contradiction)

$$\frac{@}{@p} = \frac{}{2a}[V(H;1) \quad V(H;q)]$$

- Want to show: static incentives > reputation incentives ($8q$)
- Try to break this result by increasing and $[V(H;1) \quad V(H;q)]$

Uniform Case: Optimal Pricing

Lemma

The high-quality rm always prefers choosing the highest acceptable price, $\max P_q$.

Corollary: every equilibrium is pooling, $\forall q \; p(L;q) = p(H;q) = \max P_q$.

Proof intuition (by contradiction)

$$\frac{\partial}{\partial p} = \qquad \frac{}{2a}[V(H;1) \quad V(H;q)]$$

- Want to show: static incentives > reputation incentives $(\forall q)$
- Try to break this result by increasing and $[V(H;1) \quad V(H;q)]$
- $[V(H;1) \quad V(H;q)]$ is largest when $q = 0$
- W/o underpricing: $V(H;0) = \frac{{}_{g}(L) \; V(H;1) + \; L}{{}_{g}(L) + r}$

$$\Rightarrow \quad V(H;1) \quad V(H;0) \quad \frac{rV(H;1) \qquad L}{{}_{g}(L) + \; r} = \frac{1 \quad L}{1 \quad F_{"}(u \quad 1 + L) + \; r =}$$

Uniform Case: Optimal Pricing

Lemma

The high-quality rm always prefers choosing the highest acceptable price, maxP_q.

Corollary: every equilibrium is pooling, 8q $p(L;q) = p(H;q) = \max P_q$.

Proof intuition (by contradiction)

$$\frac{@}{@p} = \qquad \frac{}{2a}[V(H;1) \quad V(H;q)]$$

- Want to show: static incentives > reputation incentives (8q)
- Try to break this result by increasing and $[V(H;1) \quad V(H;q)]$
- $[V(H;1) \quad V(H;q)]$ is largest when $q = 0$
- W/o underpricing: $V(H;0) = \frac{_g(L)\ V(H;1) + \ L}{_g(L) + r}$

$$) \quad V(H;1) \quad V(H;0) \quad \frac{rV(H;1) \quad L}{_g(L) + r} = \frac{1 \quad L}{1 \quad F_{"}(u \quad 1 + L) + r =}$$

- Good news arrives very soon with or without underpricing at q=0.

Unreasonable Underpricing

Both types underprice: $p(H; q) = p(L; q) < \tilde{}(q)$

Unreasonable Underpricing

Both types underprice: $p(H; q) = p(L; q) < \tilde{}(q)$

Continuity Re nement

Belief function $\tilde{}(p; q)$ is continuous in p.

No-Underpricing Equilibrium

Proposition

If " is distributed uniformly, NUP is the unique equilibrium.

$$8\ q :\ p(\ ;\ q) = \ \tilde{}(q) = \ qH + (1 \quad q)L$$

No-Underpricing Equilibrium

Proposition

If " is distributed uniformly, NUP is the unique equilibrium.

$$8\, q :\ p(\ ;\ q) = \tilde{\ }(q) = qH + (1 \quad q)L$$

Proof by contradiction:

Both types can increase their prices.

Table of Contents

Proof: Part 1

UP Condition

Theorem 1 (restated)

1. $h_{''} < \frac{1}{1 \quad L}$) NUP is the unique equilibrium (8q).
2. $h_{''} > \frac{1}{1 \quad L}$) there is UP in every equilibrium:

   9 0 < q < q 1, s.t.

   (a) UP 8q q : p(H; q) = 0 ; p(L; q) = L

   (b) NUP 8q q .

Adjusted hazard rate (of taste shock distribution) is

$$h_{''} = \frac{(F_{''}(u \quad 1 + L) \quad F_{''}(u \quad 1))=L}{1 \quad F_{''}(u \quad 1 + L) + r=}$$

Pricing Incentives

Lemma

$_{g}(p)$ and H's objective function $(\; p + \; _{g}(p)(V(H;1) \quad V(H;q)))$ are convex and

$$p(H;q) \in \{0, \max P(q)\}$$

Pricing Incentives

Lemma

$_g(p)$ and H's objective function $(\; p + \; _g(p)(V(H;1) \quad V(H;q)))$ are convex and

$$p(H;q) \in \{0, \max P(q)\}$$

Recall: Reviews are sufficiently selective: $u \quad 1$

Motivation: Only 1 out of 1000 consumers leaves a review (Hu, Pavlou, and Zhang 2017). Empirical Evidence

Equilibrium Dichotomy

1. If $h_{''} > \frac{1}{1 \quad L}$, then there is some UP in every equilibrium.
2. If $h_{''} < \frac{1}{1 \quad L}$, then NUP is the unique equilibrium.

