Self-Preferencing and Welfare in Hybrid Platforms

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Hybrid Platforms and Self-Preferencing

- E-commerce platforms combine 1P and 3P, e.g. Amazon, JD.com, Walmart, Target+, Best Buy, etc.
  - 1P listings: limited in variety.
  - 3P listings: expand variety, but crowd out 1P sales.
- Platforms may want to **self-preference (SP)**, i.e., lower the visibility of 3P listings, to protect 1P sales.
- Self-preferencing is a global policy concern:
  - EU DMA explicitly prohibits SP; Amazon etc. under investigation
  - CN Anti-Monopoly Guidelines on Platforms target SP
  - JP Smartphone Competition Act (2024) addresses platform SP
  - US FTC antitrust case against Amazon Buy Box SP

Model:

- A simple model of a monopolist platform that combines first and third party sales, featuring:
    - **Free entry of 3P sellers**
    - **Control of the visibility of listings on the platform**

Research Questions:

- Under what conditions would the platform use SP?
- Welfare consequences of banning SP?

The Model of a Hybrid Platform

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  - Each produces a unique variant at constant MC c
  - s denotes the measure of entering 3P sellers
- **Platform**:
  - Platform charges commission fee $\gamma \in (0, 1)$ on 3P sales.
  - Owns measure $h > 0$ of **1P listings** (h is exogenous)
  - Each listing is a unique variant at constant MC c

- The platform uses an algorithm to recommend products to consumers, which is characterized by

$$M(b, h+s)$$

  - M gives successful recommendations.
  - $M(\cdot)$ is twice differentiable, increasing in both arguments.

- Each listing obtains μ^s buyers:

$$\mu^s(b, h+s) \equiv M(b, h+s)/(h+s).$$

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- Modeling SP: Lower the likelihood that a 3P seller enters the recommendation process from 1 to $\rho < 1$: $M(b, h+\rho s)$

Micro-foundation for $M(\cdot)$ (I)

- A space of N potential variants. On the platform, H products are 1P listings, S are 3P listings; $H + S < N$.
- Each buyer has a consideration set Ω (size ω)
- The probability that the algorithm can find at least one variant in Ω among the $H + S$ variants:

$$\mu^b(H+S) = \zeta\left(1 - (1 - (H+S)/N)^{\omega}\right),$$

where $\zeta \in (0, 1]$: the algorithm efficiency.
- In the large market limit ($N \to \infty$, $H/N \to h$, $S/N \to s$),

$$\mu^b(h+s) = \zeta\left(1 - e^{-(h+s)\omega}\right), \quad M(\cdot) = b \cdot \mu^b$$
$$\mu^s(b, h+s) = b \cdot \zeta\left(1 - e^{-(h+s)\omega}\right)/(h+s).$$

Micro-foundation for $M(\cdot)$ (II)

- There are B buyers, $H+S$ listings. For any buyer-listing pair, matching Prob. q is i.i.d. drawn from a distribution $F(q)$ on $[0,1]$.
- After q's are realized, the platform recommends the listing with:

$$q_{max} = \max_i \{q_i\}.$$

- Ex-ante, the expected matching Prob. for a buyer:

$$\mathbb{E}[q_{max}] = 1 - \int_0^1 [F(q)]^{H+S} dq.$$

- Total successful recommendations:

$$M(B, H+S) = B \cdot \left(1 - \int_0^1 [F(q)]^{H+S} dq\right)$$

- Treat B, H, S as integers, and so have to deal with the integer issue for binding constraints.

Timing

1. The platform announces the commission rate γ (ad valorem).
2. Observing γ and $M(\cdot)$, 3P sellers simultaneously decide whether to enter the platform.
3. The platform uses algorithm M to recommend products to buyers.
4. Sellers (1P and 3P) set prices p; matched buyers purchase $D(p)$ units.

