Data Privacy and Temptation

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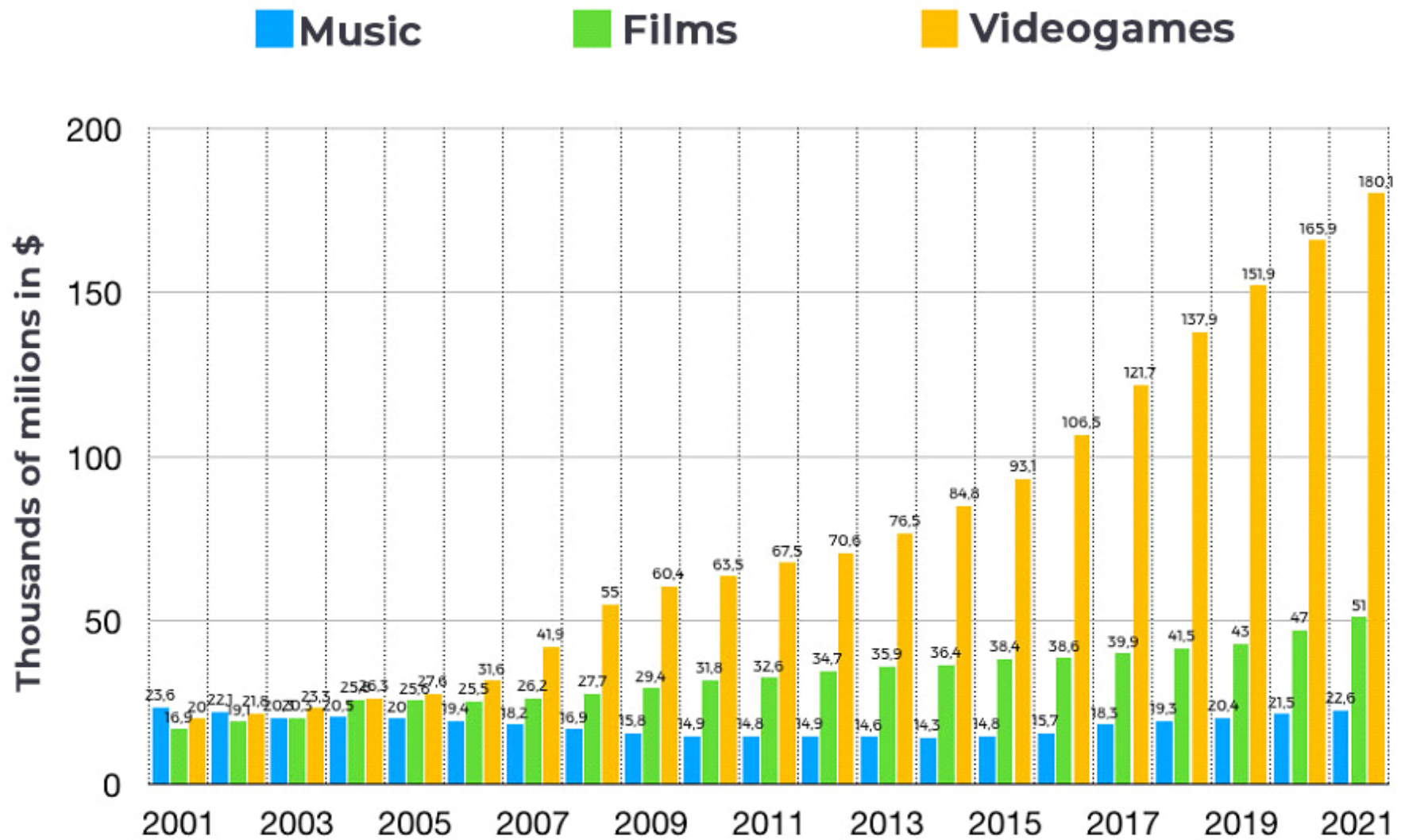
- Growing concerns about data privacy in the digital age
  - EU's General Data Privacy Regulation (GDPR), effective on 5/ 25/2018
  - California Consumer Privacy Act (CCPA), effective on 1/1/2020
  - Demand for normative analysis of privacy regulations

- Extensive literature based on an indirect approach through price discrimination, as reviewed by Acquisti, Taylor & Wagman (2016), Bergemann and Morris (2019), Goldfarb & Tucker (2019)
  - A key tradeoff of data sharing: it improves matching efficiency, thus raising social welfare; but also allows firms to price discriminate consumers
  - The net effect on consumer surplus depends on market setting

- New approach to derive a preference for privacy from temptation utility

Liu, Sockin & Xiong (2020)

A compulsive gambler

- He tries to recover from gambling:
  - he deleted all the casino apps from his smart phone;
  - he removed his profile from all of the major gambling sites;
  - he set up a rule in Gmail to automatically delete any emails that are related to gambling.

