Platform Competition and Incumbency Advantage under Heterogeneous Lock-in effects. Exploring Multihoming

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CRESSE CONFERENCE 2023
Rhodes, 30 June- 2 July 2023

Outline

- Context and Policy relevance
- Platforms, personal data, switching costs
- The Model-Game
- Some Results
- Policy implications
- Extension to a Multihoming Scenarios

Context and Policy relevance

- The existence of cross-side network effects reinforces entry barriers (Biglaiser et al., 2020; and Halaburda and Yehenzkel, 2016), so that even a platform providing superior services may be unable to enter due to user coordination failures (Halaburda and Yehenzke)
- Personal data are a possible cause of incumbency advantage since data are fed into algorithms used by the platforms to improve their matching ability for users across the different sides of the platform. Biglaiser et al. (2019) and Halaburda et al., 2020).

Policy relevance

- Data and identity portability are often advocated as regulatory remedies to remove barriers to entry in two-sided platform markets (Gans, 2018; and Coyle, 2018), especially in interconnected digital markets, dominated by the so-called "Big-Techs."
- However, while "..data can be a source of incumbency advantage … the impact on the platform's initial offer of such a measure – which amounts to giving more ownership rights over data to consumers– is far from being clear" (Jullien and Sand-Zantman, (2021), page 34)

Platforms, personal data and switching costs

Kiva

Kiva is a loans-based crowdfunding platform reaching 3.7 million borrowers, 81 per cent of them women, which offers "crowdfunding loans and unlocking capital for the underserved, improving the quality and cost of financial services, and addressing the underlying barriers to financial access around the world".

Network social capital built within the Kiva platform might be a crucial element in funding success, generating key lock-in effects. (Davies and Giovannetti, 2022)

Strava

A platform for tracking physical exercise which incorporates social network features. It is mostly used for cycling and running using Global Positioning System data.

Strava introduces clear lock-in elements by keeping track of users' progress and comparing achievements against "your friends", that is, other users on selected roads or trails. "Over 100 million athletes in 195 countries use Strava, so whatever your activity and goals, you'll have a community at your back." (Jullien and Sand-Zantman, 2021)

Google Maps

Web mapping services, train their algorithms with information sourced from users' geolocations to provide better-quality services to other users.

Similarly, search engines develop centrality metrics based on user queries to build both meaningful rankings for search results and targeted advertising.

Hence: "If a user has been a client of a platform for some time, the platform knows his or her tastes and can give more prominence to goods or services that he or she prefers. Second, the platform can use the data stemming from other users to increase the quality of the service to each of its users. (Biglaiser et al.,2019)

The Model

- Two platforms, Incumbent and Entrant, matching users on opposite sides, compete in membership fees, p, (but not ongoing transaction fees)

$$p_j^i, j = A, B; i = I, E$$

- Users draw (common) value, v, from membership, that is high enough to guarantee full market coverage, plus enjoy cross-network benefits:

