Uncharted Waters: Selling a New Product Robustly

Kun Zhang

University of Queensland

Motivation

Rapid technological development has brought more and more new products to us

In selling a new product, often the seller not only sets a price but also provides some information

Motivation

In selling a new product, often the seller not only sets a price but also provides some information

1. Is there a rationale for “charging less than they could” for sellers who set both the price and the information provision policy?

By Michael V. Marn, Eric V. Roegner, and Craig C. Zawada

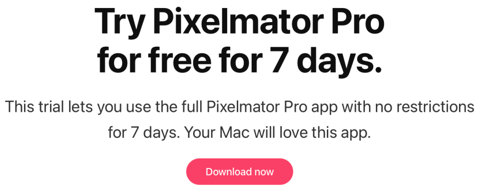
Share Print Download

Companies habitually charge less than they could for new offerings. It’s a terrible habit.

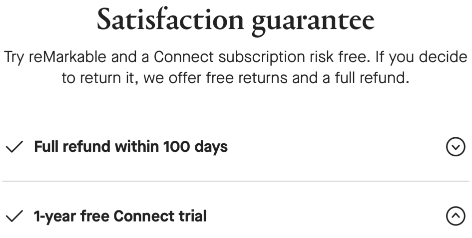
Motivation

In selling a new product, often the seller not only sets a price but also provides some information

2. Why do we see a lot of variation in information provision policies among new products?



(a) Innovative image editing app “Pixelmator”



(b) e-ink tablet “reMarkable”

The Setting

A seller has a product with unknown match value faces a buyer with unit demand

- the seller sets a price and chooses how much information to provide about the product
- after seeing the price and information, the buyer can costly search for an alternative product
- the seller has limited information about the buyer's knowledge of her alternatives
- seeking robustness, the seller evaluates any selling strategy by its worst-case profit

Main Tradeoff and Research Questions

Main tradeoff: search deterrence versus surplus extraction

- information provision can be used to boost demand through deterring buyer's search
- but this may require providing her with sufficiently high surplus via a low price

Research questions:

- What is the optimal selling strategy if the seller can design both the price and info provision?
- Is the buyer better off when learning about her alternatives becomes easier?
- How do the results shed light on selling different kinds of new products?

Preview of Results

Optimal selling strategy:

- providing full information is optimal when the search cost is sufficiently high
- different kinds of partial information can be optimal for lower search costs

Comparative statics:

- the price is nonmonotonic in the search cost
- information provision is generically more precise as search cost increases

Implications for the sale of new products:

- rationale for the large variations in information provision policies among new products
- technological advancements that reduce search costs need not benefit the consumers
- a lower price may be used, pairing with info provision, to ensure effective search deterrence

Relationship to the Literature

First to study a robust pricing problem with information provision

- Robust pricing: e.g., Carrasco et al. (2018), Du (2018), Hinnosaar and Kawai (2020)
  - this paper emphasizes the interaction between price and information
- Pricing with info provision and consumer search: e.g., Wang (2017), Lyu (2023)
  - the buyer in their setting searches for more precise information, here for another product

Encompasses search frictions and robustness concerns in selling new products

- Selling new products with info provision: Boleslavsky et al. (2017), Feinmesser et al. (2021)

Explores a novel search deterrence channel: information provision can be used to deter search

- Price-based tools: e.g., Armstrong and Zhou (2016)
- Search obfuscation: e.g., Ellison (2016)

Further

Outline

Model

Model Basics

- (Risk neutral) Buyer's match value with the product is $x \in \{0, 1\}$, with prior $\mu = \mathbb{P}(x = 1)$
- Neither Buyer nor Seller knows x, but both know μ
- Seller's production cost is normalized to zero
- Seller sets a price p and provides information about the match value (next slide)
- Buyer can draw an outside option v from a distribution G on $[0, 1]$ at cost $s \geq 0$ (search cost)
  - Call G the outside option distribution
  - denote the mean of G by ξ, assume $s < \xi$
  - Seller knows s, but can also allow for some uncertainty over s
- Buyer knows G, but Seller does not: she only knows that G is on $[0, 1]$ and its mean is ξ
- Free recall: after searching, Buyer can costlessly go back to buy Seller's new product
  - the price does not change when Buyer comes back (anonymity)

