Interoperability between Ad-Financed Platforms with Endogenous Multi-Homing

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The views expressed are those of the authors and do not reflect the official position of the European Commission.

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Interoperability in digital markets

Networks or systems are *interoperable* if they can "work together"

→ Horizontal vs. vertical interoperability

→ Some common functionalities can be used across different services

Digital Markets Act

- Interoperability between messaging services (Art. 7)
- Restricted to a few "basic functionalities" (Art. 7.2)
- Applies only to dominant players ("gatekeepers")

→ WhatsApp and Facebook Messenger designated

Idea that interoperability does not emerge as market outcome, hence the need for regulatory intervention

This paper

When platforms are ad-funded and users can multi-home:

- What are the incentives for ad-funded messaging platforms to make their services interoperable?
- How do these incentives compare to the social optimum?
- Symmetric vs. asymmetric platforms?

Main results:

- Interoperability reduces multi-homing on the consumer side
- When platforms are symmetric, interoperability emerges and is efficient
- If one platform has a large installed base advantage, interoperability does not arise in equilibrium, whereas it would be efficient...
- ... but mandating interoperability may not be efficient in very asymmetric markets.

Related litterature and contributions

Compatibility between networks and possibility of multi-homing

- Katz and Shapiro (1985); Crémer, Rey and Tirole (1999); De Palma, Leruth and Regibeau (1999); Doganoglu and Wright (2006)
- Contributions:
    - Effect of interoperability on equilibrium with endogenous multi-homing
    - Ad-funded business model → effect of interoperability on advertising side

Multi-purchasing, ad-funded business models and differentiation

- Ambrus and Reisinger (2006); Anderson, Foros and Kind (2016); Athey, Calvano and Gans (2016); Haan, Stoffers and Zwart (2021)
- Contribution:
    - Exposure to advertising depends on the (endogenous) amount of time consumers spend online

The model

Two horizontally differentiated **messaging platforms**, *A* and *B*

- Symmetric (for the moment)
- Purely ad-funded → no fee for users, but ads are a nuisance
- Charge advertisers a price p_i per ad
- Decide non-cooperatively on an interoperability level $\phi_i \in [0, 1]$
  → Quality of communications on-net = 1, off-net ≤ 1

Mass 1 of **consumers**

- Can single-home on *A* or *B*, or multi-home
  → Care about how many users to interact with (network effects)
- Decide how much time spent communicating on-net and off-net

Mass 1 of homogeneous **advertisers**

- Expected value of exposing users to ads ↑ linearly with time spent

Timing

1. Platforms non-cooperatively choose their level of interoperability ϕ_i
   $\rightarrow$ resulting level of interoperability $\phi = \min\{\phi_A, \phi_B\}$

2. Platforms simultaneously choose their price per ad p_i, and advertisers decide which platform(s) to buy ad space on

3. Consumers decide which platform(s) to join and how much time they want to spend communicating on-net and off-net

Consumers decide to **single-home** on platform A or B, or **multi-home**

Then, decide **how much time** to spend communicating on-net and off-net:

$$\tau_{on}^* \equiv \underset{\tau}{\operatorname{argmax}}\, u(\tau) - \gamma r_i \tau \quad \text{and} \quad \tau_{off}^* \equiv \underset{\tau}{\operatorname{argmax}}\, \phi u(\tau) - \gamma r_i \tau$$

with $u(\tau) = \kappa \dfrac{\tau^{1-\frac{1}{\beta}}}{1-\frac{1}{\beta}}$, with β elasticity to ad nuisance.

Denoting $\theta \equiv \phi^\beta$, we have:

$$\tau_{off}^*(\theta, r_i) = \theta \tau_{on}^*(r_i)$$

and the net utility from on-net and off-net coms can be written:

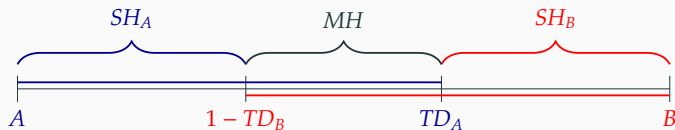$$\alpha(r_i) \text{ and } \theta\alpha(r_i), \text{ with } \alpha'(\cdot) < 0$$

$\rightarrow$ e.g., utility from single-homing on i: $v_0 + \alpha(r_i)(n_i + \theta n_j)$

Interoperability and multi-homing

Effect of interoperability on multi-homing

An increase in the level of interoperability θ *reduces* consumer multi-homing

$$\frac{dTD_A}{d\theta} = \frac{\alpha}{t}\left[-SH_A + (1-\theta)\frac{dSH_A}{d\theta}\right] < 0$$

- For given single-homing demands, ↑ interoperability improves the quality of off-net coms ⇒ multi-homing *less* attractive

- Countervailing effect: single-homing ↑ ⇒ multi-homing *more* attractive

- The first effect always dominates the second effect

Equilibrium level of interoperability

Equilibrium on the advertising market

In equilibrium, $r_i = 1$ and platforms set advertising price

$$p_i = \sigma \tau^{SH} SH_i + \frac{\sigma \tau^*_{on}}{2} MH \quad \text{with } \tau^{SH} = TD_i \tau^*_{on} + SH_j \tau^*_{off}$$

