

Privacy and Quality

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MOTIVATION

Increasing concerns that Internet giants may be abusing their dominant positions to impose unfavorable data use conditions on consumers.

To protect consumer privacy, data use restrictions have been proposed in recent regulations.

These restrictions may reduce revenues of firms who rely solely on the monetization of user data → adverse effect on investment incentives.

Research questions:

Should a regulator impose restrictions on data use (in a form of a cap on disclosure)? What would be the impact of such a regulation on a firm's choice of **quality** and on **social welfare**?

MODEL SETUP

Product Market

A monopolist provides a free service to a mass of consumers.

The firm can invest in its quality level, $q \geq 0$, and derives revenue from selling a share $d \in [0, 1]$ of user data.

Consumers decide whether to use the service and how much information $x \in [0, 1]$ to provide (if they use).

Data Market

The firm is a monopolist in the market for information.

All data buyers have the same valuation per unit information, $r > 0$, which is fully extracted by the firm.

MODEL SETUP

Consumer's utility

$$U(x, \theta, q, d) \equiv V(x, q) - (\alpha + \theta d)x - K.$$

- $V(x, q)$: gross utility. Increasing and concave in x and q .
 - ▶ Complementarity between x and q :

$$-\frac{\frac{\partial^2 V}{\partial x \partial q}}{\frac{\partial^2 V}{\partial x^2}} = \gamma \geq 0$$

- α : cost of providing an unit of information.
- θ : idiosyncratic privacy cost parameter, distributed according to F with density f (Assume $\theta \sim \mathcal{U}[\underline{\theta}, \bar{\theta}]$)
- $K \geq 0$: opportunity cost of using the service.

MODEL SETUP

Firm's profit

$$\Pi(x, q, d) = rd \int_{\underline{\theta}}^{\bar{\theta}} x(\theta) f(\theta) d\theta - C(q)$$

- $x(\theta) \in [0, 1]$: information provision level of consumer of type θ .
- $C(q)$: cost of providing a service of quality, q , with $C'(0) = 0$.

Timing

- $t = 1$: Firm chooses quality level q and commits to disclosure level d .
- $t = 2$: Consumers observe q and d and decide whether to use the firm's service and how much information to provide.

CONSUMERS' CHOICE

Information provision

- Conditional on participation, consumer of type θ chooses to provide

$$\tilde{x}(\theta, q, d) = \operatorname{argmax}_x U(\theta, x, q, d).$$

- \tilde{x} is decreasing in θ and d , but increasing in q .

Participation

- Threshold strategy: consumer of type θ uses service if

$$\tilde{U}(\theta, q, d) = U(\theta, \tilde{x}, q, d) \geq 0$$

$$\Leftrightarrow \theta \leq \tilde{\theta}(q, d).$$

- $\tilde{\theta}$ is decreasing in d and increasing in q .

FIRM'S V. PLANNER'S CHOICE

Suppose consumers participate and provide information optimally.

Firm's choice:

$$\max_{\substack{q \geq 0 \\ d \in [0,1]}} \tilde{\Pi}(q, d) = rd \int_{\underline{\theta}}^{\tilde{\theta}(q,d)} \tilde{x}(\theta, q, d) f(\theta) d\theta - C(q).$$

Social planner's choice:

$$\max_{\substack{q \geq 0 \\ d \in [0,1]}} \tilde{W}(q, d) = \tilde{\Pi}(q, d) + \underbrace{\int_{\underline{\theta}}^{\tilde{\theta}(q,d)} \tilde{U}(\theta, q, d) f(\theta) d\theta}_{\tilde{CS}(q,d)}.$$

FIRM'S V. PLANNER'S CHOICE

Firm's choices of q and d impose externalities on consumers.

\widetilde{CS} is decreasing in d for given q and increasing in q for given d .

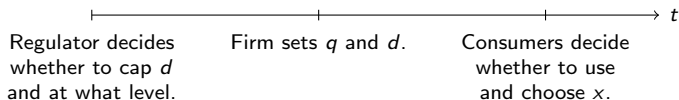
Firm versus Planner

- (i) At the unregulated equilibrium quality level, the firm **over-discloses information** relative to the social optimum.
- (ii) At the unregulated equilibrium disclosure level, the firm **under-provides quality** relative to the social optimum.

EX ANTE REGULATION

Consider an (*ex ante*) privacy regulation in the form of a cap on disclosure level.

Timing:



What would be the impact of such a disclosure cap on **quality** and on **social welfare**?

