The bright side of the GDPR: Welfare-improving privacy management

Chongwoo Choe (Monash University)
Noriaki Matsushima (Osaka University)
Shiva Shekhar (Tilburg University)

CPRC seminar

19 January 2024

What this paper does (1/2)

Setting **Consumers can decide whether to opt in to obtain opt-in benefits from a digital service monopolist that earns from opted-in data (data-based revenue).**

Consumers **are heterogeneous in terms of opt-in costs (privacy costs) and valuations for the product.**

Two cases **The two cases related to the opt-in decisions:**

1. **The monopolist forces consumers to opt in to purchase the product (no GDPR case);**
2. **Consumers can choose whether to opt in when they purchase the product (GDPR case).**

The assumption implies that the monopolist cannot commit not to use data of consumers who opt out under no GDPR case (credibility issues).

What this paper does (2/2)

Setting **Consumers can decide whether to opt in to obtain opt-in benefits from the monopolist, which earns from opted-in data (data-based revenue).**

Results **After the GDPR,**

1. **The equilibrium price increases due to (i) entries of privacy-conscious consumers; (ii) a decrease in opt-in consumers.**
2. **The equilibrium demand does not always increase. It shrinks when the level of data-based revenue is high (due to an *ex-ante* low price).**
3. **The profit increases if the data revenue is small.**
4. **Consumer welfare increases if the data-based revenue is small and the opt-in benefits are small.**

Outline of the presentation

1. **Background (2 pages)**
2. **The model (1 page)**
3. **Analysis (6 pages)**
4. **Extensions (2 pages)**
5. **Implications (1 page)**
6. **Conclusion (2 pages)**

Background (1/2)

GDPR **The European Union (EU)'s General Data Protection Regulation is a stringent law that governs personal data protection.**  **https://gdpr.eu/**

Consumers can make a "freely given, specific, informed and unambiguous" consent to the processing of their personal data (Article 7, Recital 32).

Significant penalties for non-compliance (e.g., 746 million euro fine imposed by Luxembourg's privacy watchdog (CNPD) on Amazon in 2021 (in dispute)).

Pros and cons **[pros] More user control over personal data and transparency; [cons] The complexity and compliance costs, especially, for smaller businesses.**

Background (2/2)

Criticisms from the academia **Many academic researches point out the negative sides of the GDPR.**

Empirical (1) **A decrease in the collected data (Schmitt et al., 2021; Congiu et al., 2022; Aridor et al., in press),**

Empirical (2) **dampening AI startups and data-based innovation (Bessen et al., 2020; Jia et al., 2021; Batikas et al., 2023), production of mobile apps (Janßen et al., 2022), and webpage views (Goldberg et al., 2022).**

Theory **Ineffective (Choi et al., 2019; Chen, 2022).**

Question **One may wonder if there is any salutary effect to the GDPR. Isn't privacy management beneficial for consumers? Can't such benefits be also good for firms?**

This paper **considers the (positive) effects of the GDPR.**

The model

A digital business monopolist **without marginal cost provides a product at price p.**

Consumers **are heterogeneous in valuation v and privacy cost c (independent and uniformly distributed on $[0, 1]$).**

Options **(i) buying with Sharing data (opt-in); (ii) buying but Not sharing data (opt-out); (iii) no purchasing.**

Opt-in x **(a common fixed benefit for opt-in consumers).**

Demand D_S**: The number of consumers who Share data;**

D_N**: The number of consumers who do Not share data.**

Utility **Opt-in:** $U_S \equiv v + (x - c) - p$**; Opt-out:** $U_N \equiv v - p$**.**