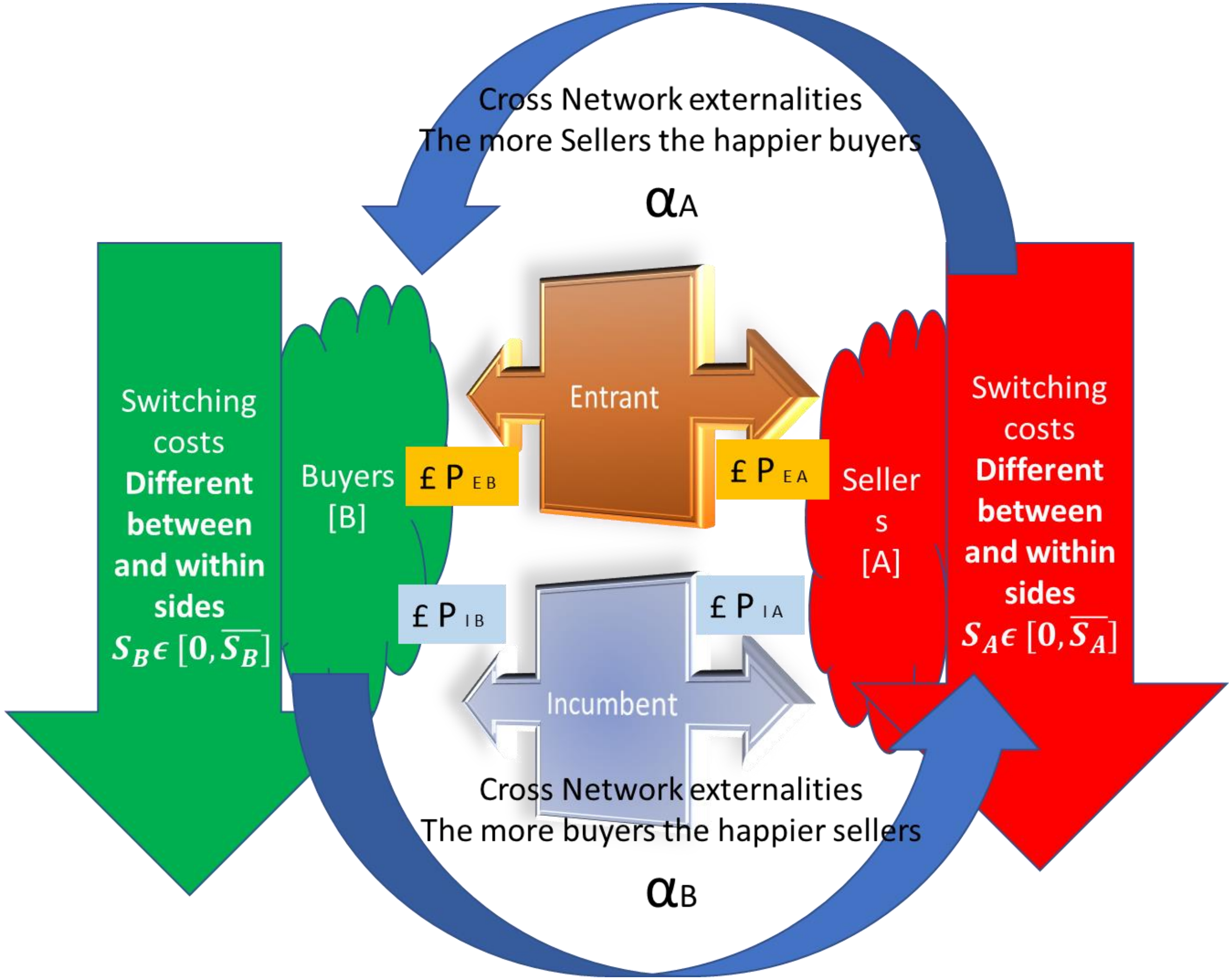
$$\alpha_j, \text{(j=A,B)}$$

linear in the number of opposite-side users attached to the same platform (Their intensity can differ across sides: $\alpha_{-j} \neq \alpha_j$)

- To switch from I to E, users on each side incur cost, s_j, drawn from a uniform distribution from zero up to a maximum level that differ across sides:

$$\boldsymbol{s_B} \;\epsilon\; [\mathbf{0}, \overline{\boldsymbol{s_B}}] \text{ and } \boldsymbol{s_A} \;\epsilon\; [\mathbf{0}, \overline{\boldsymbol{s_A}}]$$

- Game: Firms set prices, users know their switching costs and decide whether to switch from I to E.