Equilibrium Dichotomy

1. If $h_{''} > \frac{1}{1 \quad L}$, then there is some UP in every equilibrium.
2. If $h_{''} < \frac{1}{1 \quad L}$, then NUP is the unique equilibrium.

Sketch of the proof:

- Assume that NUP (8q) is an equilibrium

Equilibrium Dichotomy

1. If $h_{''} > \frac{1}{1 \quad L}$, then there is some UP in every equilibrium.
2. If $h_{''} < \frac{1}{1 \quad L}$, then NUP is the unique equilibrium.

Sketch of the proof:

- Assume that NUP (8q) is an equilibrium
- We need to check underpricing incentives only at $q = 0$

Equilibrium Dichotomy

1. If $h_{''} > \frac{1}{1 \quad L}$, then there is some UP in every equilibrium.
2. If $h_{''} < \frac{1}{1 \quad L}$, then NUP is the unique equilibrium.

Sketch of the proof:

- Assume that NUP (8q) is an equilibrium
- We need to check underpricing incentives only at $q = 0$
- $h_{''} < \frac{1}{1 \quad L}$) there are no underpricing incentives) NUP (8q) is an equilibrium and it is unique (because it yields the largest underpricing incentives).

Equilibrium Dichotomy

1. If $h_{''} > \frac{1}{1 \quad L}$, then there is some UP in every equilibrium.
2. If $h_{''} < \frac{1}{1 \quad L}$, then NUP is the unique equilibrium.

Sketch of the proof:

- Assume that NUP (8q) is an equilibrium
- We need to check underpricing incentives only at $q = 0$
- $h_{''} < \frac{1}{1 \quad L}$) there are no underpricing incentives) NUP (8q) is an equilibrium and it is unique (because it yields the largest underpricing incentives).
- If $h_{''} > \frac{1}{1 \quad L}$) there are underpricing incentives) NUP (8q) is NOT an equilibrium) there must be UP in every equilibrium.

Adjusted Hazard Rate

(a) Low adjusted hazard rate) NUP

(b) High adjusted hazard rate) UP

Comparative Statics

Corollary

Take a set of primitives $L; q_0; \; ; r; F_{"}$. Then

(1) $9 \quad < +1$, s.t. $8 \quad >$ and $"^0 = \; "$ NUP is the unique equilibrium.

(2) $9\, L \; < 1$, s.t. $8\, L > L$ NUP is the unique equilibrium.

(3) $9\, (= r) \; > 0$, s.t. $8\, (= r) < \; (= r)$ NUP is the unique equilibrium.

Adjusted hazard rate (of taste shock distribution) is

$$h_{"} = \frac{(F_{"}(u \quad 1 + L) \quad F_{"}(u \quad 1))=L}{1 \quad F_{"}(u \quad 1 + L) + \; r =}$$

Proof: Part 2

Theorem 1 (restated)

1. $h_{"} < \frac{1}{1 \quad L}$) NUP is the unique equilibrium (8q).
2. $h_{"} > \frac{1}{1 \quad L}$) there is UP in every equilibrium:

   9 0 < q < q 1, s.t.

   (a) UP 8q q : p(H; q) = 0 ; p(L; q) = L

   (b) NUP 8q q .

Adjusted hazard rate (of taste shock distribution) is

$$h_{"} = \frac{(F_{"}(u \quad 1 + L) \quad F_{"}(u \quad 1))=L}{1 \quad F_{"}(u \quad 1 + L) + r=}$$

Underpricing Equilibrium Structure

Unique signaling equilibrium is UP (8q q)

Underpricing Equilibrium Structure

Unique signaling equilibrium is UP
(8q q)

Multiple signaling equilibria
(8q < q < q)

Underpricing Equilibrium Structure

Unique signaling equilibrium is UP
(8q q)

Multiple signaling equilibria
(8q < q < q)

Unique signaling equilibrium is NUP
(8q q)

Table of Contents

Bad News

Consumers leave BAD reviews $i = L$ and $u_t < \underline{u}$.

Bad News

Consumers leave BAD reviews $i = L$ and $u_t < \underline{u}$.

Proposition

If " is distributed uniformly, NUP is the unique equilibrium.

Popularity-based Demand

Consumer arrival rate (q) is increasing in the rm's reputation q.

Popularity-based Demand

Consumer arrival rate (q) is increasing in the rm's reputation q.

Proposition

An equilibrium exists.

1. If $h_{"} < \frac{1}{\frac{(1)}{(0)} \quad L}$, then NUP is the unique equilibrium (8q).
2. If $h_{"} > \frac{1}{\frac{(1)}{(0)} \quad L}$, then 9 0 $< q < q$ 1, s.t. in every equilibrium there is UP 8q q and NUP 8q q .

