Data Privacy and Consumer Vulnerability

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Motivation

- Growing concerns about data privacy in the digital age
  - EU's General Data Privacy Regulation (GDPR), effective on 5/ 25/2018
  - California Consumer Privacy Act (CCPA), effective on 1/1/2020
    - Virginia Consumer Data Protection Act (VCDPA) and Colorado Privacy Act (CPA)
  - Demand for normative analysis of privacy regulations

- Data is sometimes regarded as a key factor for the future macroeconomy, e.g., Jones & Tonetti (2020), Farboodi & Veldkamp (2020), Cong, Xie and Zhang (2020)
  - A micro-foundation of data sharing is needed

- How to model people's privacy preference?
  - Extensive literature on price discrimination, as reviewed by Acquisti, Taylor & Wagman (2016), Goldfarb & Tucker (2019)
    - A distributional mechanism with net effect on consumer surplus hinging on market setting

- This paper highlights a motive to protect one's personal vulnerability

Consumer Vulnerability in Digital Age

- Vulnerable consumers
  - payday loans, Bertrend and Morse (2011) and Melzer (2011)
  - add-on pricing, Gabaix and Laibson (2006)
  - bank overdraft fees, Stango and Zinman (2014)

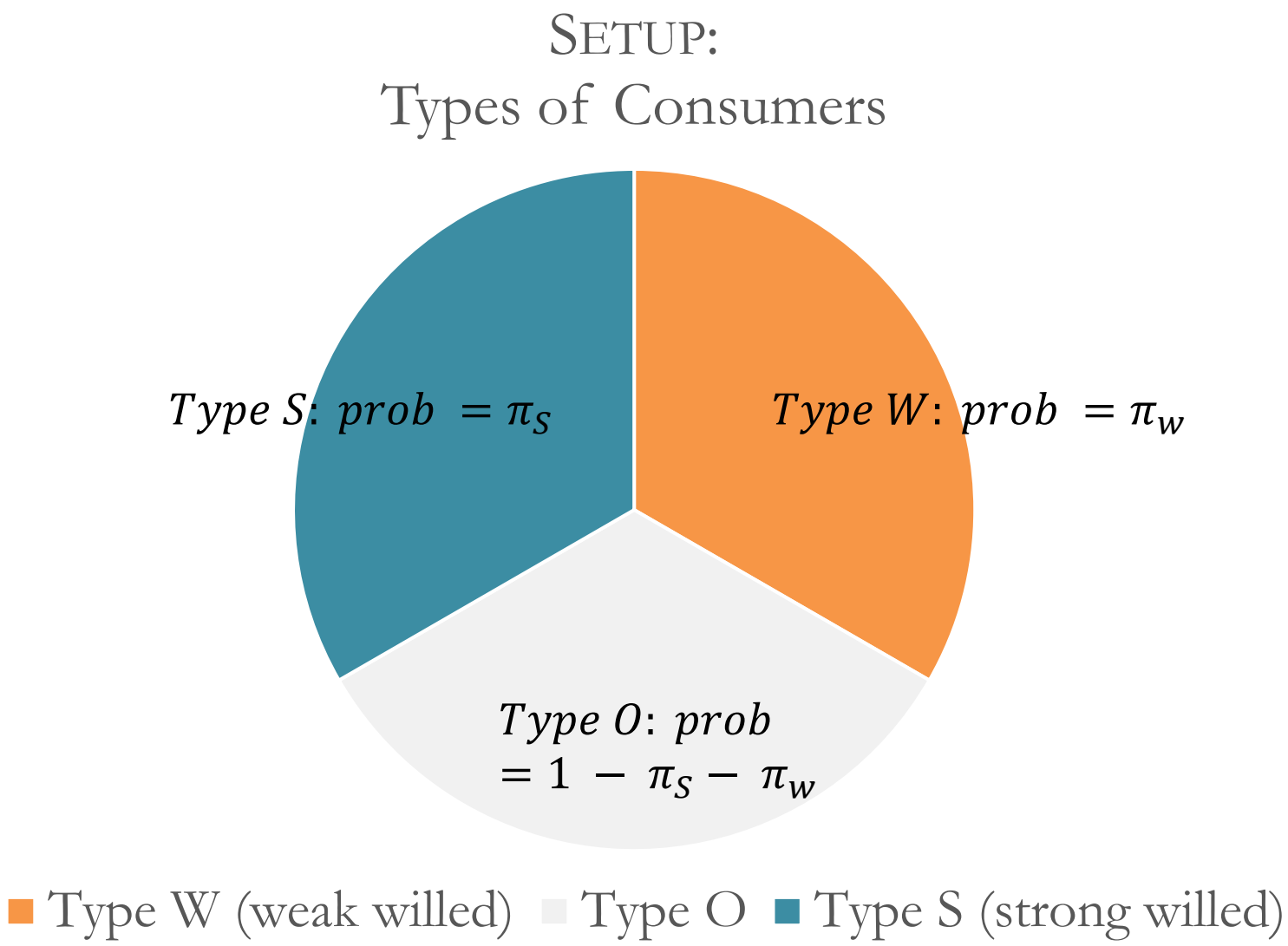
- Digital and data technologies greatly empower firms to precisely target and effectively influence consumers (Stigler Committee (2019), OECD (2019))
  - Fintech lenders induce overborrowing, Di Maggio and Yao (2021)
  - Profiled advertising, tailored nudges, dark patterns
  - Social media are addictive, Allcott et al. (2020), Allcott, Gentzkow and Song (2021)
  - Zarsky (2019) and Spencer (2020): protection of vulnerable consumers is better addressed through comprehensive data privacy legislation, i.e., GDPR & CCPA