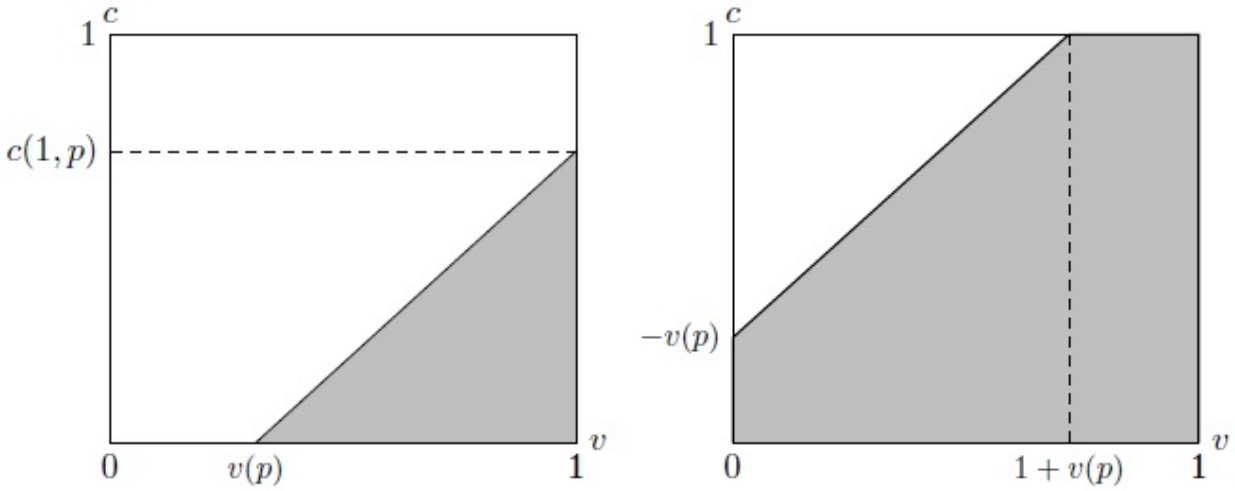
Profits $\Pi \equiv pD(\cdot) + \alpha D_S(\cdot)$;

α**: gain from per-unit data;** $D = D_S + D_N$**.**

Two scenarios **No GDPR:** p**; GDPR:** $p \to$ **opt-in decisions.**

Analysis (1/6)

No GDPR $U_S = v + (x - c) - p \geq 0 \Rightarrow c \leq c(v, p) = v - \underbrace{(p - x)}_{\equiv v(p)}$.



(a) Case 1a: $0 < v(p) < 1$ (b) Case 1b: $-1 < v(p) \leq 0$

Case (1a) iff $\alpha < \alpha_1 \equiv \max\{(1 - 2x)/2, 0\}$.

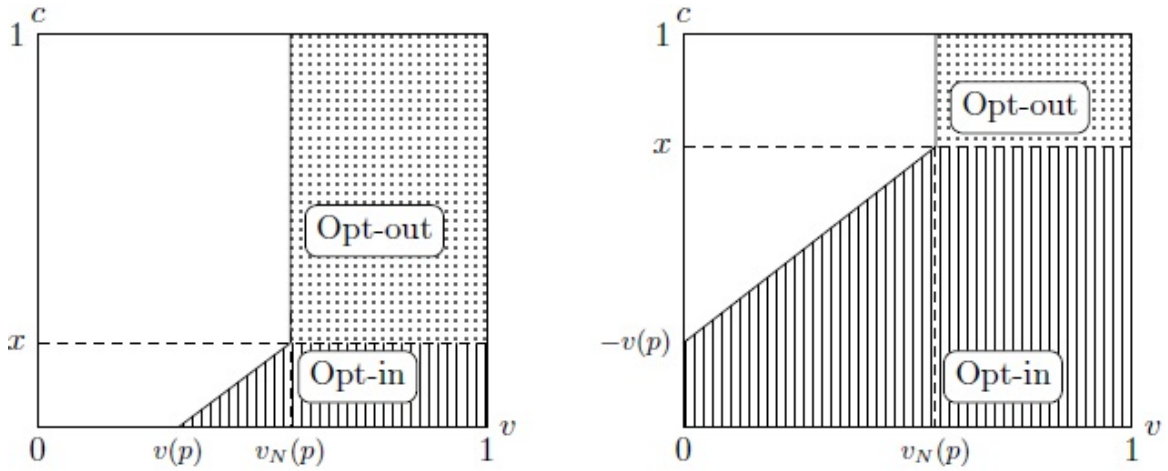
Lemma 1 $x \uparrow \Rightarrow p \uparrow$; $\alpha \uparrow \Rightarrow p \downarrow$;

$x, \alpha \uparrow \Rightarrow D, \Pi, CS \uparrow$, CS: **consumer surplus.**

Analysis (2/6)

GDPR **Opt-in:** $c \leq x$ **and** $U_S \equiv v + (x - c) - p \geq 0$; $v(p) = p - x$.