Then, platforms choose their level of interop. to maximize their profit:

$$\Pi_i(\theta_i, \theta_j) = \sigma \tau^{SH}(\theta) SH_i(\theta) + \frac{\sigma \tau^*_{on}}{2} MH(\theta) \quad \text{with } \theta = \min\{\theta_i, \theta_j\}$$

Equilibrium level of interoperability

In equilibrium, platforms implement perfect interoperability ($\theta^\star = 1$)

$\Rightarrow$ Socially-optimum level of interoperability is also $\theta^w = 1$

Intuition for the equilibrium outcome

Platforms' profit increases with the level of interoperability:

$$\frac{d\Pi_A}{d\theta} = \left(\sigma\tau^{SH}(\theta) - \frac{\sigma\tau^*_{on}}{2}\right)\frac{dSH_A}{d\theta} + \frac{\sigma\tau^*_{on}}{2}\frac{dTD_A}{d\theta} + \sigma\frac{d\tau^{SH}(\theta)}{d\theta}SH_A > 0$$

1. **Market power effect (+)** : Some multi-homers become exclusive users of $A \rightarrow$ increases market power over advertisers

2. **Total viewership effect (-)** : Less multi-homing $\rightarrow$ lower total user base to be monetized

3. **Usage intensification effect (+)** : $\uparrow$ interoperability $\Rightarrow$ single-homers spend more time communicating on $A \Rightarrow$ increases exposure to ads and thus ad revenues

Consumer surplus increases with the level of interoperability:

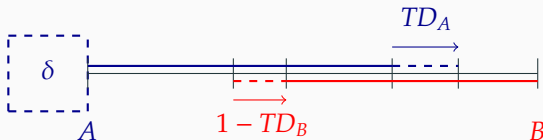$$\frac{dCS}{d\theta} = 2\alpha SH_A SH_B + \alpha(1-\theta)\left[SH_A\frac{dTD_A}{d\theta} - SH_B\frac{dSH_A}{d\theta}\right] > 0$$

- $\uparrow$ quality off-net coms. effect (+) > $\downarrow$ multi-homing effect (-)

Platform asymmetry

Assume now that there is a mass $\delta > 0$ of users located at 0

- Will always choose to single-home on $A \rightarrow$ *installed base* of A

A larger **installed base** makes platform A...

- More attractive to users in the "competitive" segment
- More attractive to advertisers: it can charge higher ad prices

Higher **interoperability** levels the playing field...

- In terms of total user demand
- In terms of ad prices

Equilibrium level of interoperability with asymmetry

Platforms' interoperability choices

- The small platform always prefers **perfect interoperability**
- The large platform prefers **no interoperability** if the installed base is large enough ($\delta > \delta_{\Pi_A}$), and **perfect interoperability** otherwise ($\delta \leq \delta_{\Pi_A}$)

Intuition: B benefits more and is hurt less by interoperability than A.

- **Market power effect: (+) for B, (-/+) for A** → $p^{SH} - p^{MH}$ higher for B than for A; and stronger increase in SH_B than SH_A (which can decrease for low θ).

- **Total viewership effect: (+/-) for B, (-) for A** → $p_A^{MH} > p_B^{MH}$ and stronger decrease in TD_A than TD_B (which can increase for low θ).

- **Usage intensification effect: (+) for B, (-/+) for A** → Increase in time spent on B, reflected in higher ad price for B, lower for A.

Comparison with social optimum

The equilibrium level of interoperability is weakly too low from a welfare point of view

Intuition:

Consumer surplus is maximized with full interoperability if $\delta < \delta_{CS}$, and no interoperability otherwise. This is because high δ:

- reduces volume of off-net interactions, weakening the ↑ quality off-net interactions effect (+).
- induces stronger shifts towards market single-homing (-).

Advertiser surplus always fully extracted by platforms.

Therefore, we have:

δ_{Π_A} δ_Π δ_W δ_{CS}

0

Efficient regulatory intervention

δ^{max}
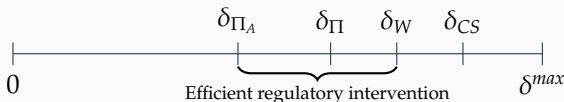
Conclusion

Interoperability...

- Increases the market power of platforms over advertisers
- Stimulates the engagement of single-homers due to higher quality interactions, increasing their exposure to advertising
- Reduces the total viewership that the platforms can monetize on the advertiser side

Symmetric platforms: positive effects outweigh negative effect, and perfect interoperability emerges w/o regulatory intervention

Asymmetric platforms: negative effect may outweigh positive effects for large platforms → interop. doesn't emerge w/o intervention

Policy implications:

- interoperability may increase the market power of platforms in the advertising market
- mandating interop. may not be efficient in very asymmetric mkts

Thank you for your attention!

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