Session 4: Bundling and Commitment

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HBS

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Agenda

- Breaks?
- Presentations?

- Today:

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  - Bundling 101

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  - Bundling 101
  - Commitment (general, one-sided, two-sided)

Bundling

- Let's use the example of PCCW selling NOW TV channels. Assume there are 5 consumers and 4 channels:

Willingness to pay:	Channel #1	Channel #2	Channel #3	Channel #4
Consumer 1	$8	$2	$2	$2
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- *In general*, under what conditions is bundling the preferred pricing strategy?

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- Explanation? Implications for the platform? Why did PCCW choose a la carte pricing?

- Assume now there is a 5th channel - HBO - which is popular with all consumers:

Willingness to pay:	Channel #1	Channel #2	Channel #3	Channel #4	HBO
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- Conclusions?

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- Stackelberg (leader-follower) equilibrium with firm 1 moving first:

$$q_1 = \frac{1}{2};\ q_2 = \frac{1}{4} \Longrightarrow \Pi_1 = \frac{1}{8} > \Pi_2 = \frac{1}{16}$$

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$$D_1 = 1 - P_1 + \alpha P_2 \text{ and } D_1 = 1 - P_2 + \alpha P_1$$

where α measures substitutability/complementarity between the two firms' products; $-1 < \alpha < 1$.

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- Stackelberg (leader-follower) pricing equilibrium with firm 1 pricing first:

$$\begin{aligned} P_1 &= \frac{2+\alpha}{2(2-\alpha^2)} \text{ and } \Pi_1 = \frac{(2+\alpha)^2}{8(2-\alpha^2)} \\ P_2 &= \frac{4+2\alpha-\alpha^2}{4(2-\alpha^2)} \text{ and } \Pi_2 = \frac{(4+2\alpha-\alpha^2)^2}{16(2-\alpha^2)^2} \end{aligned}$$

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- Interpretation?
  - Prices are strategic complements when firms are competitors ($\alpha = 1$) but strategic substitutes when firms are "complementors" ($\alpha = -1$)

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  - In particular, should the platform commit to the price it will charge to the side that arrives late when trying to attract the side that arrives early?

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- Very topical this week with E3 Expo (June 2-4) at Los Angeles Convention Center
  - The biggest "commitment venue" in the software industry

- Steve Race, president of Sony Computer Entertainment of America, at the first E3 (Electronic Entertainment Expo), May 11-13, 1995, Los Angeles, more than 6 months before the actual release of the Playstation: "*Olaf [Olafsson] was about two-thirds of the way through his speech when he said, "I would like to call up Steve Race to tell you a little bit more about the Sony Playstation." So I walked up. I had a whole bunch of sheets of paper in my hands, and I walked up, put them down on the podium, and I just said, "$299," and walked off stage to this thunderous applause.*"

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- Good idea to announce price of PlayStation so early? Why or why not?

Model

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- N identical developers, selling independent products; each has development cost f
- Each user has demand $d(p)$ for each game
- Utility derived by user indexed by θ from joining platform when n developers have joined and each developer sets a price equal to p:

$$V_0 + ns(p) - P_U - \theta$$

where θ (users' opportunity cost) is distributed with c.d.f. F ; $s(p) \equiv \int_p^{\infty} d(\rho)\, d\rho$ (user surplus from each game net of price p); P_U price charged by the platform to users

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- Profits for each individual developer who joins:

$$\pi\left(p\right) F\left(V_0 + ns\left(p\right) - P_U\right) - P_D - f$$

where P_D is the price charged by the platform to developers; $\pi\left(p\right) = pd\left(p\right)$

Timing

Two possible timings the platform can choose:

With commitment	Without commitment
1. a) Platform sets P_D and P_U	**1. a)** Platform sets P_D
1. b) Developers decide to join or not	**1. b)** Developers decide to join or not
	2. a) Platform observes developers' decisions and sets P_U
2. Consumers observe everything and decide to join or not	**2. b)** Consumers observe everything and decide to join or not
3. a) Developers who have joined set their prices p	**3. a)** Developers who have joined set their prices p
3. b) Consumers who have joined decide to which games to buy	**3. b)** Consumers who have joined decide to which games to buy

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- This is anticipated by everyone in all previous stages
- Let $\pi \equiv \pi(p^m)$ and $s \equiv s(p^m)$

Pricing with commitment

- If n developers have joined in stage 1.b), then user demand in stage 2 is:

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- A developer joins in stage 1.b) if and only if:

$$\pi F\left(V_0 + n^E s - P_U^C\right) - P_D - f \geq 0$$

where n^E is the number of developers expected to join

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- Developers arrive first => *direct* network effects among developers! Multiple equilibria possible...
- Two possibilities: favorable or unfavorable developer expectations

Pricing with commitment - favorable expectations

- The platform can set in stage 1.a):

$$P_D = \pi F \left(V_0 + Ns - P_U^C \right) - f$$

and all N developers adopt in equilibrium.