Solution concept:

- Subgame perfection

No Self-Preferencing

Pricing of 1P and 3P vendors

- 1P vendor profit-maximization:

$$\pi_M = \max_p \,(p - c)D(p).$$

- 3P vendor profit-maximization (taking γ as given):

$$\pi_S(\gamma) = \max_p \,[p(1-\gamma) - c]D(p) \;\Rightarrow \text{optimal price: } p_s(\gamma).$$

- The platform's fee revenue from each match:

$$\pi_P(\gamma) = \gamma p_s(\gamma) D(p_s(\gamma)).$$

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- Define $\hat{\gamma}$: the rate that maximizes the per-match fee revenue

$$\hat{\gamma} \equiv \arg\max_\gamma \pi_P(\gamma).$$

The Platform's Problem

- The free-entry condition for 3P sellers

$$\mu^s(b, h+s) \cdot \pi_S(\gamma) = k$$

pins down the measure of entering sellers: $s = s_0(\gamma)$, satisfying

$$\frac{\partial s_0(\gamma)}{\partial \gamma} < 0.$$

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- The platform chooses commission rate γ to maximize profits subject to free-entry condition:

$$\max_{\gamma \in [0,1]} \; M\Big(b, h+s\Big)\Big(\frac{h}{h+s}\pi_M + \frac{s}{h+s}\pi_P(\gamma)\Big),$$
$$\text{s.t.} \;\; s = s_0(\gamma).$$

- Consider the **unconstrained problem** first:

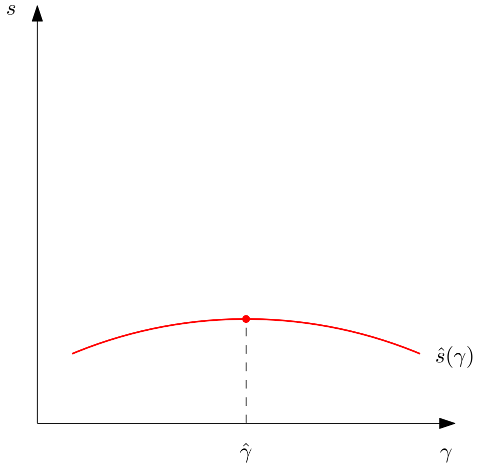
$$\max_{\gamma,s} \underbrace{M\Big(b, h+s\Big)}_{\text{Trade Volume}} \underbrace{\Big(\frac{h}{h+s}\pi_M + \frac{s}{h+s}\pi_P(\gamma)\Big)}_{\text{Business-stealing}}.$$

- Fix γ, and consider s first:
  - Trade volume effect: $s\uparrow \rightarrow M(\cdot)\uparrow$.
  - Business stealing effect: $s\uparrow\rightarrow$ shift the sales mix toward less profitable 3P sellers (note $\pi_P(\gamma) < \pi_M$ for all $\gamma \in [0,1]$).

- Assume the objective is single-peaked in s; then,

  solution of unconstrained problem is $\hat{s}(\gamma)$.

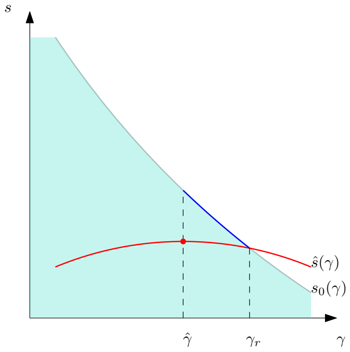
  - $\hat{s}(\gamma)$ is single-peaked in γ. When $\hat{s}(\gamma)$ is interior, it is increasing for $\gamma < \hat{\gamma}$ and decreasing for $\gamma > \hat{\gamma}$.



- The unconstrained optimum is $(\gamma^*, s^*) = (\hat{\gamma}, \hat{s}(\hat{\gamma}))$.

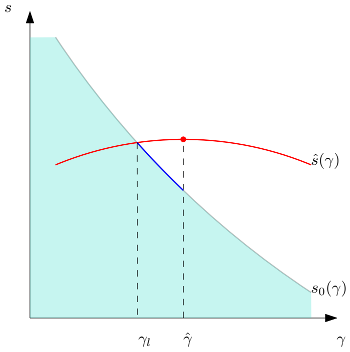
- Consider the **constrained problem**:

$$\max_{\gamma} \; M\Big(b, h+s\Big)\Big(\frac{h}{h+s}\pi_M + \frac{s}{h+s}\pi_P(\gamma)\Big), \; \text{s.t. } s = s_0(\gamma).$$



$s_0(\hat{\gamma}) > \hat{s}(\hat{\gamma})$

Excessive entry



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Insufficient entry

Self-Preferencing

Modeling SP

- SP: lower the likelihood that a 3P seller enters the recommendation process from 1 to $\rho < 1$:

$$M(b, h + \rho s)$$

- Choosing ρ is equivalent to choosing the number of displayed 3P sellers:

$$s_d = \rho s.$$

  This is clear by comparing:

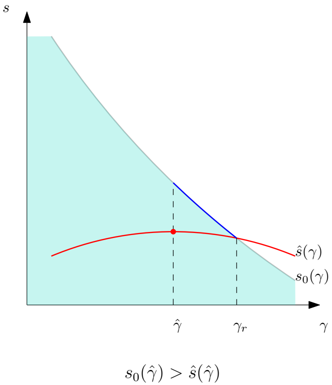
$$\mu^s (b, h + \rho s) \pi_{ss}(\gamma) \cdot \rho = k$$
$$\mu^s (b, h + s_d) \pi_{ss}(\gamma) \cdot \frac{s_d}{s} = k.$$

Timing (updated)

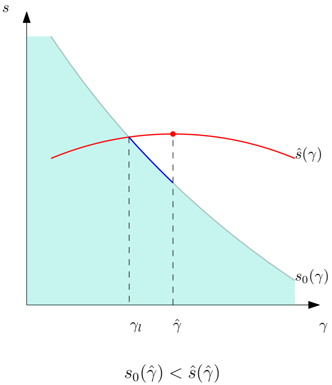
1. The platform announces the commission rate γ and the number of displayed 3P sellers s_d.
2. Observing (γ, s_d) and $M(\cdot)$, third-party sellers simultaneously decide whether to enter the platform.
3. The platform uses algorithm $M(b, h + s_d)$ to recommend products to buyers.
4. Sellers (1P and 3P) set prices p; matched buyers purchase the amount $D(p)$.

The platform's problem (allowing for SP)

$$\max_{\gamma\in[0,1],s\in\mathbb{R}_+} M\Big(b, h+s\Big)\Big(\frac{h}{h+s}\pi_M + \frac{s}{h+s}\pi_P(\gamma)\Big), \text{ s.t. } s \le s_0(\gamma).$$



Excessive entry



Insufficient entry

Proposition

Self-preferencing is used by the platform if and only if there is **excessive entry** *at* $\hat{\gamma}$*, defined as:*

$$s_0(\hat{\gamma}) > \hat{s}(\hat{\gamma})$$

Proposition (First-party Capacity triggers SP)

If the platform's own capacity h is sufficiently large ($h > \tilde{h}$), self-preferencing becomes profit-maximizing.

- **Higher 1P capacity ($h \uparrow$)**: as 1P capacity increases, both seller entry $s_0(\hat{\gamma}) \downarrow$ and platform optimum $\hat{s}(\hat{\gamma}) \downarrow$.
- But the platform wants sellers to exit faster than they naturally do since 1P has a higher profit margin:

$$\underbrace{\frac{\partial s_0(\hat{\gamma})}{\partial h} = -1}_{\text{Seller Natural Exit}} \quad > \quad \underbrace{\frac{\partial \hat{s}(\hat{\gamma})}{\partial h}}_{\text{Platform Optimal Exit}}$$

Corollary (Low Demand and Entry Cost Trigger SP)

If the market demand (b) is sufficiently low, or if the seller entry cost (k) is sufficiently low, the platform engages in self-preferencing.

- **Low Demand ($b \downarrow$):** As the market shrinks, the platform's desire for variety ($\hat{s}$) drops faster than the sellers' willingness to enter (s_0).
- **Low Entry Cost ($k \downarrow$):** Low costs trigger a flood of entrants ($s_0 \uparrow$), but the platform's ideal number of sellers ($\hat{s}$) is unchanged, creating a massive "excessive entry" gap.

Welfare Impact of Banning SP

- Under excessive entry, banning SP brings two effects:
- **Fee**: Platform increases γ to deter 3P sellers.
- **Quantity**: 3P sellers will exit. There exist $h_0 \leq h_1$ such that
  - If $h \leq h_0$, banning SP leads to more 3P entry
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  - If $h \geq h_1$; banning SP leads to less 3P entry
- **When is a ban beneficial?** If a ban moves variety closer to the social optimum and this **positive quantity effect is large enough to offset the fee effect**, a ban improves welfare.