Information Provision

- Seller provides information about the match value by an experiment (S, χ)
  - consists of a set S of signal realizations and a map $\chi : \{0, 1\} \to \Delta(S)$
- Observing a signal realization, Buyer updates her beliefs and forms posterior w
- After updating, Buyer's posterior expected value is $1 \cdot w + 0 \cdot (1 - w) = w$
- Therefore, an experiment induces a posterior value distribution H
  - providing information affects Buyer's value distribution
- In fact, one can think of Seller *as if* directly choosing posterior value distribution H so long as $\mathbb{E}_H[w] = \mu$ (e.g., Kamenica and Gentzkow, 2011) Details
  - let H represent Seller's information provision policy henceforth
- Then Seller's strategy can be summarized by (p, H)
- Buyer's net value from buying is $w - p$

Robust Optimization

To deal with the uncertainty, Seller takes a robust/maxmin approach

- maximizes the minimal profit across all outside option distributions on $[0, 1]$ with mean ξ
- she chooses price p and information provision policy H to maximize her payoff *as if* there is an adversarial nature who observes (p, H), then chooses G on $[0, 1]$ with mean ξ to minimize Seller's payoff

Timeline

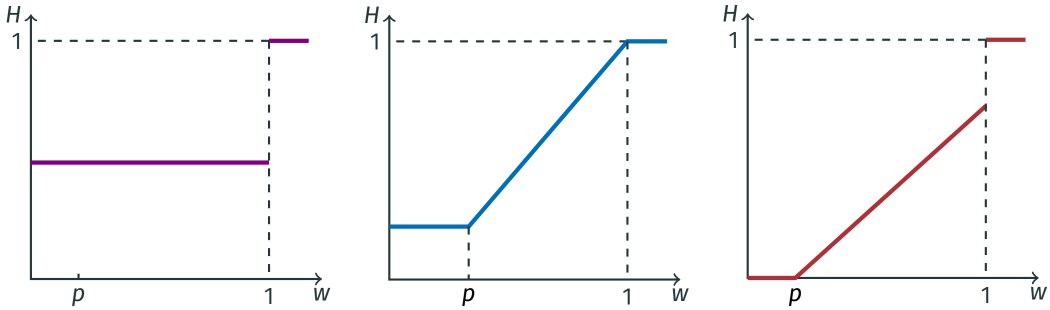
Timeline:

- Seller chooses a price p and an information provision policy H
- Nature chooses outside option distribution G
- Buyer observes p, draws a posterior expected value w from H, and she also observes G
  - buys immediately if the net value from Seller's product, $w - p$, is large enough
  - otherwise pays search cost s, draws an outside option with value v from G
  - if searches, will go back to Seller when $w - p > v$

Main Results

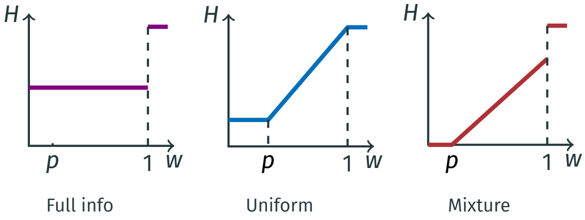
Robustly Optimal Selling Strategy: Information Provision Policies

Three kinds of information provision policies show up in an optimal selling strategy: Main



(a) Full information **(b)** Uniform information **(c)** Mixture information

Robustly Optimal Selling Strategy



Theorem (Informal)

- For small search costs, **uniform information** is optimal, and the price is $p_r > s/\xi$.
- For large search costs, **full information** is optimal, and the price is $p_r = s/\xi$.
- For intermediate search costs:
  - Depending on the prior μ and the mean of the outside option distribution ξ, both strategies above can be optimal
  - When μ is high and ξ is low, **mixture information** is optimal, and the price is $p_r = s/\xi$.

Seller's Objective

- Let a be defined by $a = \mathbb{E}_G[\max\{a, v\}] - s$
  - a represents the net value Buyer needs to forgo search
- Buyer purchases Seller's product without search whenever $w - p \geq a$
- If instead $w - p < a$
  - Buyer pays search cost s, investigates the outside option, and goes back to buy if $w - p > v$
- Hence, Buyer buys from Seller when $w - p \geq \min\{a, v\}$, or $w \geq p + \min\{a, v\}$
  - Prob. of eventual purchase when price is p and outside option has value v is $1 - H(p + \min\{a, v\})$
- Seller's revenue for a fixed outside option distribution G is

$$p\,\mathbb{E}_G[1 - H(p + \min\{a, v\})]$$

Solving Seller's Problem

Transform to a static problem first: (Armstrong, 2017 and Choi et al., 2018)

Define $z = \min\{a, v\}$, and let $\hat{G}$ denote its cdf

- by definition of a, $\mathbb{E}_{\hat{G}}[z] = \xi - s$, and $z \in [0, 1 - s/\xi]$

Details

Seller's problem:

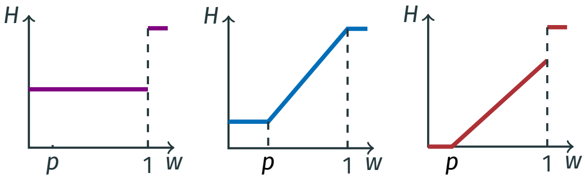
$$\max_{(p,H)} \min_{\hat{G}} p\, \mathbb{E}_{\hat{G}}[1 - H(p + z)]$$

Two-step approach for solving it:

Details

- for every fixed p, solve for the optimal H by identifying a saddle point of a zero-sum game
- then optimize over p

Why Linearity?