- Data sharing exposes a consumer's vulnerabilities to digital platforms
  - Protecting data privacy is to protect personal vulnerabilities
  - GDPR and CCPA give each consumer the option to opt in or out of data sharing with a platform
    - Pareto efficient?

The Model

- A model to evaluate how privacy affects welfare when some consumers are vulnerable
- Ecosystem of a digital platform with two consumption goods sellers
  - Good A: a normal good like music
  - Good B: a temptation good like gambling & video game
    - more generally, Good A can be a convenience provided by the platform to attract users like free search or email
    - more generally, Good B a potential harm such as impulse consumption or addictive content
- A continuum of potential consumers in three types
  - Type S: strong willed, always reject good B
  - Type W: weak willed, may cave in to good B
  - Type O: won't buy either A or B

Distribution of consumers



Temptation utility

- Temptation utility framework of Gul & Pesendorfer (2001), Stovall (2010):

$$\max_{x \in N} [u(x) + v(x) - p(x)] - \max_{x' \in N} v(x')$$

  - $u(x)$ normal utility, $v(x)$ temptation utility
  - $\max_{x' \in N} v(x') - v(x)$ cost of self control
  - multi-self interpretation: Strotz (1955), Benabou & Pycia (2002), Dekel & Lipman (2012)

- Good A induces only normal utility to consumer i (either strong or weak-willed):

$$u(A) = \tilde{u}_i, \quad \tilde{u}_i \in [0, \bar{u}]$$

  - A consumer (with the choice) buys good A if $\tilde{u}_i \geq p_A$
  - Random utility prevents price discrimination by seller A

- Good B gives a negative normal utility of $u_B < 0$ (to all consumers) and temptation utility to consumer i (only weak-willed):

$$v_W(B) = \gamma_i \bar{v} - u_B, \qquad \gamma_i \in [0,1]$$

  - Weak-willed will buy if $\gamma_i \bar{v} > p_B$, leading to a utility of $\mathrm{u_B} - p_B$;
  - will reject it if $\gamma_i \bar{v} < p_B$, at a self-control cost of $\mathrm{u_B} - \gamma_i \bar{v}$

Menu preferences

- Possible menus for each consumer:

$$\{\emptyset, \{A, \emptyset\}, \{B, \emptyset\}, \{A, B, \emptyset\}\}$$

  - A strong-willed prefers a larger menu
  - A weak-willed is hurt by having good B on the menu:

$$U_W(\{B, \emptyset\}) = u_B + \max\{-p_B, -\gamma_i \bar{v}\} < 0$$

- Each consumer's menu is random and depends on sellers' advertising strategies and the platform's data sharing scheme