Demand and Market shares

- The indifferent user is identified by a critical level of switching costs s_j^* such that:

$$v + \alpha_j m_{-j}^I - p_j^I = v + \alpha_j(1 - m_{-j}^I) - p_j^E - s_j^*$$

$$s_j^* = (p_j^I - p_j^E) + \alpha_j(1 - 2m_{-j}^I)$$

- Hence, Market shares, as a function of prices are given by:

$$m_j^I = \frac{\overline{s_j} - s_j^*}{\overline{s_j}} = \frac{\overline{s_j} - \alpha_j(1 - 2m_{-j}^I) - (p_j^I - p_j^E)}{\overline{s_j}} = 1 - m_j^E$$

Equilibrium prices

Under same cross-group benefits $\alpha_{-j} = \alpha_j = \alpha$ and asymmetric lock-in effects: $\overline{s_j} \neq \overline{s_{-j}}$

$$p_j^{I*} = \frac{2\overline{s_j}}{3} - \alpha \text{ and } p_j^{E*} = \frac{\overline{s_j}}{3} - \alpha$$

Under asymmetric cross-group benefits If $\alpha_{-j} \neq \alpha_j$ and lock-in effects $\overline{s_j} \neq \overline{s_{-j}}$

$$p_j^{I*} = \frac{\overline{s_j s_{-j}}(6\overline{s_j} - 10\alpha_{-j} + \alpha_j) + 2(\alpha_{-j} + 2\alpha_j)[2\alpha_{-j}(2\alpha_{-j} + \alpha_j) - \overline{s_j}(3\alpha_{-j} + \alpha_j)]}{9\overline{s_j s_{-j}} - 4(2\alpha_j + \alpha_{-j})(\alpha_j + 2\alpha_{-j})}$$

$$p_j^{E*} = \frac{\overline{s_j s_{-j}}(3\overline{s_j} - 8\alpha_{-j} - \alpha_j) - 2(\alpha_{-j} + 2\alpha_j)[\overline{s_j}(\alpha_{-j} + \alpha_j) - 2\alpha_{-j}(2\alpha_{-j} + \alpha_j)]}{9\overline{s_j s_{-j}} - 4(2\alpha_j + \alpha_{-j})(\alpha_j + 2\alpha_{-j})}$$

Same network benefits on both sides

$$\alpha_{-j} = \alpha_j = \alpha$$

$$p_j^{I*} = \frac{2\overline{s_j}}{3} - \alpha \; and$$

$$p_j^{E*} = \frac{\overline{s_j}}{3} - \alpha$$

1. Incumbent charges higher prices than the entrant on both sides
2. Prices higher on side with higher switching costs

Lock-in costs, market shares & profit differential:

Under same cross-group benefits : $\alpha_{-j} = \alpha_j = \alpha$ and asymmetric lock-in costs $\overline{s_j} \neq \overline{s_{-j}}$

a) *Equilibrium market shares,* $m_j^{i*}, for\ i = E, I\ and\ j = A, B$ *are given by:*

$$m_j^{I*} = \frac{2\overline{s_j s_{-j}} + \overline{s_{-j}}\alpha - 6\alpha^2}{3\left(\overline{s_j s_{-j}} - 4\alpha^2\right)} \text{ and } m_j^{E*} = 1 - \frac{2\overline{s_j s_{-j}} + \overline{s_{-j}}\alpha - 6\alpha^2}{3\left(\overline{s_j s_{-j}} - 4\alpha^2\right)};$$

b) *The incumbent's market share is larger on the side where lock-in effects are lower:*

$m_j^{I*} \geq m_{-j}^{I*} \Leftrightarrow \overline{s_j} \leq \overline{s_{-j}}$ *[The opposite holds for the entrant, E].*

c) *The market shares of the incumbent platform are at least twice as large as those of the entrant; and*

d) *The Profit differential increases in the lock-in effects :* $\Delta\pi = \pi^{I*} - \pi^{E*} = \frac{\overline{s_j} + \overline{s_{-j}}}{3} > 0$