Under linearity of H, Seller's demand is constant in Nature's choice of $\hat{G}$:

$$\mathbb{E}_{\hat{G}}[1 - H(p + z)] = 1 - H\left(p + \mathbb{E}_{\hat{G}}[z]\right) = 1 - H(p + \xi - s)$$

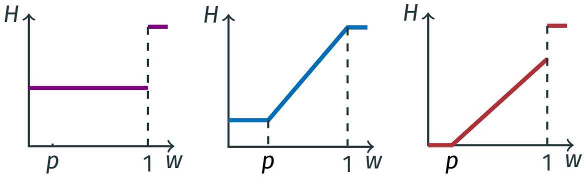
"Matching-pennies" style equilibrium:

Alternative

- linearity of H makes Nature indifferent between contracting and spreading mass in choosing $\hat{G}$
- Nature also chooses $\hat{G}$ in such a way that makes Seller indifferent

Takeaway: linearity of H hedges well against Nature

Mass Point at the Top



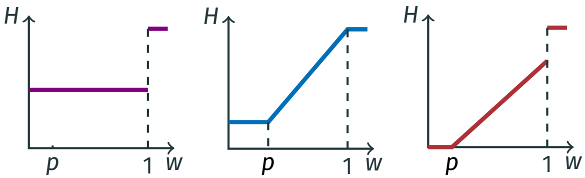
Mass point "at the top" of H to deter search?

- Call an information provision policy with a mass point "at the top" a deterrence policy
- To make sure that its effectiveness is not affected by Nature's choice, the mass point must be at $w - p \geq \underbrace{1 - s/\xi}_{\text{largest } z}$, or $w \geq p + 1 - s/\xi$ Details
- This is only possible when $p + 1 - s/\xi \leq 1$, or $p \leq s/\xi$

Takeaway: a deterrence policy is only effective when $p \leq s/\xi$.

⇒ Highlights the trade-off between search deterrence and surplus extraction More

Summarizing...

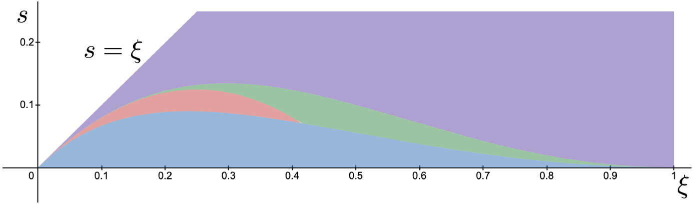


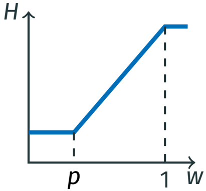
Summarizing:

- if $p > s/\xi$, Seller would employ a linear distribution without a mass point "at the top"
- if $p \leq s/\xi$, a mass point "at the top" can be helpful, and linear "on the interior" for hedging

s/ξ is the upper bound on price for effective search deterrence ("the upper bound" for simplicity)

Robustly Optimal Selling Strategy: Details

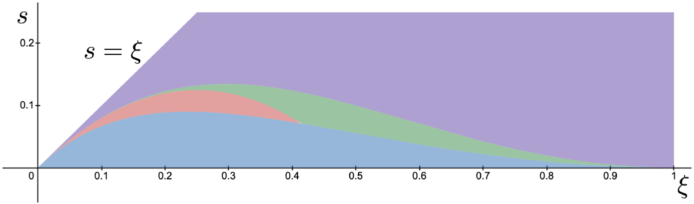


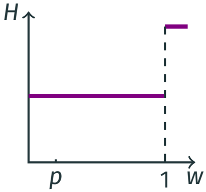


Blue region: uniform information is optimal, optimal price $p_r > s/\xi$

- search cost small, so is s/ξ, deterrence policy unprofitable
- using uniform information allows charging a higher price and extracting more surplus

