

Opt0.4pt

Tailored Advertising and Consumer Privacy

Roman Inderst, Frankfurt & Imperial College London

Marco Ottaviani, Northwestern & Bocconi

Motivation

- Technological progress in collecting and processing personally identifiable data
 - Firms can better tailor *marketing messages* to individual consumers, according to perceived preferences.
- E.g., stress style or comfort; different emphasis on price.
 - (Formal) presumption: Scope of message is always limited due to restrictions in (air-)time, (billboard, package) space, or consumer attention.

Key Questions

- Does such *tailored advertising* benefit consumers?
 - Need for regulation (e.g., EC Privacy & Data Protection Directives)?
 - Sufficient to ask for consent on collecting personalized data?
- Role of consumer "naivité/wariness" with respect to this practice?
- Role of competition?
- Interaction with *personalized pricing*?
[Relevance? Services vs. products?]

Themes of the Analysis

- **Theme 1:** Tailored advertising is *more informative*.
[Dispersion of ex-ante utility]
→ But distribution of efficiency gains depend on possibility of personalized pricing and competition.

Themes of the Analysis

- **Theme 1:** Tailored advertising is *more informative*.
[Dispersion of ex-ante utility]
→ But distribution of efficiency gains depend on possibility of personalized pricing and competition.
- **Theme 2:** Consumer wariness
→ Even naive consumers may benefit: "Value of information effect" stronger than "bias effect".
→ "Bias effect" disappears with competition!

Themes of the Analysis

- **Theme 1:** Tailored advertising is *more informative*.
[Dispersion of ex-ante utility]
 - But distribution of efficiency gains depend on possibility of personalized pricing and competition.
- **Theme 2:** Consumer wariness
 - Even naive consumers may benefit: "Value of information effect" stronger than "bias effect".
 - "Bias effect" disappears with competition!
- **Theme 3:** Differentiation
[Case: Price discrimination & competition]
 - Tailored advertising then dampens competition.
 - Now ignorance/naivité is of advantage as intensifies competition.

Regulation ?

- In the absence of personalized pricing:
 - Efficiency gains from tailored advertising likely, also with naive consumers.
 - Also likely higher consumer surplus.

Regulation ?

- In the absence of personalized pricing:
 - Efficiency gains from tailored advertising likely, also with naive consumers.
 - Also likely higher consumer surplus.
- With personalized pricing:
 - One rationale for intervention: To protect naive consumers from exploitation by firm with market power.

Literature

- Stigler (1980), Posner (1981): Greater transparency expands efficiency-enhancing trade.
→ Here, less immediate as allows firm to selectively communicate.
- We abstract from (potentially "excessive"; Hirshleifer 1971) costs of information acquisition.
- We analyze whether "property rights" over personally identifiable information are enough (cf. Shapiro and Varian 1997).

Literature (cont.)

- IO literature focus: Personalized price discrimination (e.g., Villas-Boas 1999; including "naive consumers" in Taylor 2004).
- Marketing literature focus: Targeted advertising (e.g., Goldfarb and Tucker 2011).
- Key formal ingredient: Constrained verifiable communication, as in Fishman and Hagerty (1990), Glazer and Rubinstein (2004).
→ Key difference: "Horizontal differentiation". Akin to Lewis and Sappington (1995), Johnson and Myatt (2006).

(Non-)Tailored Advertising: Set-Up

- Consider a single firm. And a product with two attributes $n = 1, 2$.
- Simplified notation: If consumers knows attributes = learns values u_n , he knows true valuation

$$u = \sum_{n=1,2} u_n.$$

- Ex-ante: u_n IID with $F(u_n)$ on (for now bounded) support $[\underline{u}, \bar{u}]$.
- Firm strategy: Reveal $d \in \{1, 2\}$.