Lock-in effects and Incumbent's market shares

Under symmetrical cross-group benefits $\alpha_{-j} = \alpha_j = \alpha$ *and asymmetric lock-in effects* $\overline{s_j} \neq \overline{s_{-j}}$

a) *An increase in lock-in effects on one side of the platform leads to smaller incumbent's market shares on the same platform's side:*

$$\frac{\partial m_j^{I*}}{\partial \overline{s_j}} = -\frac{\overline{s_{-j}}\alpha(\overline{s_{-j}}+2\alpha)}{3\left(\overline{s_j s_{-j}}-4\alpha^2\right)^2} < 0$$

b) *An increase in lock-in effects on one side of the platform leads to smaller incumbent's market shares on the opposite platform's side:*

$$\frac{\partial m_j^{I*}}{\partial \overline{s_{-j}}} = -\frac{2\alpha^2(\overline{s_j}+2\alpha)}{3\left(\overline{s_j s_{-j}}-4\alpha^2\right)^2} < 0$$

Cross-group benefits and Incumbent's market shares

Under symmetrical cross-group benefits

$\alpha_{-j} = \alpha_j = \alpha$

and asymmetric lock-in effects: $\overline{s_j} \neq \overline{s_{-j}}$

a) *An increase in cross-group benefits, α, leads to larger market shares for the incumbent on both sides of the platform.*

$$\frac{\partial m_j^{I*}}{\partial \alpha} = \frac{\overline{s_{-j}}\left(\overline{s_j s_{-j}} + 4\alpha\left(\overline{s_j} + \alpha\right)\right)}{3\left(\overline{s_j s_{-j}} - 4\alpha^2\right)^2} > 0$$

b) *This positive effect on the incumbent market shares is greater on the platform's side with lower lock-in effects.*

The impact of data portability on Consumers surplus depends on the pre-existing level of switching costs.

Total Consumer Surplus has an inverted-U shape.

Policies aimed at lowering switching costs improve Consumer surplus for high levels of these costs.

At medium level of switching costs, reductions are detrimental for consumer surplus.

Policies lowering lock-in costs, negatively affect the entrant's competitive stake because the strategic attitude of the incumbent becomes more aggressive.