Robustly Optimal Selling Strategy: Details

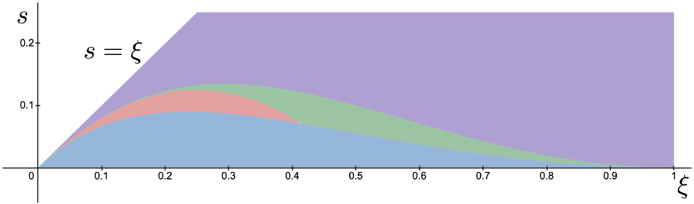


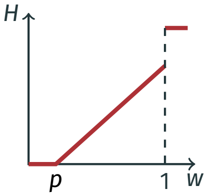


Violet region: full information is optimal, optimal price $p_r = s/\xi$

- as s gets large, so is s/ξ, hence eventually more profitable to use a deterrence policy
- the tension between search deterrence and surplus extraction is alleviated for larger s
- providing full information helps Seller secure a sizable demand while charging a higher price
  - identifies those who highly value the product (prob. μ) and make them buy without search
  - maximally differentiates Seller's product from Buyer's outside option, allows extracting more surplus

Robustly Optimal Selling Strategy: Details





Intermediate regions: a cutoff in μ

More

- below the cutoff same as blue region, above the cutoff a deterrence policy is optimal, $p_r = s/\xi$;
  - green: ξ large, use **full info** to maximally differentiate and soften competition
  - maroon: ξ small, **mixture info** is optimal since important to attract searchers to come back
- price vs demand effect: former dominates for low μ, latter dominates for high μ

Recap: Robustly Optimal Selling Strategy

Theorem

- If $s < B_1(\xi)$ (Blue), uniform information is optimal, price is $p_r > s/\xi$.
- If $s \geq B_3(\xi)$ (Violet), full information is optimal, and the price is $p_r = s/\xi$.
- If $B_1(\xi) \leq s < B_3(\xi)$, there are two cases:
  - If $B_1(\xi) \leq s < B_2(\xi)$ (Maroon), there exists $\check{\mu} \in (0, 1)$ s.t.
    - for $\mu < \check{\mu}$, uniform information is optimal, price $p_r > s/\xi$; and
    - for $\mu \geq \check{\mu}$, mixture information is optimal, and price $p_r = s/\xi$.
  - If $B_2(\xi) \leq s < B_3(\xi)$ (Green), there exists $\hat{\mu} \in (0, 1)$ s.t.
    - for $\mu < \hat{\mu}$, uniform information is optimal, price $p_r > s/\xi$; and
    - for $\mu \geq \hat{\mu}$, full information is optimal, and price $p_r = s/\xi$.

- providing full information is optimal if the search cost is sufficiently large, and
- different kinds of partial information provision policies are optimal for smaller search costs
- in each of the cases accompanied by a suitable price that reflects the main trade-off

Implications

New Products

Three kinds of new products:

- evolutionary products: existing products made slightly better

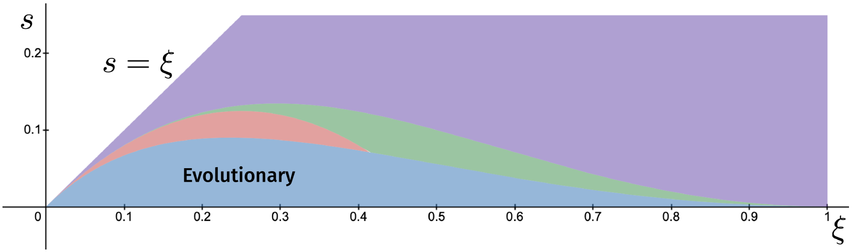
  example: smart thermostat
- revolutionary products: a completely new concept

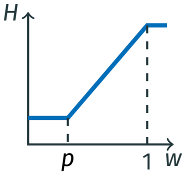
  example: 3D-printer
- alternatives to existing products: revolutionary on some aspects at the cost of losing some existing features

  example: portable speaker

Search cost measures how difficult it is for a buyer to find the best alternative

Implications



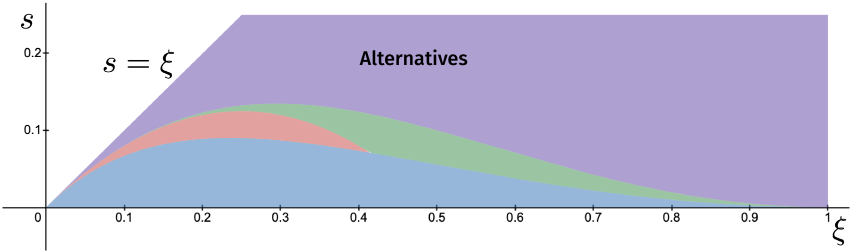


Evolutionary products: low s, μ not too far from ξ

$\Longrightarrow$ providing partial information is optimal

(recall the image editor "Pixelmator")