Other Fee Structures

Per-unit Fee

- Replace ad valorem fee with per-unit fee $\tau \geq 0$.
- Seller's Profit: $\pi_S(\tau) = \max_p [p - \tau - c] D(p)$
- Platform Revenue per match: $\pi_P(\tau) = \tau D(p_s(\tau))$
- Optimal measure of sellers $\hat{s}(\tau)$ is still single-peaked in τ and maximized at $\hat{\tau} \equiv \arg\max \pi_P(\tau)$.
- $\pi_S(\cdot)$, $\pi_P(\cdot)$, $s_0(\cdot)$, and $\hat{s}(\cdot)$ retain all essential properties (monotonicity, single-peakedness).
- This does not change the fundamental mechanics of self-preferencing or welfare analysis.

The Entry Fee Can Replicate SP

The platform can hit a target variety $s' < s_0(\gamma)$ using either instrument:

- **SP**: Deter surplus entry $\mathbf{s'_E} > \mathbf{s'}$ by limiting visibility:

$$\mu^s(h + s')\pi_S \cdot \frac{s'}{s'_E} = k$$

- **Entry Pricing (F)**: Deter entry directly by raising entry costs:

$$\mu^s(h + s')\pi_S = k + F$$

With $F = k\left(\frac{s'_E}{s'} - 1\right)$, both methods are outcome-equivalent for final variety.

Superiority of Entry Fees

- While entry fee and SP can implement the same quantity of 3P sellers, they are **NOT** equivalent.
- In terms of **profit maximization**, entry fee dominates SP, because SP is wasteful, i.e., undisplayed entrants incur cost k but create no matches.
- In terms of **social welfare**:

$$W_F = W_{sp} + \hat{s} \cdot F > W_{sp}$$

  Then entry fee improves welfare by converting the **social waste** (redundant entry costs) into a **private transfer** to the platform.

Placing Our Work & Work in Progress

Literature Landscape

- **Pre-Match Self-Preferencing**
  - Platform intervenes before consumer matches, SP implies blanket search weight reductions.
  - **Literature:** Anderson and Bedre-Defolie (2024), Zennyo (2022), Kittaka and Sato (2022).
- **Post-Match Self-Preferencing**
  - Platform intervenes after observing realized consumer matches or specific seller profitability (e.g., targeted steering).
  - **Literature:** de Cornière and Taylor (2019), Hagiu et al. (2022), Choi et al. (2023).

Comparing Pre- and Post-Match SP

Pre-Match SP

- Uniformly lowers 3P visibility.
- Leads to lower trade volume.
- Fee is set to $\hat{\gamma}$.

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Post-Match SP

- Set up:
  - Demote 3P *only if* a consumer matches 1P and 3P.
  - Preserves matches (pure traffic transfer to 1P). 3P sellers become mere residual claimants.
- The most radical ex-post SP: $\rho^* = 0$
- Platform must drop γ lower: $\gamma^* < \hat{\gamma}$.
- Reversal Effect of 1P Capacity $d\gamma^*/dh < 0$.

A unified model with platform information advantage

- The platform uses both ex-ante (ρ^-) and ex-post (ρ^+) SP, with parameter $\alpha \in [0, 1]$ capturing the share of observable matches:

$$\Pi = (1 - \alpha)\Pi_{pre} + \alpha\Pi_{post}$$

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- **Hierarchical Strategy:**
  1. The platform will always exhaust ex-post SP first ($\rho^+ = 0$).
  2. It resorts to ex-ante SP ($\rho^- < 1$) *only* if ex-post reallocation is insufficient to curb excessive entry.
- The platform's choice of SP is ultimately constrained by its **information advantage** (α).
- The platform prefers ex-post SP because it avoids the deadweight loss of unmatched consumers.

Policy Implications

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We show that ex-post SP brings higher welfare (lower fee distortion, better matching efficiency). This provides two novel policy insights:

- Whether to allow SP should depend on the platform's information advantage. For highly informed platforms , allowing SP might be welfare-enhancing.
- **An alternative to banning SP:**
  - Algorithmic self-preferencing is notoriously difficult to monitor.
  - Regulators could instead **allow platforms to use more personal data**, steering them toward the ex-post SP.

Summary

- **Entry Management**: SP emerges under excessive entry, decoupling fees from variety control.
- **Ban Consequences**: Banning SP forces high commissions and triggers over-deterrence.
- **Welfare Driver**: h is the critical determinant; a ban helps only when h is low.
- **Policy Insights**: Whether to allow SP should depend on the platform's information advantage. For highly informed platforms , allowing SP might be welfare-enhancing.