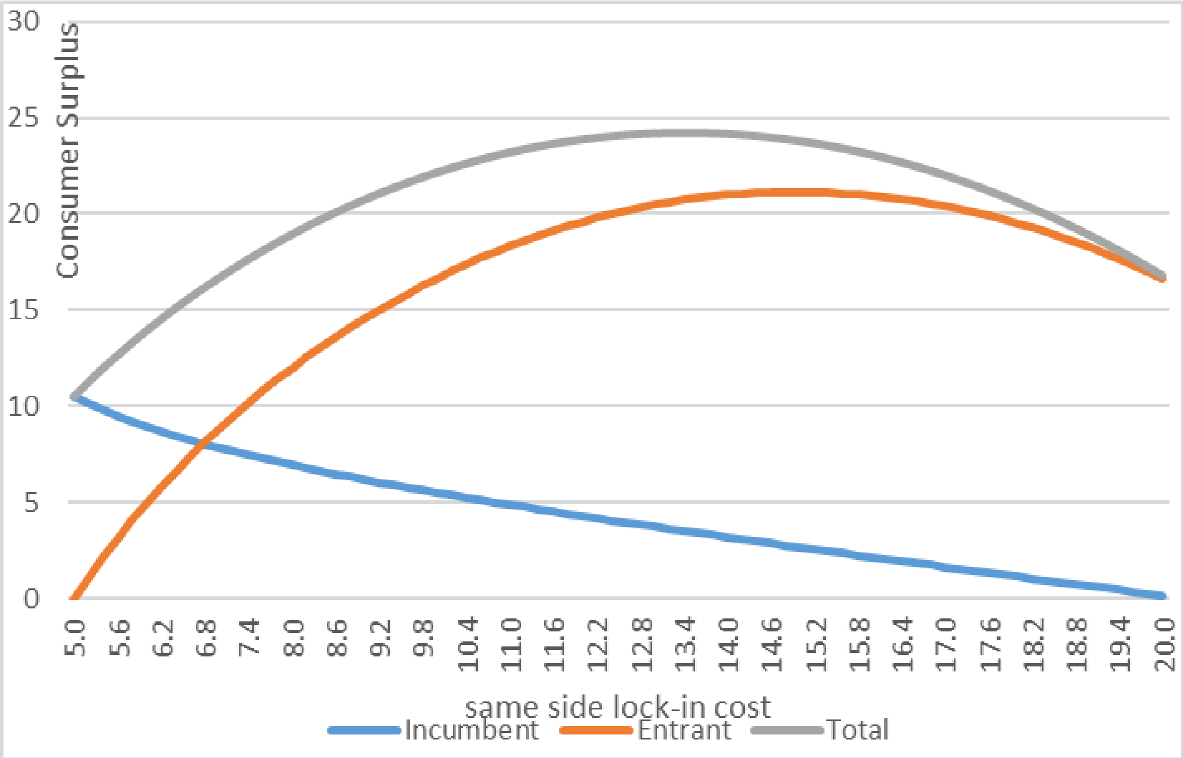


Figure: Consumer surplus on side j, depending on the same side lock-in cost (i.e., for $\overline{s_j} > 5$) with symmetric cross-group network benefits, for $\alpha = 2$, v = 10 and $\overline{s_{-j}} = 8$.

Different network benefits between sides: $\alpha_{-j} \neq \alpha_j$

Under asymmetric cross-group benefits and lock-in effects the Equilibrium prices are given by:

$$p_j^{I*} = \frac{\overline{s_j s_{-j}}\left(6\overline{s_j} - 10\alpha_{-j} + \alpha_j\right) + 2\left(\alpha_{-j} + 2\alpha_j\right)\left[2\alpha_{-j}\left(2\alpha_{-j} + \alpha_j\right) - \overline{s_j}\left(3\alpha_{-j} + \alpha_j\right)\right]}{9\overline{s_j s_{-j}} - 4\left(2\alpha_j + \alpha_{-j}\right)\left(\alpha_j + 2\alpha_{-j}\right)}$$

$$p_j^{E*} = \frac{\overline{s_j s_{-j}}\left(3\overline{s_j} - 8\alpha_{-j} - \alpha_j\right) - 2\left(\alpha_{-j} + 2\alpha_j\right)\left[\overline{s_j}\left(\alpha_{-j} + \alpha_j\right) - 2\alpha_{-j}\left(2\alpha_{-j} + \alpha_j\right)\right]}{9\overline{s_j s_{-j}} - 4\left(2\alpha_j + \alpha_{-j}\right)\left(\alpha_j + 2\alpha_{-j}\right)}$$

Different network benefits between sides: $\alpha_{-j} \neq \alpha_j$

Under asymmetric cross-group benefits and lock-in effects:

Similarities with simplified regime

1. Incumbent eq. prices are higher than the Entrant's ones
2. Both platforms' eq. prices increase with same-side switching costs, $\overline{s_j}$.
3. Incumbent's eq. market shares are higher on both sides
4. Incumbent's eq. market shares fall as switching costs $\overline{s_j}$ increase, including on the opposite side switching costs $\overline{s_{-j}}$
5. Coexistence requires preponderance of switching costs over cross network benefits to avert tipping outcomes

Extensions to a Multihoming setting

- All agents on both sides are members of the incumbent platform.
- The switching costs s_k is linked to a fixed transport cost, t_k, and a distance x, from the entrant .
- Hence, group k agents are located uniformly along the unit interval and incur a transport cost $t_k x$, $t_k \geq 0$, to switch to the entrant platform.
- The benefits of multihoming are captured, by a reduction in these costs, when joining the entrant while keeping also membership with the incumbent:
- So, when multihoming the transport cost is reduced to $(1-\lambda_k)t_k x$, $0 \leq \lambda_k \leq 1$.
- The measure of agents from group k who buy from platform $i = I, E$ exclusively is denoted n_k^i, while the number who multihome is denoted N_k.
- Accordingly, the utility of a group k agent located at $x \in [0,1]$ by staying with the incumbent platform is given by

$$v_k^I(x) = v_k^0 - p_k^I + b_k(n_l^I + N_l),$$

for $k = B, S$ and $l \neq k$.