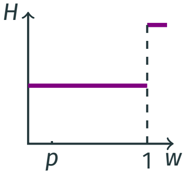
Implications



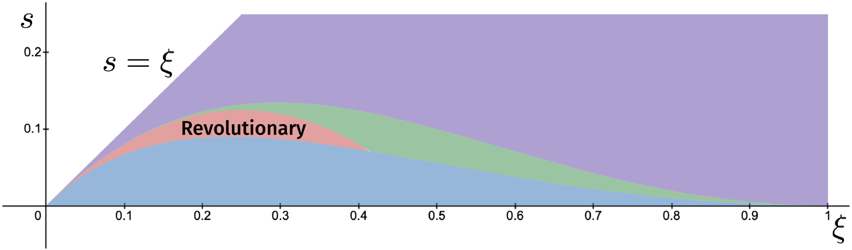
Alternatives to existing products: high s, μ not too far from ξ

$\implies$ divide potential consumers into “lovers” and “haters”, and serve the former only

(recall e-ink tablet “reMarkable”)



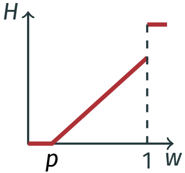
Implications



Revolutionary products: μ sufficiently high compared to ξ

$\Longrightarrow$ identify some "die-hard fans", and the rest of the potential consumers get noisy signals

(think about some Apple products and Tesla)



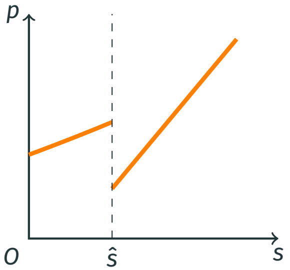
Comparative Statics

Comparative Statics

Proposition

(i) The price p_r is non-monotonic in the search cost s.

(ii) The info provision policy generically becomes more informative as the search cost increases.



Stems from the trade-off between deterrence and extraction:

- small $s \implies$ no deterrence, charge higher price
- as s increases, so is s/ξ, and hence deterrence policies become increasingly attractive
- at a threshold Seller would switch to a deterrence policy even if she must lower the price

Comparative Statics

Proposition

(i) The price p_r is non-monotonic in the search cost s.

(ii) The info provision policy generically becomes more informative as the search cost increases.

- as search cost increases, so long as it doesn't cross the "jump down point", price also increases
- an increase in price typically leads to more precise information Details
- crossing the "jump down point" calls for providing more info when the match value is high

Discussion

Two Benchmarks

Zero search cost

Details

- no point deterring search $\Longrightarrow$ "mass point at the top" no longer useful
- Seller's hedging motive renders uniform information optimal

Known outside option distribution

Details

- full information is always optimal
- does not generate as clear-cut implications for new products as the main model
- the main trade-off (search deterrence vs surplus extraction) and some interesting features (e.g., nonmonotonicity of price) remain

Extensions I

Recognizable Buyer identity

Details

- Exploding offers: always superior
- Buy-now discounts: need not be useful

Search cost distribution designed by Nature

- deterrence policies less attractive, otherwise similar

"Safe" outside option $u_0 > 0$ that she can consume without incurring the search cost

- does not change the qualitative features of the main results

Allowing random prices

- Seller's design object is the distribution of Buyer's net values, but many insights remain valid

Extensions II

Buyer's match value is distributed continuously on an interval (instead of binary matching value)

- many insights carry over: e.g.,
  - the trade-off between search deterrence and surplus extraction, and price comparative statics
  - linearity "hedges well" against Nature

Alternative assumptions on Seller's knowledge

- in the main model Seller knows $\mathbb{E}_G[v] = \xi$ and $\text{supp}(G) = [0, 1]$
- qualitative insights remain unaffected by small adjustments in the upper and lower bounds of the support
- if instead of the support condition, Seller knows that $\text{Var}(G) \leq \tau$, main insights intact so long as τ not too large

Summary

Summary

I characterize the robustly optimal way of selling a new product when the seller

- sets a price and chooses how much information to provide about the product
- faces uncertainty over the buyer's alternatives and seeks robustness to it

The seller trades off between search deterrence and surplus extraction

- full information optimal when search cost is high, otherwise provide partial information
- the price is non-monotonic in the search cost
- information provision generically becomes more precise as search cost increases

Concrete implications for the sale of (different kinds of) new products

- evolutionary products, alternatives to existing products, and revolutionary products
- technological advancements that reduce search costs need not benefit the consumers
- shed light on the variety of price-info combinations we observe across products