Goods sellers

SETUP:
Normal and temptation goods sellers

Seller A

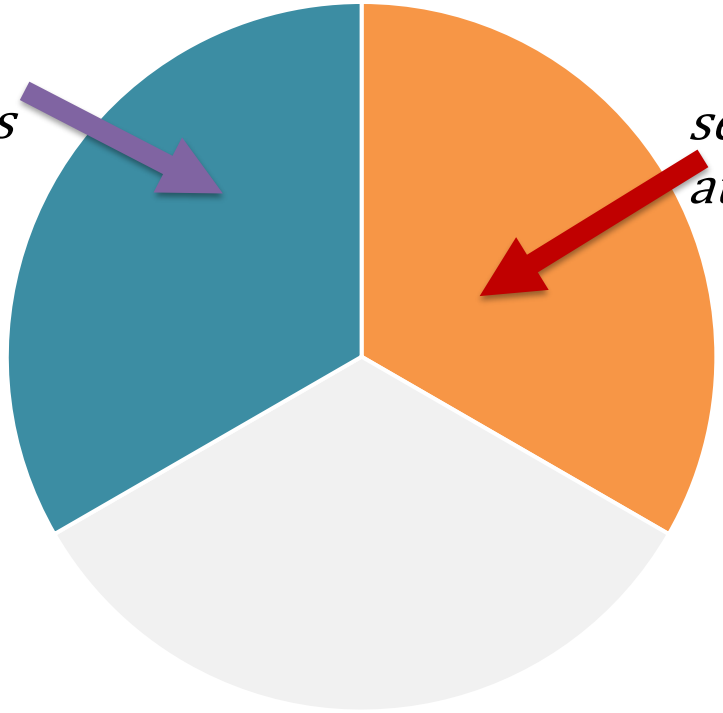
sends AD to z_A consumers at a price of p_A, costing

$$F\frac{z_A}{1-z_A}$$

Seller B

sends AD to z_B consumers at a price of p_B, costing

$$F\frac{z_B}{1-z_B}$$



Type W (weak willed) Type O Type S (strong willed)

Equilibrium and welfare

- Rational expectations equilibrium
  - Consumer optimization & seller optimization

- Social welfare:

$$W = \int \tilde{u}_A \left(\pi_S \mathbf{1}_{\left\{A \in \mathcal{M}_S^A \cap x_S = A\right\}} + \pi_W \mathbf{1}_{\left\{A \in \mathcal{M}_W^A \cap x_W = A\right\}} \right) dH\left(\tilde{u}_A\right)$$
$$+ \pi_W \int \left(u_B \mathbf{1}_{\left\{B \in \mathcal{M}_W^B \cap x_W = B\right\}} + \left(u_B - \gamma_i \bar{v}\right) \mathbf{1}_{\left\{B \in \mathcal{M}_W^B \cap x_W = \emptyset\right\}} \right) dG\left(\gamma_i\right).$$

  - Marginal cost of production is zero
  - Good price and advertising cost are distributional

- First-best equilibrium: seller A advertises to all strong-willed and weak-willed consumers and seller B advertises to no one.

- Equilibrium under four data sharing schemes
  - No data sharing
  - Full data sharing
  - GDPR
  - CCPA