Non-Tailored Advertising

- Given symmetry, wlog suppose $d = 1$ is communicated.
→ Expected utility: $U = u_d + E[u]$.
- Ex-ante distribution with CDF

$$H_N(U) = F(U - E[u]).$$

Tailored Advertising

- Suppose firm prefers to communicate "highest" attribute (endogenized later).
- Wary consumer's expected utility: $U = u_d + E[u \mid u \leq u_d]$.
- Ex-ante distribution with CDF

$$H_T(U) = F^2(u_D(U)).$$

Tailored Advertising

- Suppose firm prefers to communicate "highest" attribute (endogenized later).
- Wary consumer's expected utility: $U = u_d + E[u \mid u \leq u_d]$.
- Ex-ante distribution with CDF

$$H_T(U) = F^2(u_D(U)).$$

- *Naive* consumer's expected utility: $\hat{U} = u_d + E[u]$.
- Ex-ante distribution with CDF

$$H_{Tn}(\hat{U}) = F^2(\hat{U} - E[u]).$$

Comparison: Tail Behavior

- Tailored CDF with wary consumers has more mass *at left-hand tail* than non-tailored CDF (simply as lower bound is no longer $\underline{u} + E[u]$, but $\underline{U} = 2\underline{u}$).
- *Right-hand tail*: Same boundary $\bar{U} = \bar{u} + E[u]$. And $H'_N(\bar{U}) \leq H'_T(\bar{U})$ ("more mass" with tailored CDF) if

$$\frac{dE[u \mid u \leq u_D]}{du_D} \leq 1,$$

i.e., implied by logconcavity of f .

[Also with unbounded support.]

Comparison (Cont.)

- Uniform distribution and exponential distribution: Rotation property holds generally
→ H_N and H_T intersect once.
- Further, though no generalized result, all examples calculated with all logconcave density functions in Table 1 of Bagnoli and Bergstrom (2005) exhibit rotation property.

Comparison (Cont.)

- Uniform distribution and exponential distribution: Rotation property holds generally
 → H_N and H_T intersect once.
- Further, though no generalized result, all examples calculated with all logconcave density functions in Table 1 of Bagnoli and Bergstrom (2005) exhibit rotation property.
- For what follows, we assume rotation property (though for most results mean-preserving spread sufficient):
 → *Given the distribution $F(u_n)$, $H_T(U)$ results from $H_N(U)$ through a rotation around some interior value \tilde{U} :*

$$H_T(U) \underset{<}{\overset{\geq}{\approx}} H_N(U) \text{ for } U \underset{>}{\overset{\leq}{\approx}} \tilde{U}.$$

Comparison (Cont.)

- Immediate with naive consumers:

The distribution of a naive consumer's perceived valuation \hat{U} under tailored advertising, $H_{Tn}(\hat{U})$, dominates the distribution of his true valuation U under non-tailored advertising, $H_N(U)$, in the sense of FOSD.

Analysis with Monopolistic Firm

- Also: No personalized price discrimination.
- Simplification: Consumer buys if expected (perceived) valuation is at least R .

Analysis with Monopolistic Firm

- *Firm preferences:* \rightarrow Maximize $1 - H.(R)$.
 - Always prefers tailored with naive consumers.
 - Only prefers tailored with wary consumers when R is sufficiently high (Low ex-ante likelihood of purchase; "niche market").

Analysis with Monopolistic Firm

- *Firm preferences:* \rightarrow Maximize $1 - H.(R)$.
 - Always prefers tailored with naive consumers.
 - Only prefers tailored with wary consumers when R is sufficiently high (Low ex-ante likelihood of purchase; "niche market").
- Commitment?
 - \rightarrow If gathering information is non-observable, then tailored advertising always results.

Regulation and Consumer Preferences

- Wary consumers: Expected utility (after integration by parts) is higher under tailored advertising if

$$\int_R^{\bar{U}} [H_N(U) - H_T(U)] dU > 0.$$

→ For all R implied by rotation property.

Regulation and Consumer Preferences

- Wary consumers: Expected utility (after integration by parts) is higher under tailored advertising if

$$\int_R^{\bar{U}} [H_N(U) - H_T(U)] dU > 0.$$

→ For all R implied by rotation property.

- Regulation?
 - Forbidding gathering customer-specific information hurts wary consumers.
 - Also, requiring consumers' consent hurts wary consumers when R is low.

Regulation and Consumer Preferences

- Naive consumers: Despite bias they are
 - Equally well-off when u_n is uniformly distributed.
 - Strictly better off with tailored advertising when u_n is exponentially distributed.
- Intuition: Trading-off two errors.