Multihoming

- When the same agent switches to the entrant platform, without multihoming, she obtains

$$v_k^E(x) = v_k^0 - p_k^E - t_k x + b_k\left(n_l^E + N_l\right).$$

- Multihoming yields

$$v_k^{IE}(x) = v_k^0 - p_k^I - p_k^E - (1 - \lambda_k)t_k x + b_k.$$

- The comparisons between pairs of utilities gives us the critical values of x, or market shares.

  - $v_k^E(x) \geq v_k^I(x) \rightarrow x \leq \frac{p_k^I - p_k^E - b_k(n_l^I - n_l^E)}{t_k}$, $\quad v_k^E(x) \geq v_k^{IE}(x) \rightarrow x \leq \frac{p_k^I - b_k n_l^I}{\lambda_k t_k}$ and

$$v_k^{IE}(x) \geq v_k^I(x) \rightarrow x \leq \frac{b_k n_l^E - p_k^E}{(1-\lambda_k)t_k}.$$

Scenario 1 The incumbent platform maintains full coverage on side k by setting: $p_k^I \le b_k n_l^I$. i.e. by setting its price below the cross-platform externalities from the other side.

- In this case $v_k^E(x) \ge v_k^{IE}(x) \rightarrow x \le \frac{p_k^I - b_k n_l^I}{\lambda_k t_k} = 0$
- Then the only relevant threshold on side k is given by, $v_k^{IE}(x) \ge v_k^I(x) \rightarrow x \le \frac{b_k n_l^E - p_k^E}{(1-\lambda_k) t_k}$

which determines the side share of the entrant platform, through multihoming, since E has no singlehoming on side k. In this scenario, given the full coverage of the incumbent on side k, the opposite side, l, utilities become

$$v_l^I(x) = v_l^0 - p_l^I + b_l$$
$$v_l^E(x) = v_l^0 - p_l^E - t_l x + b_l N_k$$
$$v_l^{IE}(x) = v_l^0 - p_l^I - p_l^E - (1 - \lambda_l) t_l x + b_l$$

Scenario 1 The incumbent platform maintains full coverage on side k no multihoming on side l

- Now multihoming , on side l, is dominated by the option to remain with the incumbent platform:
- $v_l^I(x) > v_l^{IE}(x)$ since: $v_l^I(x) = v_l^0 - p_l^I + b_l > v_l^0 - p_l^I - p_l^E - (1 - \lambda_l)t_l x + b_l = v_l^{IE}(x)$
- Therefore, the only relevant threshold, on side *l*, is given by the comparison between the two singlehoming options:

$$v_l^E(x) = v_l^0 - p_l^E - t_l x + b_l N_k > v_l^I(x) = v_l^0 - p_l^I + b_l$$

$$\widetilde{x_l} = n_l^E = \frac{p_l^I - p_l^E - b_l(1 - \widetilde{x_k})}{t_l}$$

Hence, the market shares for the entrant are given,

on side k, via multihoming: $\widetilde{x_k} = \frac{b_k \widetilde{x_l} - p_k^E}{(1-\lambda_k)t_k}$ and, on side l, via singlehoming: $\widetilde{x_l} = \frac{p_l^I - p_l^E - b_l(1-\widetilde{x_k})}{t_l}$

Scenario 1 The incumbent platform maintains full coverage on side k no multihoming on side l: Equilibrium Shares and Profits .

We now assume $b_l = b_k = b$ and $\lambda_k = \lambda_l = \lambda$

Entrant's market share on side, l, via singlehoming:

$$\widetilde{x_l}^* = \frac{1}{3} - \frac{2b(1-\lambda)t_k}{3[(1-\lambda)t_k t_l - b^2]}$$

Entrant's market share on side, k, via multihoming

$$\widetilde{x_k}^* = \frac{b\widetilde{x_l}^*}{(1-\lambda)t_k}$$

Equilibrium profits, are: $\pi^{I*} = \frac{4[b(b-(1-\lambda)t_k)-(1-\lambda)t_k t_l]^2}{9(1-\lambda)t_k[(1-\lambda)t_k t_l - b^2]}$, and $\pi^{E*} = \frac{[b(b+2(1-\lambda)t_k)-(1-\lambda)t_k t_l]^2}{9(1-\lambda)t_k[(1-\lambda)t_k t_l - b^2]}$.