Equilibrium without data sharing

BASELINE

Seller A

$$z_A^{NS} = 1 - 2\sqrt{\frac{1}{\pi_S + \pi_W}\frac{F}{\bar{u}}}$$

$$p_A^{NS} = \frac{1}{2}\bar{u}$$

Effective AD: $(\pi_S + \pi_W) z_A^{NS}$

Half accepted by $\tilde{u}_i > \frac{1}{2}\bar{u}$

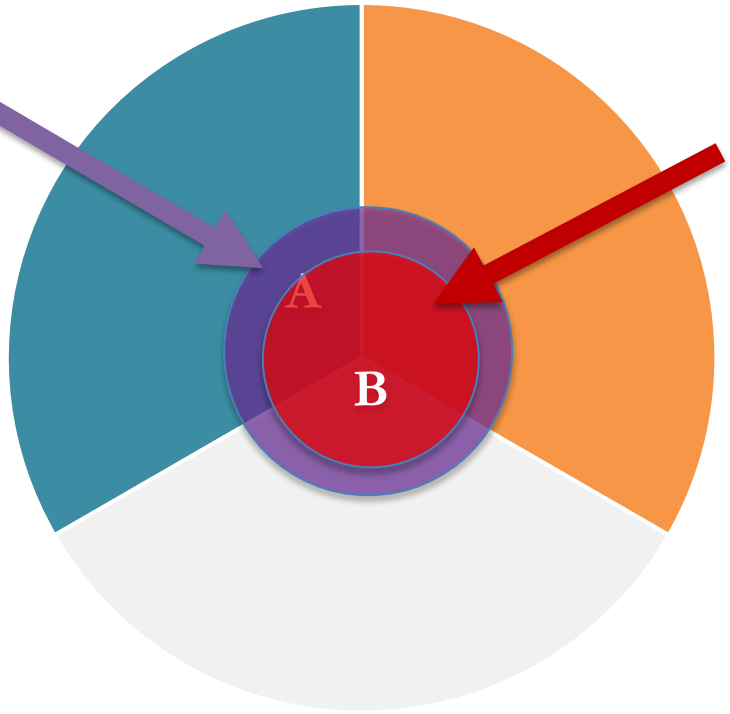
Seller B

$$z_B^{NS} = 1 - 2\sqrt{\frac{1}{\pi_W}\frac{F}{\bar{v}}}$$

$$p_B^{NS} = \frac{1}{2}\bar{v}$$

Effective AD: $\pi_W z_B^{NS}$

Half accepted by $\gamma_i > \frac{1}{2}$



Type W (weak willed) Type O Type S (strong willed)