- One day, he logged on to YouTube: "99% of the ads I see on YouTube are for gambling."

Consumer temptation

- Temptation is a problem of bounded self-control
  - Gambling
  - Video game
    - In 2018, the World Health Organization (WHO) for the first time recognized "gaming disorder". The great majority of gamers would not experience anything close to addiction, but some gamers do struggle with addiction
    - Aguiar et al. (2018): gaming reduced labor supply of young men (ages 21-30) in U.S. by 1.5 to 3.1% since 2004
  - E-cigarette, online alcohol, adult film...
  - Payday loans

- These industries have all been using big data to target consumers, especially potential addicts

Music Films Videogames

Sources
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En.Digital

Liu, Sockin & Xiong (2020)

Temptation and data sharing

- Data sharing may expose tempted consumers to temptation goods, inducing a net social loss
  - Different from price discrimination: a distributional effect

- Competition does not cure temptation, even though it helps to mitigate price discrimination
  - Competition drives firms to exploit consumer temptation by making their products and ads even more tempting
  - Williams (2018): technology competes for people's limited time and attention by using addictive content

- Reminders and disclosures do not reduce temptation, even though they help to mitigate consumer neglect

- Consumer temptation motivates privacy regulations
  - Can allowing consumers to opt in & out of digital tracking, such as GDPR & CCPA, protect them? If so, which one is more effective?

Liu, Sockin & Xiong (2020)

The Model

- A model to evaluate how privacy affects welfare when some consumers subject to temptation

- An ecosystem around a digital platform, with two consumption goods sellers
  – Good A: a normal good like music
  – Good B: a temptation good like gambling & video game

- 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

SETUP:
Types of Consumers

Type S: $prob = \pi_S$ Type W: $prob = \pi_w$

Type O: $prob = 1 - \pi_S - \pi_w$
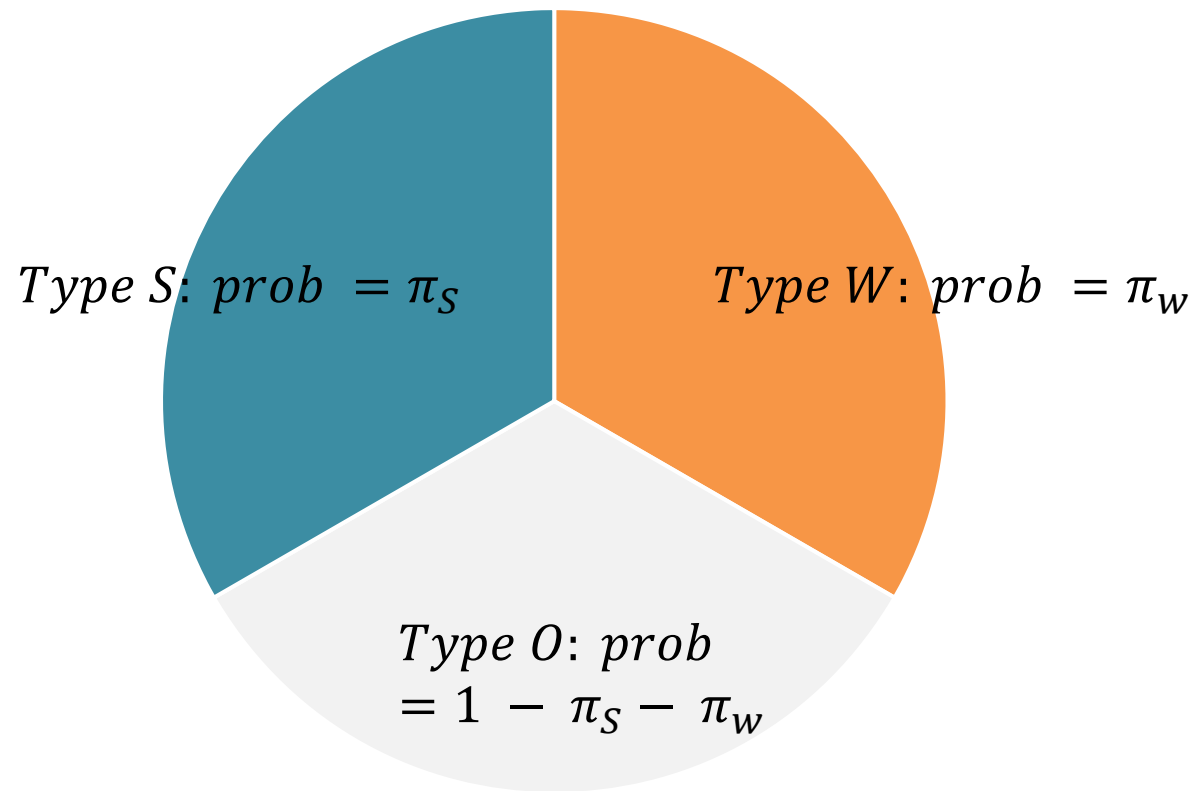
■ Type W (weak willed)   ■ Type O   ■ Type S (strong willed)