Scenario 2:

The incumbent and the entrants both choose $p_k^I > b_k n_l^I$ and $p_k^E > b_k n_l^E$, so that there is only singlehoming on both sides.

Under Scenario 2, there is only singlehoming on both sides. This is the result of both platforms setting

$p_k^i > b_k n_l^i$ on both sides. Hence, there is only one relevant threshold on either side given by

$$\widetilde{x_k} = \frac{p_k^I - p_k^E - b_k(1-2\widetilde{x_l})}{t_k}, \text{ for } k = S, B,$$

- *We now assume $b_l = b_k = b$*
- Equilibrium prices and shares are given by: $p_k^{I*} = \frac{2t_k}{3} - b$ and $p_k^{E*} = \frac{t_k}{3} - b$ and $\widetilde{x_k}^* = \frac{t_k t_l - b t_l - 6b^2}{3[t_k t_l - 4b^2]}$ for $k = S, B$.
- Equilibrium profits are given by: $\pi^{I*} = \frac{(t_k+t_l)(4t_k t_l - 15b^2) - 4b(2t_k t_l - 9b^2)}{9(t_k t_l - 4b^2)}$ and $\pi^{E*} = \frac{(t_k+t_l)(t_k t_l - 3b^2) - 4b(2t_k t_l - 9b^2)}{9(t_k t_l - 4b^2)}$.

Scenario 3 Whilst the incumbent sets $p_k^I > b_k n_l^I$ on both sides, the entrant platform promotes multihoming on both sides by setting $p_k^E \leq b_k n_l^E$.

- As a result, there are two relevant thresholds on either side given by

- $v_k^E(x) \geq v_k^{IE}(x) \rightarrow x \leq \frac{p_k^I - b_k n_l^I}{\lambda_k t_k} \rightarrow \widehat{x_k} = \frac{p_k^I - b_k(1-\widecheck{x_l})}{\lambda_k t_k}$ and

- $v_k^{IE}(x) \geq v_k^I(x) \rightarrow x \leq \frac{b_k n_l^E - p_k^E}{(1-\lambda_k)t_k} \rightarrow \widecheck{x_k} = \frac{b_k \widehat{x_l} - p_k^E}{(1-\lambda_k)t_k}$

  for $k = S, B$, and satisfying $0 < \widehat{x_k} < \widecheck{x_k} < 1$.

- Firms' profits are $\pi^I = \sum_k (p_k^I)(1 - \widehat{x_k})$ and $\pi^E = \sum_k (p_k^E)\widecheck{x_k}$.

Scenario 3 Whilst the incumbent sets $p_k^I > b_k n_l^I$ on both sides, the entrant platform promotes multihoming on both sides by setting $p_k^E \leq b_k n_l^E$. *We now assume* $b_l = b_k = b$

$$\pi_{3I} =$$

$$(-1+\lambda)\left(\frac{t_l(b^3 + 2ab^2 t_k + 2(-1+\lambda)\lambda b t_k t_l + 2(-1+\lambda)\lambda^2 b^2 t_k t_l)^2}{(b^2 + (-1+\lambda)\lambda b^2 t_k t_l)(b^2 + 4(-1+\lambda)\lambda b^2 t_k t_l)^2}\right.$$

$$\left. + \frac{t_k(2\lambda^3 + 2\lambda b(b - t_k)t_l + b^3 {t_l}^2 + 2\lambda^2 t_k(-1 + b t_l))^2}{\lambda(-\lambda t_k + \lambda^2 t_k + b^2 t_l)(-4\lambda t_k + 4\lambda^2 t_k + b^2 t_l)^2}\right)$$