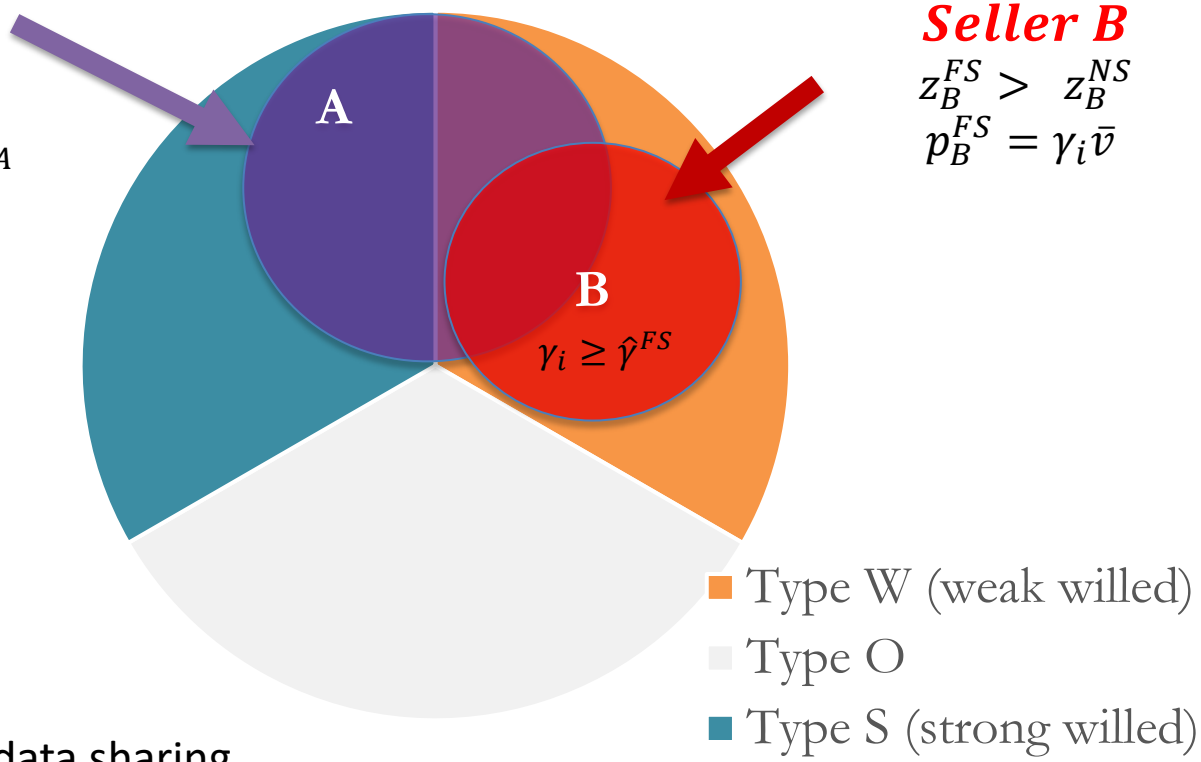
Equilibrium with full data sharing

Full Data Sharing: Sellers know W, S, O

Seller A

$$z_A^{FS} = 1 - 2\sqrt{\frac{F}{\bar{u}}} > z_A$$

$$p_A^{FS} = \frac{1}{2}\bar{u}$$



Seller B

$$z_B^{FS} > z_B^{NS}$$

$$p_B^{FS} = \gamma_i \bar{v}$$

- Consequences of full data sharing
  - Improves the profits of both sellers
  - Improves the welfare of strong-willed consumers
  - Reduces social welfare if temptation problem is sufficiently severe, i.e., u_B sufficiently low

Opt-in & opt-out policies

- GDPR & CCPA give each consumer the choice to opt in or out of data sharing on digital platforms