Thank you!

zhangkun081@gmail.com

Backup Slides

Further Related Literature

Monopoly pricing with information provision: e.g.,

- Bergemann, Heumann, and Morris (2023), Li and Zhao (2023), Wei and Green (2023)

Also related to information design under non-probabilistic uncertainty:

Back

- Dworczak and Pavan (2022), Hu and Weng (2021), Kosterina (2022), Sapiro-Gheiler (2021)

The robustly optimal information provision policy features similarities to

- robust contracting (e.g., Carroll and Meng, 2016), and
- information design contests (e.g., Boleslavsky and Cotton, 2015, 2018; Au and Whitmeyer, 2023)

Information as Experiment

Seller provides information by an experiment (S, χ)

Model

- a signal σ realizes according to $\chi(x)$ when the match value is $x \in \{0, 1\}$
- Buyer updates using Bayes rule, and gets a posterior $\mathbb{P}(x = 1 \mid \sigma)$
- the law of iterated expectation requires $\mathbb{E}[\mathbb{P}(x = 1 \mid \sigma)] = \mathbb{P}(x = 1) = \mu$
- "merging" all signals that leads to the same posterior w: $\mathbb{E}_H[w] = \mu$
- conversely, for any given H with $\mathbb{E}_H[w] = \mu$, let $S = \text{supp}(H)$ and

$$p_1(\sigma) = h(\sigma)\sigma/\mu, \quad \text{and} \quad p_0(\sigma) = h(\sigma)(1 - \sigma)/(1 - \mu),$$

for all $\sigma \in S$, where p_x and h are the "generalized pdf" of $\chi(x)$ and H, respectively

Details about $z = \min\{a, v\}$

Recall that $a = \mathbb{E}[\max\{a, v\}] - s$

Back

1. The mean of z is

$$\mathbb{E}[z] = \mathbb{E}[\min\{a, v\}] = \mathbb{E}[a + v - \max\{a, v\}] = \mathbb{E}[\mathbb{E}[\max\{a, v\}] - s + v - \max\{a, v\}] = \mathbb{E}[v] - s = \xi - s$$

2. In search problems, a decision maker prefers a more dispersed distribution
   - the most dispersed distribution is the binary distribution with support on $\{0, 1\}$; denote its CDF by G_B
   - now by definition of a,

     $$s = \mathbb{E}_{G_B}[\max\{a, v\}] - a = \xi \max\{a, 1\} + (1 - \xi) \max\{a, 0\} - a = \xi(1 - a),$$

     and hence the largest a is $1 - s/\xi$
   - therefore, $z \in [0, 1 - s/\xi]$

More on Buyer Search

- Observe that

$$a = \mathbb{E}_G[\max\{a, v\}] - s \Leftrightarrow s = \int_0^a a \, dG(v) + \int_a^1 v \, dG(v) - a$$
$$\Leftrightarrow s = \int_0^a a \, dG(v) + \int_a^1 v \, dG(v) - \int_0^1 a \, dG(v)$$
$$\Leftrightarrow s = \int_a^1 (v - a) \, dG(v)$$

- From the last equality we see that the left-hand side is constant in a and the right-hand side is strictly decreasing in a
- So if Buyer's net value is larger than a, she would not search

Back

Two-Step Approach: Technical Details

Optimal posterior value distribution for a fixed p:

- Seller and Nature play a zero-sum game in which Seller chooses H and Nature chooses $\hat{G}$:

$$\max_{H} \min_{\hat{G}} \Phi(H, \hat{G} \mid p), \text{ where } \Phi(H, \hat{G} \mid p) = \mathbb{E}_{\hat{G}}[1 - H(p + z)]$$

- $H^*(p)$ is optimal if and only if there exists $\hat{G}^*(p)$ such that $(H^*(p), \hat{G}^*(p))$ is a Nash equilibrium of the zero-sum game
- equivalently, $(H^*(p), \hat{G}^*(p))$ is a saddle point: for all feasible H and $\hat{G}$,

$$\Phi(H, \hat{G}^*(p) \mid p) \leq \Phi(H^*(p), \hat{G}^*(p) \mid p) \leq \Phi(H^*(p), \hat{G} \mid p)$$

- it then remains to verify that there exists an outside option distribution G that induces $\hat{G}$

Solve for optimal p: $\max_{p \in [0,1]} p\, \Phi^*(p)$, where $\Phi^*(p) = \Phi(H^*(p), \hat{G}^*(p) \mid p)$