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):

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

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

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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

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)

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11
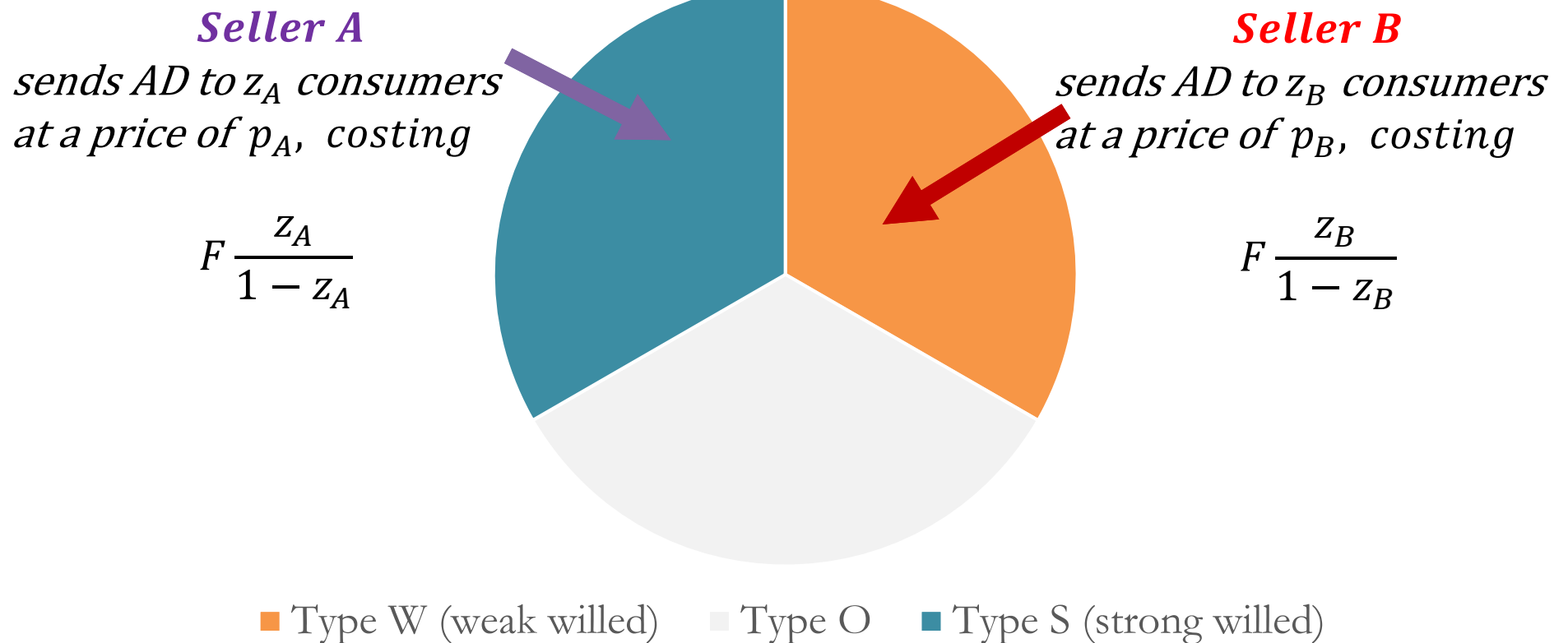
Equilibrium and welfare