  - Strong-willed & modestly weak-willed can choose to opt in and benefit from improved matching with seller A
  - Severely weak-willed can opt out to hide from seller B
  - These policies appear Pareto efficient and thus dominate both no-sharing and full-sharing schemes
    - Does this logic work?
- GDPR & CCPA differ in default choice, as nudging (e.g., Thaler and Sunstein)
  - **GDPR:** cannot collect data unless consumer explicitly opts in
  - **CCPA:** can collect data unless consumer explicitly opts out

Equilibrium under GDPR

Seller A

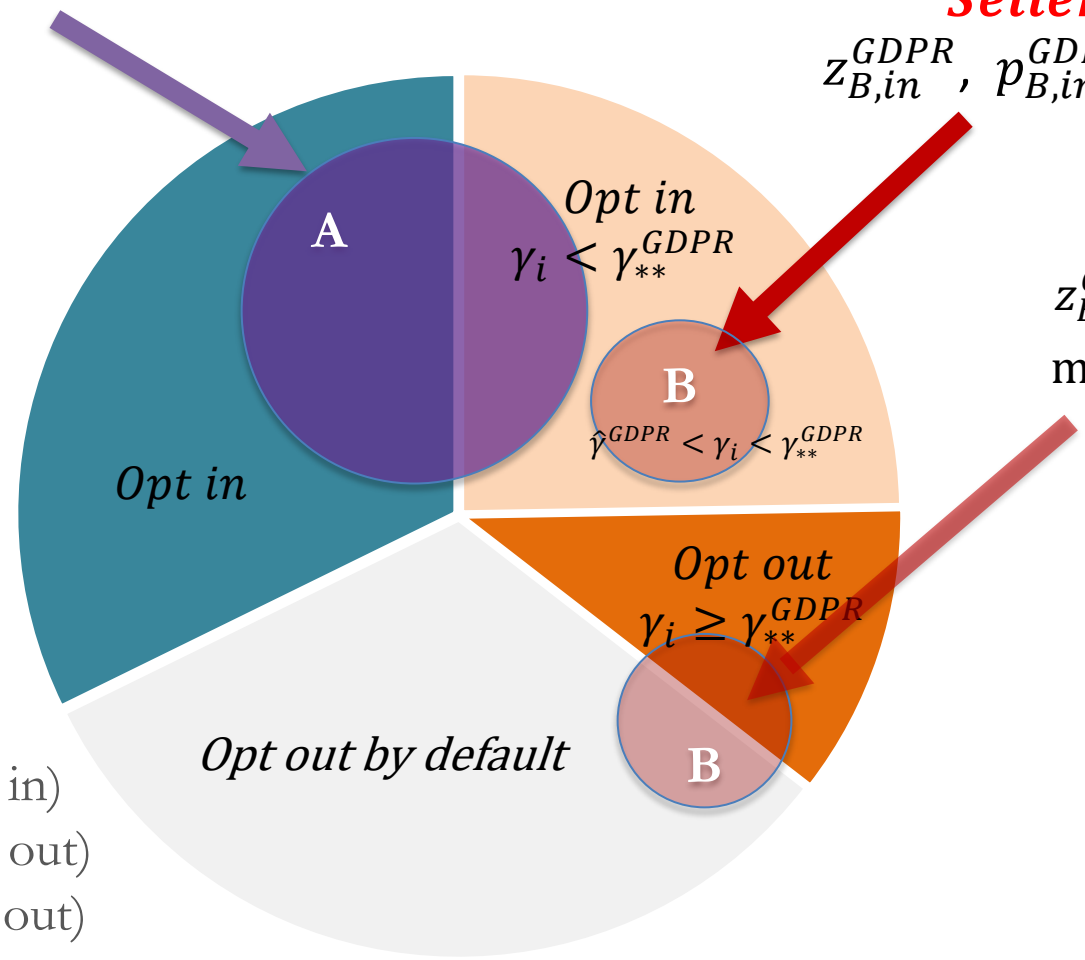
$$z_{A,in}^{GDPR} = 1 - 2\sqrt{\frac{F}{\bar{u}}}$$