$$\pi_{3E}$$

$$= ab^2\left(-\frac{t_k(b^2 + (-1+\lambda)\lambda t_k t_l + b(t_l - \lambda t_l))^2}{(b^2 + (-1+\lambda)\lambda t_k t_l)(b^2 + 4(-1+\lambda)\lambda t_l)^2} - \frac{(\lambda^2 t_k + b(b + t_k)t_l - \lambda(t_k + b t_k t_l))^2}{(-\lambda t_k + \lambda^2 t_k + b^2 t_l)(-4\lambda t_k + 4\lambda^2 t_k + b^2 t_l)^2}\right))$$

Scenario 4 the incumbent sets $p_k^I > b_k n_l^I$ on both sides, the entrant platform promotes multihoming only on one side, k, by setting $p_k^E \leq b_k n_l^E$;

- Whilst the incumbent sets $p_k^I > b_k n_l^I$ on both sides, the entrant platform promotes multihoming only on one side, k, by setting $p_k^E \leq b_k n_l^E$; whereas there is only singlehoming on the opposite side. The corresponding system of thresholds is given by

$$\begin{cases} \widehat{x_k} = \frac{p_k^I - b_k(1-\widetilde{x_l})}{\lambda_k t_k} \ and \ \widecheck{x_k} = \frac{b_k \widetilde{x_l} - p_k^E}{(1-\lambda_k) t_k} \\ \widetilde{x_l} = \frac{p_l^I - p_l^E - b_l(1-\widecheck{x_k} - \widehat{x_k})}{t_l} \end{cases}.$$

Firms' profits are: $\pi^I = (p_k^I)(1-\widehat{x_k}) + (p_l^I)(1-\widetilde{x_l})$, and $\pi^E = (p_k^E)\widecheck{x_k} + (p_l^E)\widetilde{x_l}$.

Scenario 4 the incumbent sets $p_k^I > b_k n_l^I$ on both sides, the entrant platform promotes multihoming only on one side, *k*, by setting $p_k^E \leq b_k n_l^E$

- *We now assume* $b_l = b_k = b$

- *Resulting Equilibrium Profits*

- $\pi_{4I} =$

$$\frac{4(1+\lambda)^2 b^4 + 8v(-1+\lambda^2) b^3 t_k + 16(-1+\lambda)^2 \lambda^2 b {t_k}^2 t_l + (-1+\lambda)^2 \lambda^2 {t_k}^2 t_l (9\lambda t_k + 16 t_l) + (-1+\lambda)\lambda b^2 t_k (5\lambda t_k + 4\lambda^2 t_k + 16 t_l + 16\lambda t_l)}{36(-1+\lambda)\lambda t_k (b^2 + (-1+\lambda)\lambda t_k t_l)}$$

- $\pi_{4E} = \dfrac{(-2b^2 + \lambda b^2 - \lambda b t_k + \lambda^2 b t_k + \lambda t_k t_l - \lambda^2 t_k t_l)^2}{9(-\lambda + \lambda^2) t_k (b^2 - \lambda t_k t_l + \lambda^2 t_k t_l)}$

Conclusions/1

- The competitive advantage of incumbent platforms is one of the key topics of debate in platform regulation and competition policy (Jullien and Sand-Zantman, 2021).
- Heterogeneity in lock-in effects across sides provides the incumbent with an opportunity to capture a greater share of the markets on both sides of the platform while also increasing its customers' prices.
- However, the prevalence of these costs over the cross-group benefits is a necessary condition to prevent equilibria whereby the incumbent will be monopolising the entire platform markets.

Conclusions/2

- Interventions aimed at lowering search and lock-in costs, especially for those consumers facing higher lock-in costs, could unwillingly weaken the entrant's competitive stake as the incumbent becomes more aggressive.

- Policies aimed at increasing data and personal information portability need to focus on the distribution of these lock-in costs both across and within the two sides of the platform participants.

- Is it of critical relevance to extend this to the multihoming scenarios …and
- We have started characterising the equilibria