- Rational expectations equilibrium
  - Consumer optimization & seller optimization

- Social welfare:
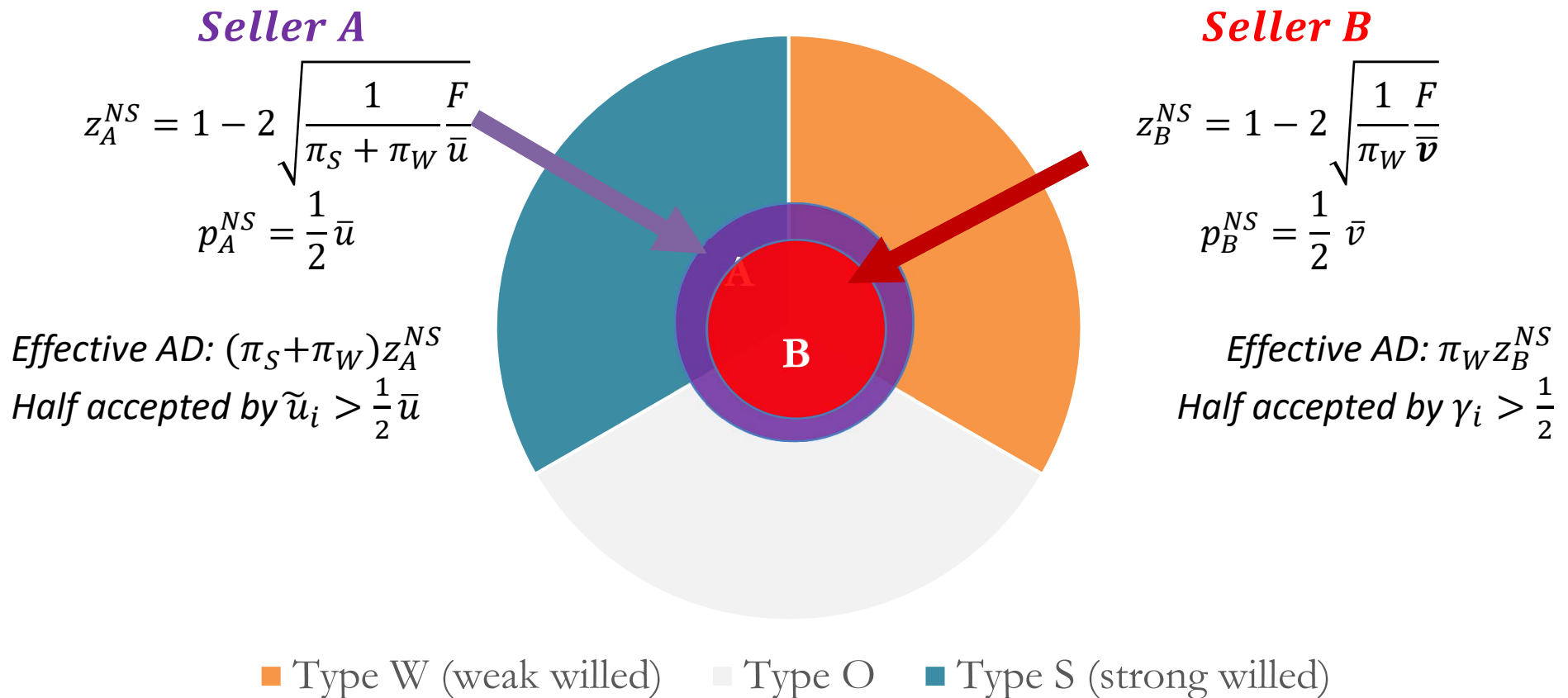
$$W = \int \tilde{u}_A \left(\pi_S \mathbf{1}_{\{A \in \mathcal{M}_S^A \cap x_S = A\}} + \pi_W \mathbf{1}_{\{A \in \mathcal{M}_W^A \cap x_W = A\}} \right) dH\left(\tilde{u}_A\right)$$

$$+ \pi_W \int \left(u_B \mathbf{1}_{\{B \in \mathcal{M}_W^B \cap x_W = B\}} + \left(u_B - \gamma_i \bar{v}\right) \mathbf{1}_{\{B \in \mathcal{M}_W^B \cap x_W = \emptyset\}} \right) dG\left(\gamma_i\right).$$