Adjusted hazard rate (of taste shock distribution) is

$$h_{"} = \frac{(0) \quad (F_{"}(u \quad 1 + L) \quad F_{"}(u \quad 1))=L}{(0) \quad (1 \quad F_{"}(u \quad 1 + L)) + r}$$

Table of Contents

Welfare and Learning Effects of Underpricing

- If the firm is myopic, L and H prefer the highest price $\Rightarrow$ NUP $\Rightarrow$ CS = 0

Welfare and Learning Effects of Underpricing

- If the firm is myopic, L and H prefer the highest price $\Rightarrow$ NUP $\Rightarrow$ $CS = 0$
- UP $\Rightarrow$ $CS > 0$.

Welfare and Learning Effects of Underpricing

- If the firm is myopic, L and H prefer the highest price $\Rightarrow$ NUP $\Rightarrow$ $CS = 0$
- UP $\Rightarrow$ $CS > 0$.
- High-quality firm underprices more, but the low-quality firm loses the surplus.

Welfare and Learning E ects of Underpricing

- If the rm is myopic, L and H prefer the highest price) NUP) CS = 0
- UP) CS > 0.
- High-quality rm underprices more, but the low-quality rm loses the surplus.
- Underpricing speeds up learning and makes both ratings and prices more informative.

Welfare and Learning Effects of Underpricing

- If the firm is myopic, L and H prefer the highest price $\Rightarrow$ NUP $\Rightarrow$ $CS = 0$
- UP $\Rightarrow$ $CS > 0$.
- High-quality firm underprices more, but the low-quality firm loses the surplus.
- Underpricing speeds up learning and makes both ratings and prices more informative.
- Platform transparency and observable past prices may harm consumers.

Summary

- Price-dependent reviews can but need not induce underpricing.
  - Underpricing depends on the ratio of the density of marginal reviewers to the mass of the inframarginal ones, who leave reviews without underpricing.
- If underpricing happens, it must occur at low-reputation levels in every equilibrium.
  - High-quality rm underprices more than low-quality rm.
- Underpricing hurts low-quality rm, increases CS, and speeds up social learning.

Thank you!

Empirical Motivation

- Firms' ratings affect their revenue
  Luca (2011); Chevalier and Mayzlin (2006)
- Higher prices negatively affect product reviews/ratings
  Luca and Reshef (2021); Cabral and Li (2015)
- Firms take these reputational incentives into account when setting prices
  "...firms close to upgrading their tier are 4-9% more likely to discount." Sorokin (2021)

Back

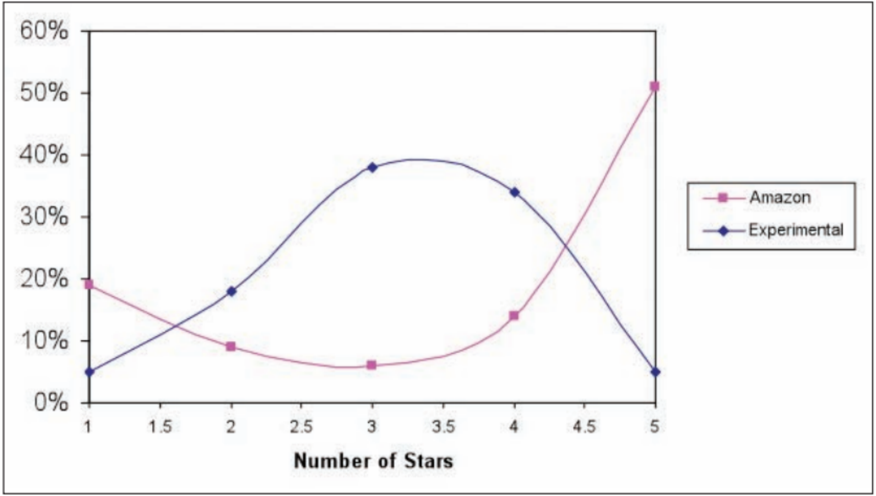
Extreme Reviews Empirical Evidence

- Across 25 platforms and 280 million reviews, there are extreme or polarized reviews (Schoenmüller, Netzer, and Stahl 2019)
- But experimental reviews are uni-modal (Hu, Zhang, and Pavlou 2009, Schoenmüller, Netzer, and Stahl 2019)
- Medium quality products are not rated possibly due to a cost of leaving a rating (Lafky 2014)
- Compensated reviews on Glassdoor are less extreme (Marinescu et al. 2021)

Back

Extreme Reviews

Figure 2. Distribution of Experimental versus Amazon's Ratings for a Music CD



Source: Hu, Zhang, and Pavlou (2009)