Opt-out: $c > x$ **and** $U_N \equiv v - p \geq 0$; $v_N(p) \equiv p$



(a) Case 2a: $0 < v(p) < 1$ (b) Case 2b: $-1 < v(p) \leq 0$

Case (2a) iff $\alpha < \alpha_2 \equiv \max\{(2 - 4x + x^2)/(2x), 0\}$.

Lemma 2 $x \uparrow \Rightarrow p \downarrow$ **iff** $\alpha_2 > \alpha \geq x$; $x \uparrow \Rightarrow D, D_S \uparrow$;

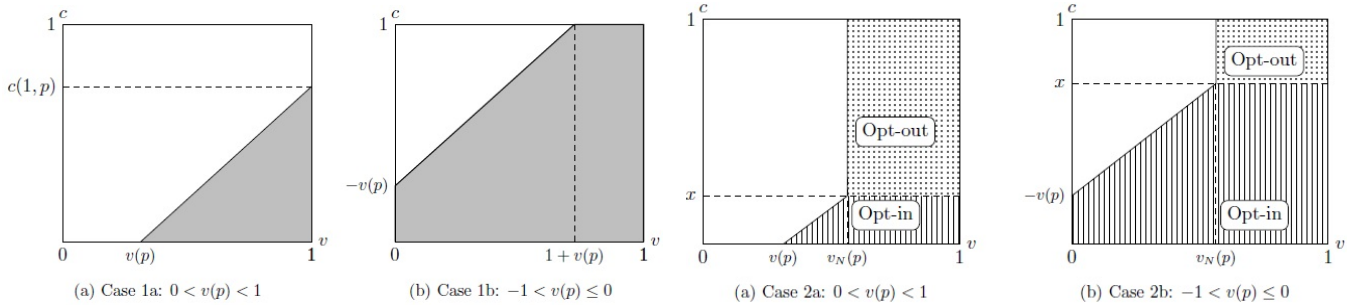
$x \uparrow \Rightarrow D_N \uparrow$ **iff** $\alpha_2 > \alpha > (2 + 2x - 3x^2)/(2(1 - 2x))$;

$\alpha \uparrow \Rightarrow p \downarrow$; $\alpha \uparrow \Rightarrow D_S, D_N \uparrow$; $x, \alpha \uparrow \Rightarrow \Pi, CS \uparrow$.

Analysis (3/6)

Lemma 3 **Classifying the two scenarios into the followings:**

1. $x \leq 1/2$, $\alpha < \alpha_1$: **Cases (1a) and (2a);**
2. $1/2 < x \leq 2 - \sqrt{2}$, $\alpha_1 \leq \alpha < \alpha_2$: **Cases (1b) and (2a);**
3. $2 - \sqrt{2} < x \leq 1$, $\alpha_2 \leq \alpha$: **Cases (1b) and (2b).**



(a) Case 1a: $0 < v(p) < 1$ (b) Case 1b: $-1 < v(p) \leq 0$ (a) Case 2a: $0 < v(p) < 1$ (b) Case 2b: $-1 < v(p) \leq 0$

Proposition 1 **After the GDPR, the price increases.**

(i) Entries of privacy-conscious consumers;