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

- The 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

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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 $\gamma_i > \frac{1}{2}$

A

B

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

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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

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

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

A

B

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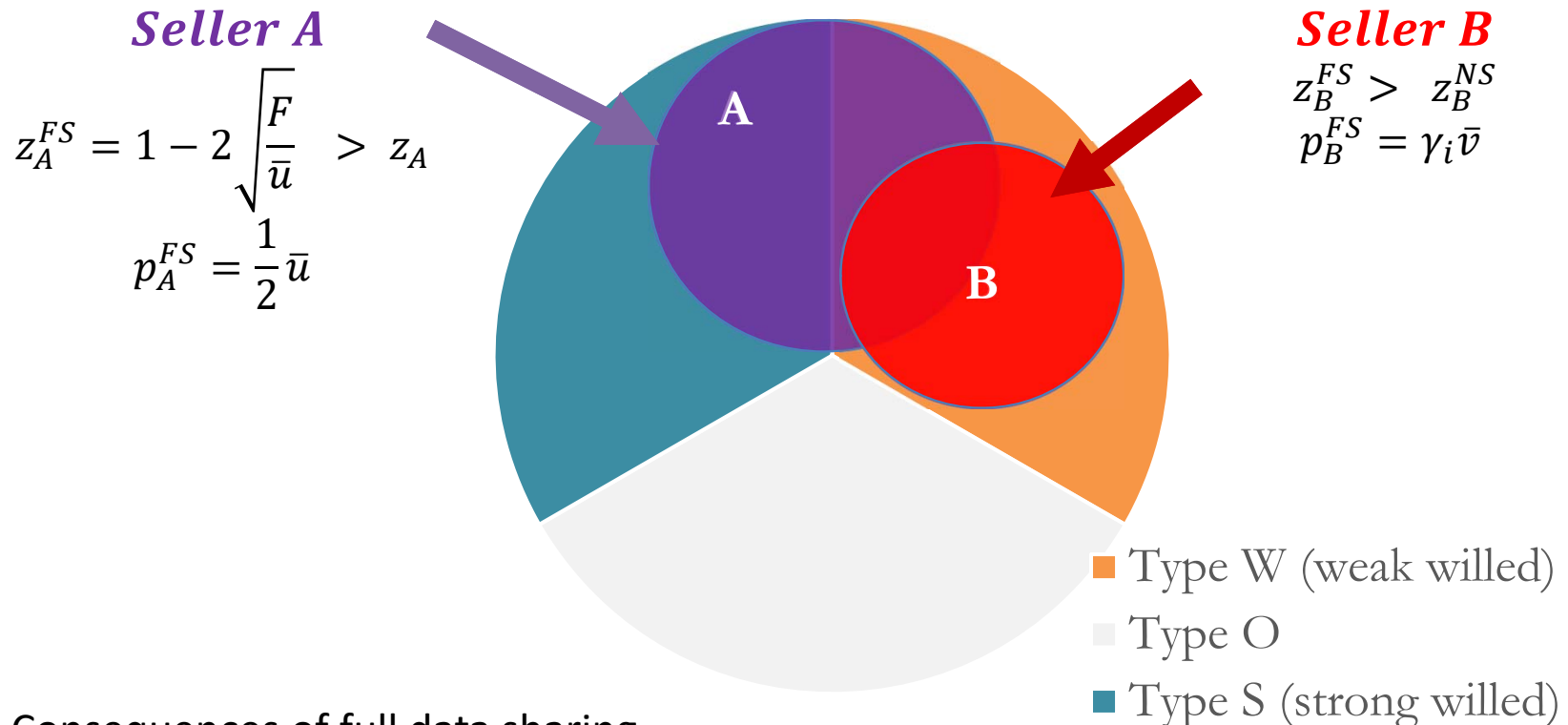
- Consequences of full data sharing
  - Improves the profits of both sellers
  - Improves the welfare of strong-willed consumers
  - Reduces social welfare if temptation problem is sufficiently severe, i.e., u_B sufficiently low