IMPACT ON QUALITY

Quality investment raises the amount of information generated and hence disclosure revenues.

$$\frac{\partial \tilde{\pi}}{\partial q} = \underbrace{rd\gamma F(\tilde{\theta}(q, d))}_{\text{intensive margin effect}} + \underbrace{r \frac{\partial V}{\partial q}(q, \tilde{x}(\tilde{\theta}(q, d), q, d)) f(\tilde{\theta}(q, d))}_{\text{extensive margin effect}} - C'(q).$$

MB of quality investment

Intensive margin effect

- Impact of q on **amount of information** provided (+)

Extensive margin effect

- Impact of q on **demand** (+)

The size of these effects depends on the level of disclosure.

FULL MARKET COVERAGE

Assume that K is sufficiently small such that market is fully covered.

- Only intensive margin effect

A reduction in d **weakens** the firm's incentives to invest in quality:

- Lower revenue per unit of information provided by consumers
- Smaller intensive margin effect from investing in quality

Impact of disclosure cap under full market coverage

When the market is fully covered, an *ex ante* disclosure cap (weakly) **decreases quality level**.

- Reduction in quality level increasing in the level of complementarity.

PARTIAL MARKET COVERAGE

Consider the case were the unregulated market is partially covered.

A reduction in d

- decreases the revenue per unit of information (– intensive margin effect)
- increases the size of user base (+ intensive margin effect)

Overall impact of the disclosure cap depends on the [elasticity](#) of F .

Impact of a Decrease in d on the Intensive Margin Effect

For given demand	From bigger user base	Combined effect
< 0	> 0	> 0 if F elastic < 0 if F inelastic

F is elastic in the uniform case.

Impact of disclosure cap under partial market coverage

When the (unregulated) market is partially covered, an ex ante disclosure cap **increases quality level** in the case where the privacy cost parameter follows a uniform distribution.

No trade-off between quality and privacy when market is partially covered.

SOCIAL DESIRABILITY

A cap is socially desirable \Leftrightarrow marginal reduction in d from its unregulated level increases welfare (due to regularity conditions)

Effect of this marginal decrease in d on

(i) Profit:

- No effect (by Envelope theorem)

(ii) Consumer surplus:

- Direct effect: Lower privacy costs (+)
- Indirect effect: Change in firm's choice of q ; positive if cap raises q , negative otherwise

Welfare is **higher** under a disclosure cap if

- quality level increases;
- the decrease in quality level is relatively small.

SOCIAL DESIRABILITY

Social desirability of an ex ante disclosure cap

(i) When the market is **fully covered**, an *ex ante* disclosure cap is **socially desirable** if quality and information are **sufficiently weak complements**.

(ii) When the (unregulated) market is **partially covered**, an *ex ante* disclosure cap is **socially desirable**.

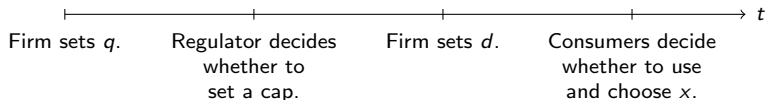
GENERAL DISTRIBUTION FUNCTIONS

When θ follows a more general distribution function F :

- Impact of disclosure on quality under partial market coverage depends on both the **elasticity** and the **curvature** of F .
- Disclosure cap increases quality and social welfare if F is **weakly convex** and has an ambiguous effect otherwise.

EX POST REGULATION

Timing:



- With an *ex ante* cap, impact on q depends on how d affects the marginal **private** benefit of quality investment
- With an *ex post* cap, firm also sets q to (favorably) influence cap set by regulator → **strategic effect**
- Strategic effect depends on how d affects the marginal **social** benefit of quality investment
- Under full market coverage, an *ex post* cap **decreases quality** if the **value of information** is lower than the **average privacy cost**.

RELATED LITERATURE

Data disclosure/exploitation by Internet firms:

Casadesus-Masanell and Hervas-Drane (2015), Bloch and Demange (2017), Bourreau et al. (2017)

Privacy regulation and innovation:

Goldfarb and Tucker (2012), Goldfarb and Tucker (2011), Tucker and Miller (2009, 2011a and 2011b)

CONCLUSION

We show that quality can either increase or decrease under a disclosure cap \Rightarrow may not be a trade-off.

Important to distinguish between cases where disclosure level only affects information provision and where it also affects participation.

Our model can be extended to more general settings:

- Data could be exploited by the firm for internal use
- q and x could correspond to other inputs besides quality and information

Thank you.

Feedback and comments are welcomed at
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