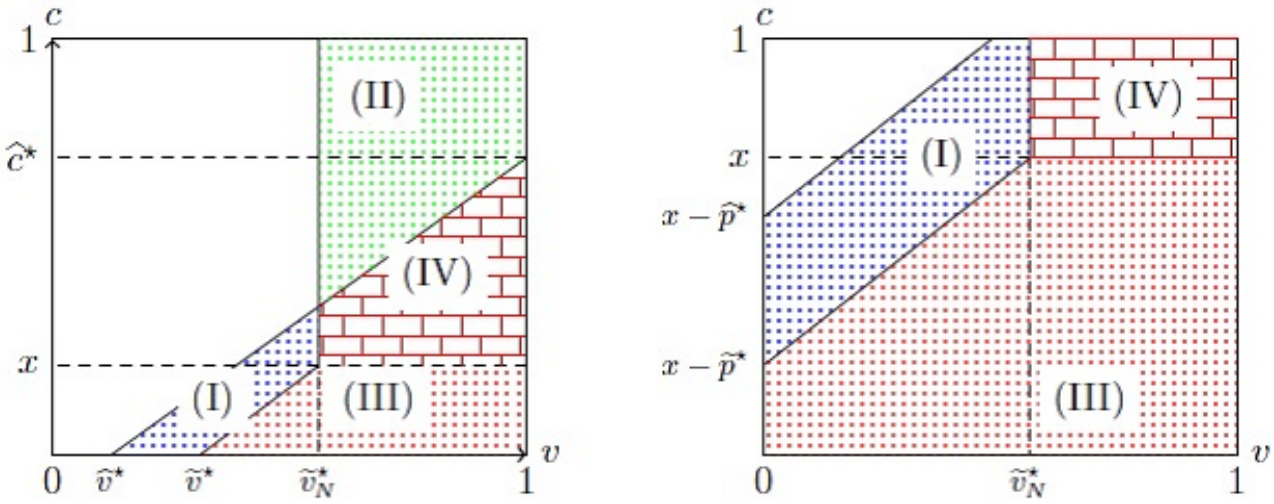
(ii) A decrease in opt-in consumers

(Schmitt et al., 2021, and others).

Analysis (4/6)

Proposition 2 **The change in demand after the GDPR:**

- **The total demand D increases iff α is lower than a threshold;**
- **Consumers without privacy costs are less likely to buy;**
- **The opt-in demand decreases.**



(a) Case 1: $\alpha < \alpha_1(x)$ (b) Case 2: $\alpha_1(x) \leq \alpha_2(x) \leq \alpha$

(I) Exit; (II) Entry (Opt-out); (III) Opt-in; (IV) Opt-out

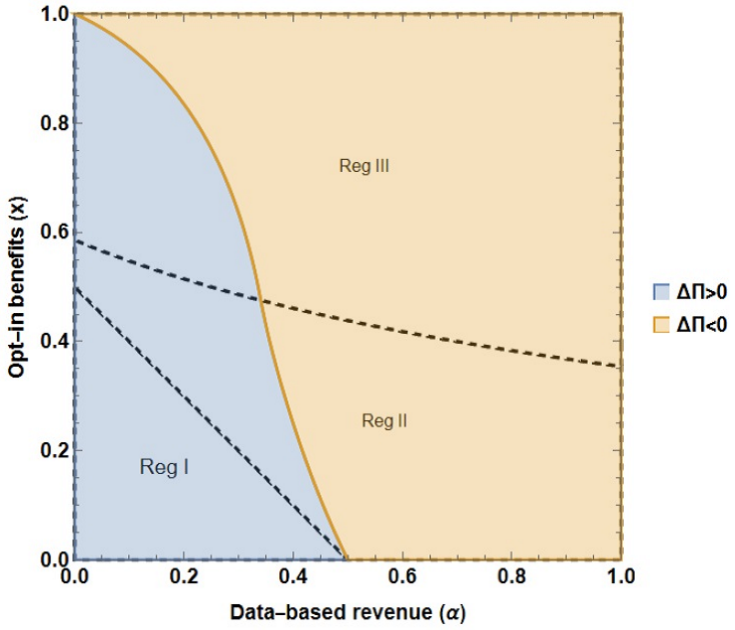
Analysis (5/6)

Proposition 3 **The change in profits after the GDPR: The profit increases iff α is lower than a threshold.**

Blue: $\Pi\uparrow$; **Orange:** $\Pi\downarrow$.

Low (High) α: **Small (Large) losses from opt-out decisions;**

Low (High) x: **Large (Small) gains from entries of high cost consumers.**



An increase in price partially offsets the losses.

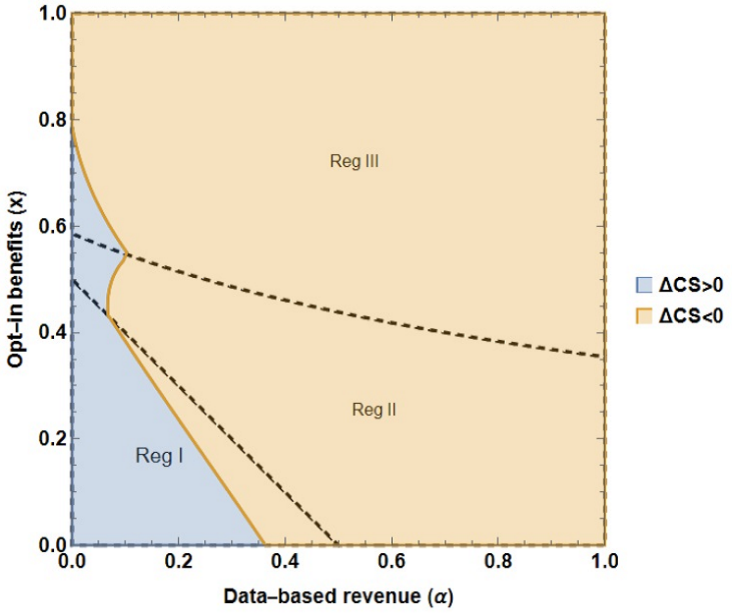
Analysis (5/6)