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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 the default choice
  - Under GDPR, no data collection unless a consumer explicitly opts in
  - Under CCPA, firms are allowed to collect data unless a consumer explicitly opts out
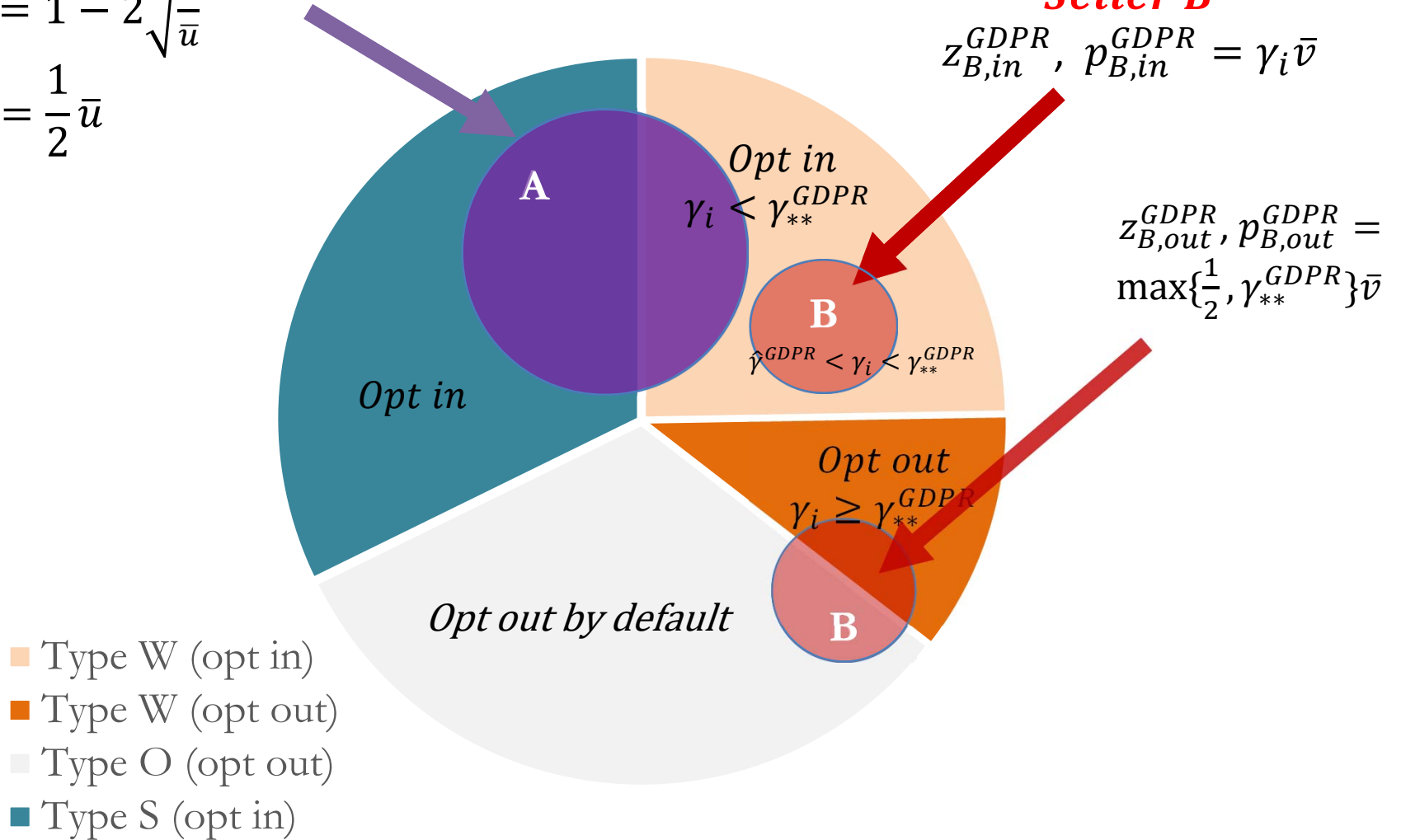
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Seller A