Back

Finding the Saddle Point I

Observing Seller's choice of (p, H), Nature's problem can be written as

$$\max_{\hat{G}\in M(\xi - s)} \int_0^{1-\frac{s}{\xi}} H(p+z)\,\mathrm{d}\hat{G}(z),$$

where $M(\xi - s)$ is the set of distributions with support on $[0, 1 - s/\xi]$ whose mean is $\xi - s$

Taking p as given, Seller's problem can be written as

$$\max_{H\in M(\mu)} \int_0^1 G_p(w)\,\mathrm{d}H(w)$$

where

$$G_p(w) = \begin{cases} 0 & \text{if } w < p \\ \hat{G}(w-p) & \text{if } w \geq p \end{cases}$$

Finding the Saddle Point II

Lemma

For a fixed p, $(H^*, \hat{G}^*)$ is a saddle point if and only if

$$H^* \in \arg\max_{H \in M(\mu)} \int_0^1 G_p^*(w)\,\mathrm{d}H(w), \quad \text{and} \quad \hat{G}^* \in \arg\max_{\hat{G} \in M(\xi - s)} \int_0^{1-\frac{s}{\xi}} H^*(p+z)\,\mathrm{d}\hat{G}(z)$$

where

$$G_p^*(w) = \begin{cases} 0 & \text{if } w < p, \\ \hat{G}^*(w-p) & \text{if } w \geq p. \end{cases}$$

Kamenica and Gentzkow (2011): Seller's and Nature's values are $\tilde{G}_p^*(\mu)$ and $\tilde{H}^*(p + \xi - s)$, respectively

- for a function f, $\tilde{f}$ denotes its concave hull

In equilibrium, Seller make $\tilde{H}^*(p + \cdot)$ linear on $[0, 1 - s/\xi]$ and Nature make $\tilde{G}_p^*$ linear on $[0, 1]$

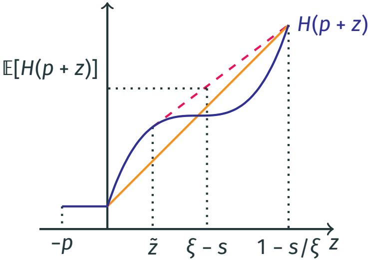
- both parties are indifferent between spreading and contracting mass

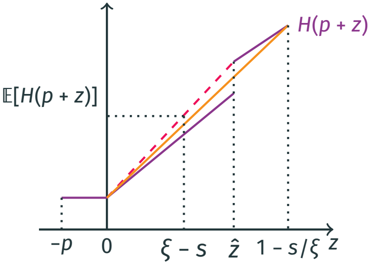
Back

The Virtue of Linearity: An Alternative Illustration

What happens if H is not linear? Observing (p, H), Nature maximizes $\mathbb{E}_{\hat{G}}[H(p+z)]$

Back



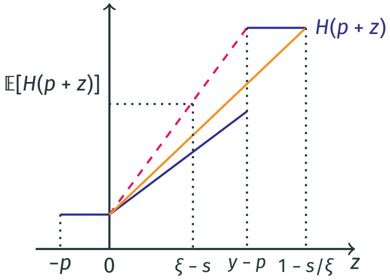


Mass Point at the Top: Details

Seller's problem: $\max_{(p,H)} \min_{\hat{G}} p\, \mathbb{E}_{\hat{G}}[1 - H(p+z)] \implies$ Nature maximizes: $\mathbb{E}_{\hat{G}}[H(p+z)]$

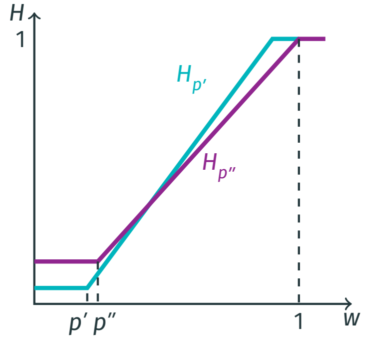
Back

What if there is a mass point in H at $y < p + 1 - s/\xi$? Not robust to Nature's choice.



Why H May Take Value at $w = 1$?

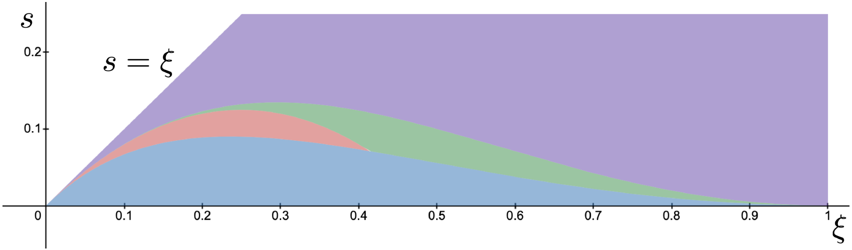
Why the supremum of supp(H) is 1 for any optimal H?