Proposition 4 **The change in consumer surplus (CS) after the GDPR: The consumer surplus increases iff α and x are lower than thresholds.**

Blue: $CS \uparrow$; **Orange:** $CS \downarrow$.

Low (High) α: **Small (Large) losses from opt-out decisions;**

Low (High) x: **Large (Small) gains from entries of high cost consumers.**

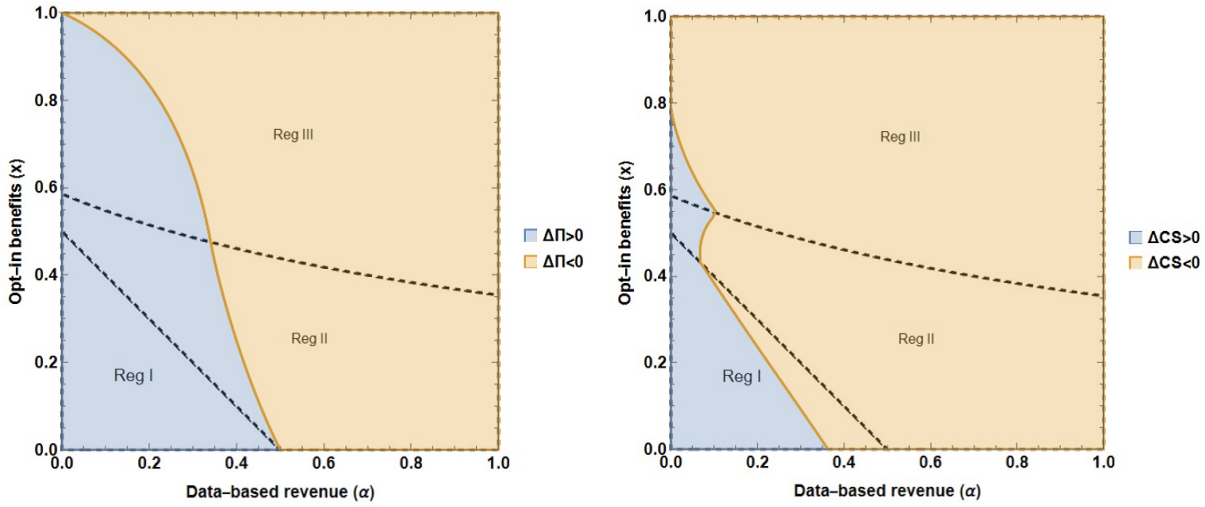


An increase in price worsens the consumer surplus.

Analysis (6/6)

Proposition 3 **Π increases iff α is low.**

Proposition 4 **CS increases iff α and x are low.**



Low/High α: Small/Large losses from opt-out decisions.

Low/High x: Large/Small gains from high-cost consumers.

An increase in price benefits the firm.

An increase in price worsens the consumer surplus.

Extensions (1/2)

Preference correlation **Positive and negative correlations.**

Positive correlation ($c = \phi v$): **No demand expansion, harming the firm and benefiting consumers.**

Negative correlation ($c = 1 - \phi v$): **Entries of low v consumers; the demand becomes independent of x (indifferent consumers are opt-out consumers with low v).**

Proposition 5 **Under the positive correlation, $\Pi \downarrow$, $CS \uparrow$; Under the negative correlation, $\Pi \uparrow$ if α is smaller than a threshold, $CS \uparrow$ if α is smaller than a threshold.**

Extensions (2/2)

Data externality **Positive and negative network benefits. The key insights do not change.**

Positive network benefits (θD_S): **Add θD_S to the utility functions.**

$$U_S = v + (x - c) + \theta D_S - p;$$
$$U_N = v + \theta D_S - p;$$
$$U_O = 0.$$