Comment: No Advertising

- Additional choice option for firm: Not to reveal any attribute!
- Key: All results survive (weakly).

Comment: No Advertising

- Additional choice option for firm: Not to reveal any attribute!
- Key: All results survive (weakly).
- Details:
 - Wary consumers: Standard unravelling argument can be used.
 - Naive consumers: Additional case of "no revelation" when $2E[u] \geq R$.

Competition

- Key change: No longer outside option with fixed value R , but competition by ex-ante symmetric firm!
→ Firms a, b .

Competition

- Key change: No longer outside option with fixed value R , but competition by ex-ante symmetric firm!
→ Firms a, b .
- Wary consumer: Realizes $U^* = \max\{U^a, U^b\}$.
→ Respective CDFs H_N^* and H_T^* inherit rotation property.

Competition

- Key change: No longer outside option with fixed value R , but competition by ex-ante symmetric firm!
→ Firms a, b .
- Wary consumer: Realizes $U^* = \max\{U^a, U^b\}$.
→ Respective CDFs H_N^* and H_T^* inherit rotation property.
- Naive consumers: End up with same decision as wary consumers!
→ In this sense, protected by competition (=selective communication of both firms!)

Competition

- Key change: No longer outside option with fixed value R , but competition by ex-ante symmetric firm!
→ Firms a, b .
- Wary consumer: Realizes $U^* = \max\{U^a, U^b\}$.
→ Respective CDFs H_N^* and H_T^* inherit rotation property.
- Naive consumers: End up with same decision as wary consumers!
→ In this sense, protected by competition (=selective communication of both firms!)
- Key result: All consumers always better off under tailored advertising.

Price Discriminating Monopolist

- With perceived expected valuation \hat{U} , monopolist charges $p(\hat{U}) = \hat{U} - R$.

Price Discriminating Monopolist

- With perceived expected valuation \hat{U} , monopolist charges $p(\hat{U}) = \hat{U} - R$.
- *Wary consumers*: Tailored advertising
 - has no impact on consumers,
 - but strictly increases efficiency (and thus always firm profits).

Price Discriminating Monopolist

- With perceived expected valuation \hat{U} , monopolist charges $p(\hat{U}) = \hat{U} - R$.
- *Wary consumers*: Tailored advertising
 - has no impact on consumers,
 - but strictly increases efficiency (and thus always firm profits).
- *Naive consumers*: Tailored advertising
 - strictly harms consumers ("exploited beliefs"),
 - but may increase efficiency (e.g., strictly with exponential distribution).

Price Discrimination with Competition

- Assumption: Joint observability of revealed attributes
 - Bertrand pricing: Consumer realizes

$$\check{U}^* = \min \{ \hat{U}^a, \hat{U}^b \}.$$

Price Discrimination with Competition

- Assumption: Joint observability of revealed attributes
→ Bertrand pricing: Consumer realizes

$$\check{U}^* = \min \{ \hat{U}^a, \hat{U}^b \}.$$

- *Wary consumers*: Now harmed by tailored advertising!
→ From ex-ante perspective, this increases differentiation!

Price Discrimination with Competition

- Assumption: Joint observability of revealed attributes
 - Bertrand pricing: Consumer realizes

$$\check{U}^* = \min \{ \hat{U}^a, \hat{U}^b \}.$$

- *Wary consumers*: Now harmed by tailored advertising!
 - From ex-ante perspective, this increases differentiation!
- But less so for *naive consumers*!
 - They end up with the same choice as wary consumers, but a lower price
 - They do not update beliefs on unobserved attribute.
 - Always lower perceived difference and thus lower price!

Concluding Remarks

- Framework to study firms' use of personally identifiable data to individually target (selective) communication.
- Tailored advertising should increase *informativeness* and thus decision efficiency when consumers are wary
[But this may also more than outweigh bias when consumers are naive.]
—> Regulation (including asking for consumers' consent !) may be harmful!
- Most "clear cut" case *pro* selective communication: Competition and no personalized *price* discrimination.
- Instead, with personalized price discrimination: In particular, exploitation of naive consumers' beliefs!

Tailored Advertising and Consumer Privacy

Roman Inderst, Frankfurt & Imperial College London

Marco Ottaviani, Northwestern & Bocconi