Suppose not, then it is profitable to jointly increase the price (p' to p'') and increase the likelihood of high posterior values ($H_{p'}$ to $H_{p''}$)

Back

More Details

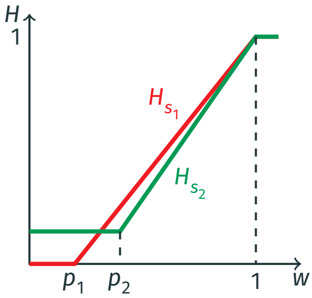


- Cutoffs in search cost $B_1(\xi)$, $B_2(\xi)$, and $B_3(\xi)$ are hump-shaped
- No information is never optimal: the price is too low

Back

Information Comparative Statics: Details

"more informative as search cost increases" $\Leftrightarrow H_{s_2}$ is a mean-preserving spread of H_{s_1} if $s_1 < s_2$



Back

Zero Search Cost

Proposition

Suppose $s = 0$. Uniform information is always optimal, and the robust price is $p_0 := \lim_{s \searrow 0} p_r$.

When search frictions are absent,

- the trade-off between search deterrence and surplus extraction disappears, and
- Seller's hedging motive renders uniform information optimal.

Back

Known Outside Option Distribution

Now suppose Seller knows the outside option distribution G

- assume that G has full support, and admits a log-concave density g

Proposition

The optimal selling strategy provides full information, and the optimal price is

$$p^o = \begin{cases} 1 - a & \text{if } 1 - a \geq p_h G(1 - p_h), \\ p_h & \text{if } 1 - a < p_h G(1 - p_h), \end{cases}$$

where p_h solves

$$p = \frac{G(1-p)}{g(1-p)}.$$

Intuition: the absence of hedging motive makes maximally differentiating the product optimal

Known Outside Option Distribution

Corollary

For every outside option distribution G, there exists $\hat{s}_G \in (0, \xi)$ such that $p^o = p_h$ for every $s < \hat{s}_G$, and $p^o = 1 - a$ for every $s \geq \hat{s}_G$. Furthermore, at $s = \hat{s}_G$, the optimal price drops from p_h to $1 - a(\hat{s}_G)$.

Compared to the main model:

- the main trade-off (search deterrence vs surplus extraction) and some interesting features (e.g., nonmonotonicity of price) remain
- less uncertainty $\implies$ more precise information provision
- does not generate as clear-cut implications for new products

Back

Recognizable Buyer Identity

Suppose now Seller can recognize whether Buyer is a first-time visitor or came back from search

- One way that Seller can take advantage of this is to make an exploding offer: she commits not to sell to Buyer if she does not buy in her first visit
- Another possibility is that Seller commits to a price path: if Buyer comes back to buy she has to pay a higher price

Recognizable Buyer Identity I: Exploding Offers

Proposition

Suppose that Seller can recognize whether Buyer is a first-time visitor. Then

(i) if Seller can commit to an exploding offer, it is optimal to offer $p = 1 - \xi + s$ with full information;

(ii) for all $\mu, \xi \in (0, 1)$ and $0 \leq s < \xi$, Seller earns strictly higher profits than the case that she cannot distinguish between first-time visitors and searchers.

(iii) if Seller cannot commit to the price, and there is a cost of returning to Seller $r > 0$, then the equilibrium outcome is the same as Seller committing to exploding offers.

Intuition:

- exploding offer is outcome equivalent to that the outside option distribution is δ_ξ
- full information is optimal because it creates the highest total surplus, and Seller can appropriate all the surplus

Recognizable Buyer Identity II: Price Discrimination

Suppose now that while the information provision policy cannot be changed, Seller can commit to a price path (p_1, p_2) with $p_1 < p_2$

Back

- p_1 and p_2 are the prices charged if Buyer buys immediately or after search, respectively

Proposition

Suppose that Seller can recognize whether Buyer is a first-time visitor. Let (p_r, H^*) be a robustly optimal selling strategy, and let G^* be the corresponding worst-case outside option distribution. If Seller deviates by committing to a pair of prices (p_1, p_2), where either $p_1 = p_r$ or $p_2 = p_r$, then

(i) If Nature cannot detect this deviation and hence the outside option distribution is still G^*, Seller can benefit from such a deviation unless H^* corresponds to full information;

(ii) If Nature can detect this deviation and optimally responds to it by choosing a new outside option distribution, Seller cannot benefit from such a deviation.