Pricing with commitment - favorable expectations

- The platform can set in stage 1.a):

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- The platform can therefore obtain:

$$\begin{aligned}\Pi_F^C &= \max_{P_U^C}\left\{P_U^C F\left(V_0 + Ns - P_U^C\right) + NP_D\right\} \\ &= \max_{P_U^C}\left\{\left[P_U^C + N\pi\right] F\left(V_0 + Ns - P_U^C\right) - Nf\right\}\end{aligned}$$

by setting $P_U^C = P_U^{FB} \equiv \arg\max_{P_U}\left\{\left[P_U + N\pi\right] F\left(V_0 + Ns - P_U\right)\right\}$

Pricing with commitment - unfavorable expectations

- If the platform sets $P_D > \pi F\left(V_0 - P_U^C\right) - f$ in stage 1.a), then developers coordinate on the no-adoption equilibrium.

Pricing with commitment - unfavorable expectations

- If the platform sets $P_D > \pi F\left(V_0 - P_U^C\right) - f$ in stage 1.a), then developers coordinate on the no-adoption equilibrium.
- Thus, if the platform wants to attract any developers, it must set:

$$P_D = \pi F\left(V_0 - P_U^C\right) - f$$

and therefore can only obtain:

$$\Pi_{UF}^C = \max_{P_U^C}\left\{P_U^C F\left(V_0 + Ns - P_U^C\right) + N\pi F\left(V_0 - P_U^C\right) - Nf\right\} < \Pi_F^C$$

Pricing without commitment

- If n developers have joined in stage 1.b), then in stage 2.a) the platform sets:

$$P_U^*(n) = \arg\max_{P_U} P_U F(V_0 + ns - P_U)$$

note that $P_U^*(n)$ is increasing.

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- **Lemma 1**: $n^E s - P_U^*\left(n^E\right)$ *is increasing in* n^E.

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- A developer joins in stage 1.b) if and only if:

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  where n^E is the number of developers expected to join
- **Lemma 1**: $n^E s - P_U^*\left(n^E\right)$ *is increasing in* n^E.
- The lemma implies that there are positive *direct* network effects among developers and that for *any* P_D set in stage 1.a), there are *at most* 2 possible adoption equilibria in stage 1.b): all N developers join or 0 developers join.

Proof of Lemma 1

- $P_U^*(n)$ solves:

$$-P_U^*(n) f(V_0 + ns - P_U^*(n)) + F(V_0 + ns - P_U^*(n)) = 0$$

and verifies the second order condition:

$$-2f(V_0 + ns - P_U^*(n)) + P_U^*(n) f'(V_0 + ns - P_U^*(n)) \leq 0$$

- Take derivative of FOC in n and re-arrange:

$$\begin{aligned} \frac{s - P_U^{*\prime}(n)}{s} &= \frac{f(V_0 + ns - P_U^*(n))}{2f(V_0 + ns - P_U^*(n)) - P_U^*(n) f'(V_0 + ns - P_U^*(n))} \\ &\geq 0 \end{aligned}$$

which means $s - P_U^{*\prime}(n) \geq 0$ and $ns - P_U^*(n)$ is increasing in n

Pricing without commitment - favorable expectations

- The platform can set in stage 1. a):

$$P_D = \pi F\left(V_0 + Ns - P_U^*(N)\right) - f$$

and attracts all N developers.

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  and attracts all N developers.

- Total platform profits are then:

$$\Pi_F^{NC} = \left[P_U^*\left(N\right) + N\pi\right] F\left(V_0 + Ns - P_U^*\left(N\right)\right) - Nf$$

  where (recall): $P_U^*\left(n\right) = \arg\max_{P_U} P_U F\left(V_0 + ns - P_U\right)$

Pricing without commitment - favorable expectations

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  and attracts all N developers.

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- Implication: $\Pi_F^{NC} < \Pi_F^C$ (platform with favorable expectations should always commit)

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- How does this compare with Π_{UF}^{C}? Recall:

$$\Pi_{UF}^{C} = \max_{P_U}\left\{P_U F\left(V_0 + Ns - P_U\right) + N\pi F\left(V_0 - P_U\right) - Nf\right\}$$

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$$P_U^*(N) = \frac{V_0 + Ns}{2} \;\; ; \;\; P_U^*(0) = \frac{V_0}{2} \;\; ; \;\; P_U^C = \frac{V_0 + N(s - \pi)}{2}$$

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- Interpretation?

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  - charging variable fees (royalties)

Next week

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Thank you for your attention.