Negative network benefits ($\gamma c D_S$): **Add $\gamma c D_S$ to consumers who do not opt in.**

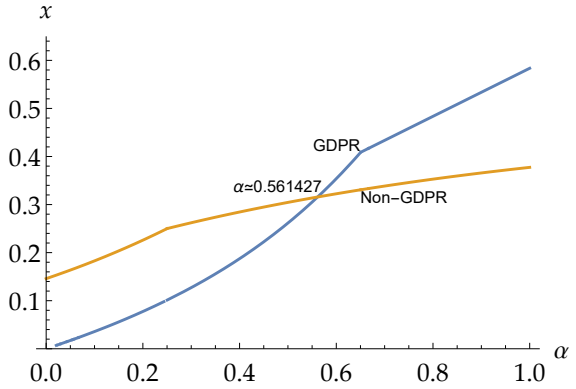
$$U_S = v + (x - c) - p;$$
$$U_N = v - \gamma c D_S - p,$$
$$U_O = -\gamma c D_S.$$

Implications

Data revenue **The profitability of data is a key factor:**

- **Firms with low data revenues sufficiently increase demands, improving welfare.**
  Such firms should provide clear privacy management systems to consumers.
- **Firms with high data revenues do not sufficiently increase demands, harming welfare.**

What such firms should do? **If we endogenize the choice of opt-in benefits, x, under investment costs x^2, the monopolist should make more efforts to improve the benefits.**

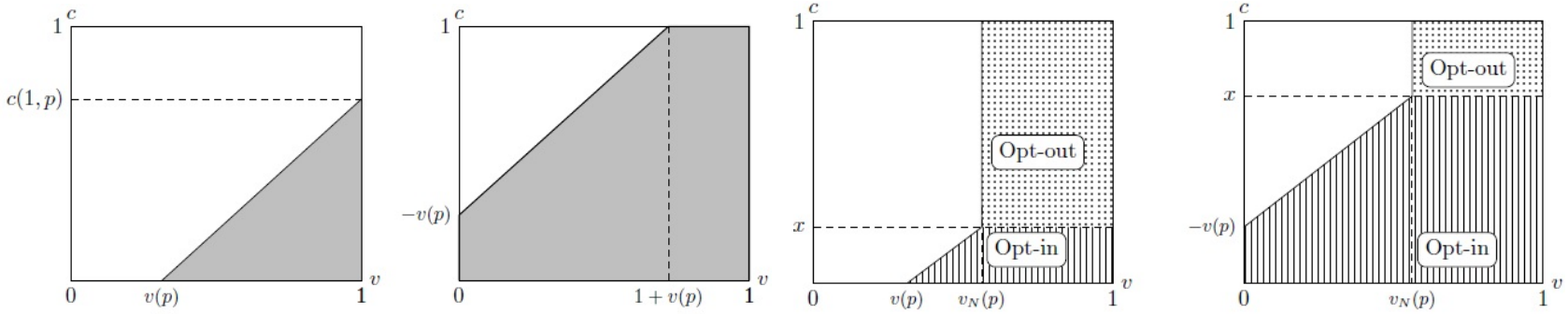


♣ **The discussion is not included yet.**

Conclusion (1/2)

Setting **Consumers can decide whether to opt in to obtain opt-in benefits from a digital service monopolist that earns from opted-in data (data-based revenue).**

Consumers **are heterogeneous in term of opt-in costs (privacy costs) and valuations for the product.**



(a) Case 1a: $0 < v(p) < 1$ (b) Case 1b: $-1 < v(p) \leq 0$ (a) Case 2a: $0 < v(p) < 1$ (b) Case 2b: $-1 < v(p) \leq 0$

Conclusion (2/2)

Results **After the GDPR,**

1. **The equilibrium price increases (privacy-conscious consumers; a decrease in opt-in consumers).**
2. **The equilibrium demand can shrink when the level of data-based revenue is high.**
3. **The profit increases if the data revenue is small.**
4. **The consumer surplus increases if the data revenue is small and the opt-in benefits are small.**

Result (E1) **When privacy costs and valuations have positive correlation,** $\Pi \downarrow$**,** $CS \uparrow$**;**

Result (E2) **When privacy costs and valuations have positive correlation,** $\Pi \uparrow$ **if** α **is smaller than a threshold,** $CS \uparrow$ **if** α **is smaller than a threshold.**