$$p_A^{GDPR} = \frac{1}{2}\bar{u}$$

Seller B

$$z_{B,in}^{GDPR},\ p_{B,in}^{GDPR} = \gamma_i \bar{v}$$

$$z_{B,out}^{GDPR},\ p_{B,out}^{GDPR} = \max\{\frac{1}{2}, \gamma_{**}^{GDPR}\}\bar{v}$$



- Type W (opt in)
- Type W (opt out)
- Type O (opt out)
- Type S (opt in)

Liu, Sockin & Xiong (2020)

Equilibrium under CCPA

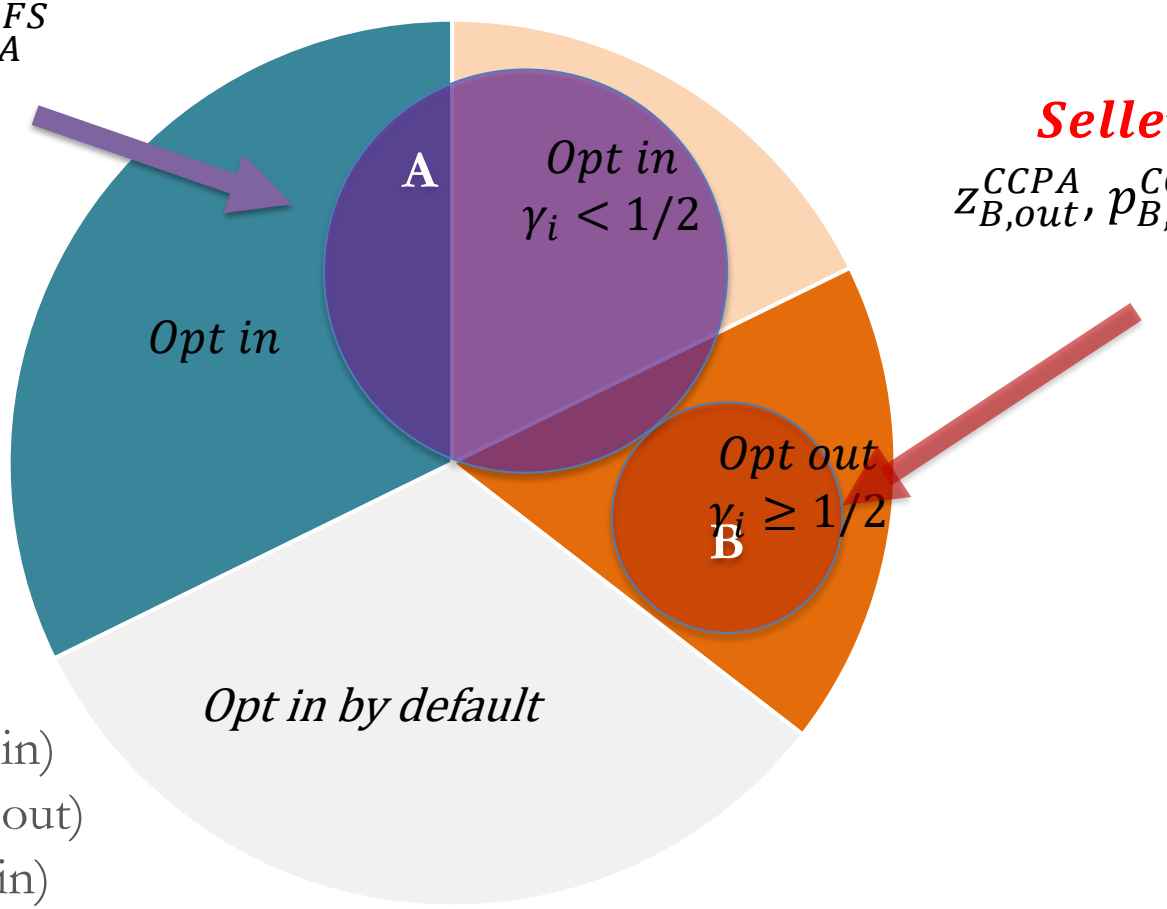
Seller A

$$z_A^{CCPA} = 1 - 2\sqrt{\frac{F}{\bar{u}}} = z_A^{FS}$$

$$p_A^{CCPA} = \frac{1}{2}\bar{u}$$

Seller B

$$z_{B,out}^{CCPA}, p_{B,out}^{CCPA} = \frac{1}{2}\bar{v}$$



- Type W (opt in)
- Type W (opt out)
- Type O (opt in)
- Type S (opt in)

Liu, Sockin & Xiong (2020)

Social Ranking

- CCPA strictly dominates Full Data Sharing
  - CCPA allows seller A to fully cover strong- & weak-willed, and provides some protection to weak-willed
- Among CCPA, GDPR, No Data Sharing
  - CCPA superior if temptation (u_B) sufficiently modest
  - No Data Sharing superior if temptation (u_B) sufficiently severe
  - May exist intermediate range where GDPR most desirable

Externality in data sharing

Opt-in & opt-out choices are supposed to make the equilibrium Pareto efficient, but

- $W^{NS} \geq W^{GDPR}$ if u_B is sufficiently negative

- Negative externality:
  - Opt-in by strong-willed reduces camouflage of weak-willed who opt-out

GDPR provides stronger consumer protection, but

- $W^{CCPA} \geq W^{GDPR}$ if u_B is only modestly negative

- Positive externality:
  - By making opt-in default setting, seller A can fully cover weak-willed consumers in opt-out pool

Social nature of data market, e.g., Bergemann et al (2019), Acemoglu et al (2019), Easley et al. (2019)

- In these models, a monopolist platform drives a consumer's cost of data-sharing to zero because other's data already reveals a lot of information about consumer

- In our setting, data-sharing cost positive for vulnerable consumers and platforms must offer benefits to offset this cost
  - both costs and benefits depend on others' data-sharing choices

Summary

- A model of privacy preferences through temptation utility
- A simple tradeoff of data sharing
  - Improves the matching between normal good sellers and consumers
  - Exposes weak-willed consumers to temptation good sellers
- Data sharing comes with positive and negative externalities:
  - Each consumer is indirectly affected by data sharing choices of others, with both improved matching with normal good and greater exposure to temptation good
  - The net of these externalities determine the welfare ranking of GDPR, CCPA, and no data sharing

Implications

- The Data Privacy Paradox
  - Gross and Acquisti (2005), Goldfarb and Tucker (2012), Athey et al. (2017), Tang (2019), Acquisti, Brandimarte, and Loewenstein (2020): various consumer biases in making data sharing decisions
  - Our model highlights the trade-off bw cost and benefit in data sharing, consistent with evidence from Chen et al. (2021)

- Data privacy regulations have limited capabilities to protect vulnerable consumers due to
  1. Digital platforms bundle data sharing choices
  2. Externalities of data sharing
  - Nevertheless data privacy regulations are more suitable than current consumer protection laws, which are based on fraud and misrepresentation, e.g., Calo (2013) and Sunstein (2015)

- The default choice in data privacy regulation can have substantial effects on data sharing equilibrium
  - Different from default choice as nudge, Thaler and Sunstein (2008)