Nonlinear pricing of information goods

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Motivation

Examples of pricing for information goods

- Usage-based pricing
  - Digital music (iTunes)
  - Wireless internet service (AT&T)
  - Corporate software (Oracle, WebLogic,…)
  - Industry research (Aberdeen)
- Fixed-fee (unlimited usage) pricing
  - Wireline internet service (AOL)
  - Online newspapers (Wall Street Journal)
  - Wireless internet service (Sprint)
  - Industry research (Jupiter MediaMetrix)
  - Digital music (MusicNet's initial pricing)
- Both fixed-fee and usage-based
  - Corporate software (IBM zSeries)
  - Long-distance service (Sprint, AT&T)
  - Corporate internet service
  - OCLC library information service

Motivation

Possible explanations:

- Distribution of customers is the kind that causes bunching at the top
- Multi-dimensional types

Is there a simpler explanation?

- Near-zero marginal costs?
  - Make unlimited-usage feasible
  - But by themselves, do not make it optimal
- Network effects?
- "Step-function" variable costs?
- Imperfect competition?
- Transaction costs of usage-based pricing?
  - Seller-side (administering and billing)
  - Buyer-side (keeping track of usage)

Outline of model

Standard one-dimensional-type model

- Monopolist, one good, variable quantities
- Customers indexed by type $\theta \in [\underline{\theta}, \overline{\theta}]$

$$u(q,\theta,p) = U(q,\theta) - p$$

- (Standard) assumptions on *U, F* that usually make separation of types optimal
- Upper bound on $U : v(\theta) = \lim_{q \to \infty} U(q,\theta) < \infty$

Cost structure

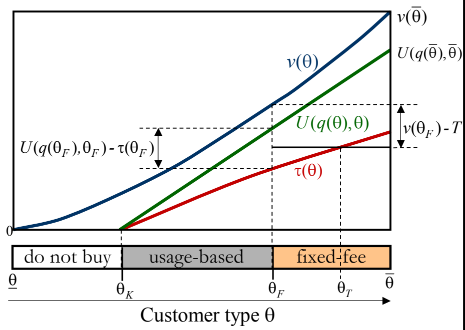
- Zero variable costs of production/distribution
- Usage-based pricing: Transaction costs $C(q)$

Feasible pricing schedules (contracts)

- Usage-based: $q(\theta), \tau(\theta)$
- Fixed-fee (unlimited-usage): T

Results

Segmentation due to a fixed fee T



Optimality of fixed-fee

- For every transaction cost function satisfying

$$C(q) > 0 \text{ for } q > 0$$

offering a fixed-fee T improves profits from any usage-based pricing contract

Outline of model (again)

More assumptions on transaction costs

(1) $C(q) = 0$ for $q = 0$

(2) $C(q) = K + c(q)$ for $q > 0$

(a) $K \geq 0$

(b) $\dfrac{c_{11}(q)}{c_1(q)} > \dfrac{U_{11}(q)}{U_1(q)} \quad (<0)$

(2b) is sufficient (ensures quasiconcavity of profit function in q), may not be necessary

Results

Independence of pricing schedules

- Optimal usage-based contract designed after accounting for T is independent of T.

Therefore, the optimal combination of usage-based and fixed-fee pricing is:

- Optimal screening contract using cost $C(q)$

$$q^*(\theta) = \begin{cases} 0, & \theta < \theta_K \\ q^0(\theta), & \theta \geq \theta_K \end{cases}$$

$$U_1(q^0(\theta),\theta) = c_1(q) + U_{12}(q^0(\theta),\theta)\frac{1-F(\theta)}{f(\theta)}$$

$$\theta_K = \min \theta : U(q^0(\theta),\theta) \geq C(q^0(\theta))$$

- Profit-maximizing T in the presence of $q(\theta), \tau(\theta)$

$$T^* = v(\theta_F^*) - U(q^*(\theta_F^*),\theta_F^*) + \tau^*(\theta_F^*)$$

$$\theta_F^* = \arg\max_{\theta_F} \int_{\theta_K}^{\theta_F} [\tau^*(\theta) - C(q^*(\theta))]dF(\theta)$$

$$+[1-F(\theta_F)][v(\theta_F) - U(q^*(\theta_F),\theta_F) + \tau^*(\theta_F)]$$

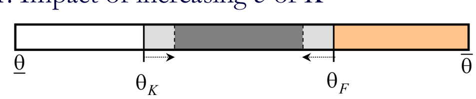
Example

$$U(q,\theta) = \begin{cases} (w+\theta)q - \frac{1}{2}q^2, & q \leq \theta + w \\ \frac{1}{2}(w+\theta)^2, & q \geq \theta + w \end{cases}$$

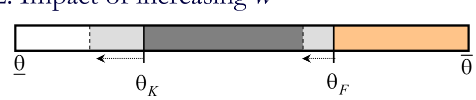
$$f(\theta) = b(1-\theta)^{(b-1)}$$

$$C(q) = K + cq$$

1. Impact of increasing c or K



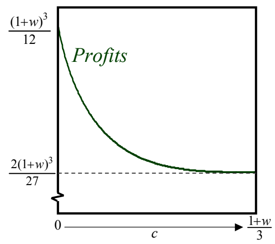
2. Impact of increasing w



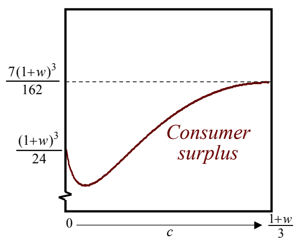
3. Impact of decreasing b

Example

Changes in profits as c increases

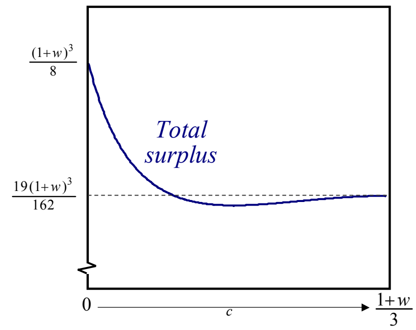


Changes in consumer surplus as c increases



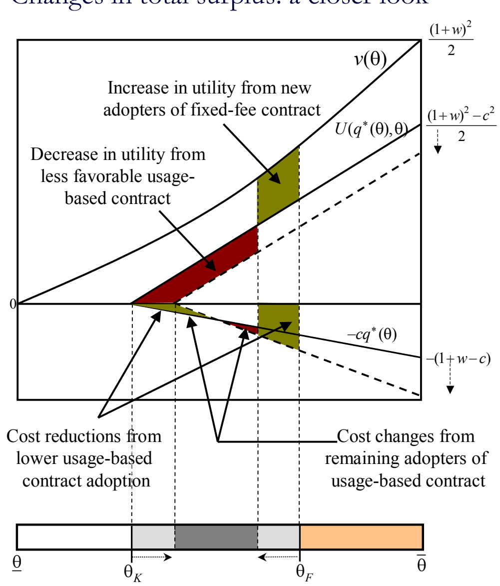
Example

Changes in total surplus as c increases



Example

Changes in total surplus: a closer look



Conclusion and related work

Summary

- Established a simple explanation for the widespread prevalence of fixed-fee pricing
- Separability of design of usage-based schedule and fixed-fee is promising (but…)
- Guidelines for companies who price information goods

Ongoing and related work

- Network effects and nonlinear pricing
  - separation is optimal for "small" customers
  - fixed-fees are optimal for finite-sized customers
- Step-function variable costs
  - with bounded usage, fixed fees are often optimal
- Piracy reduces the desirability of fixed fees
- Imperfect competition