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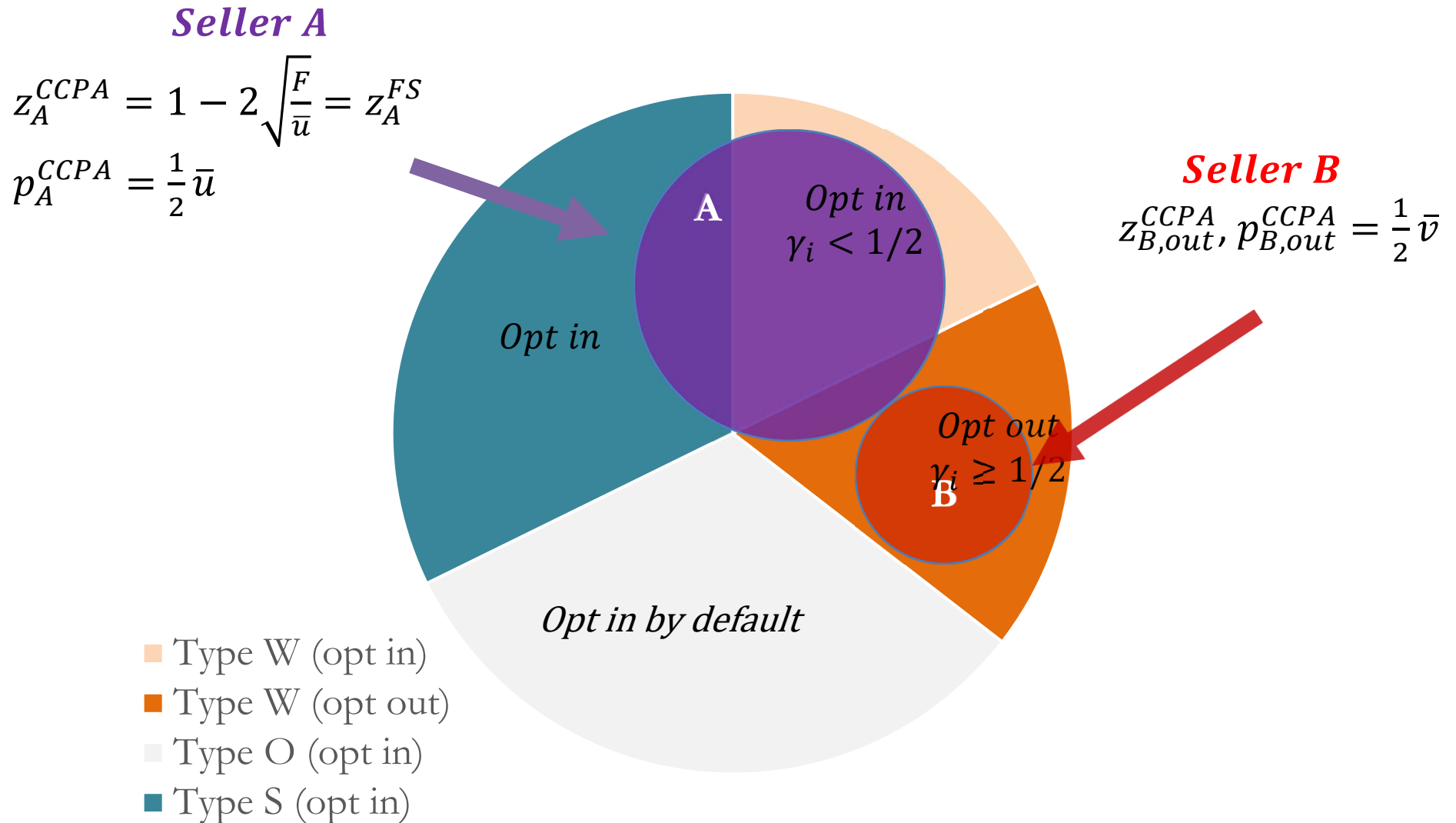
$$p_A^{GDPR} = \frac{1}{2}\bar{u}$$

Seller B

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

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

A

Opt in
$\gamma_i < \gamma_{**}^{GDPR}$

B

$\hat{\gamma}^{GDPR} < \gamma_i < \gamma_{**}^{GDPR}$

Opt in

Opt out
$\gamma_i \geq \gamma_{**}^{GDPR}$

Opt out by default

B

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

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16

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

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

A

Opt in
$\gamma_i < 1/2$

Opt in

Opt out
$\gamma_i \geq 1/2$

B

Opt in by default

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

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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 is superior if temptation (u_B) sufficiently modest
  - No Data Sharing is superior if temptation (u_B) sufficiently severe
  - There may exist an intermediate range for GDPR to be 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 the camouflage of weak-willed in the opt-out pool

GDPR provides stronger consumer protection, but

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

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

The social nature of data sharing, e.g., Bergemann et al (2019) and Acemoglu et al (2019)

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 other consumers, 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

- Digital privacy paradox
  - Consumers' data sharing choices reflect intricate trade-offs between cost and benefit

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