Bundling and Entry Deterrence

Paper: Andrea Greppi & Domenico Menicucci (2020)
Presenter: Will Ottenheimer

Intro - Contribution to existing literature

Based on GE Honeywell merger

Whinston (1990) - Incumbent multiproduct firm can use bundling to reduce entrant’s profits (build a barrier) - This paper explores changes in the rival entrants structure

Choi (2008) - mixed bundling w/ symmetric firms to deter entry - This paper assumes vertical differentiation and no mixed

Intro - key question

Two games

Incumbent faces “Generalist” multiproduct firm

Incumbent faces “Specialist” single product firm

Compare games and establish “when bundling is more effective deterrent as a function of vertical differentiation?”

Setting - Competition Setting One

Incumbent: Firm A offer products A1 & A2 and faces entry threat from

Single product firms B1 and B2 who produce B1 and B2 respectively

Entrants face entry cost $k > 0$

Setting - Competition Setting Two

Same as first except now B1 and B2 are merged entity “B”

B has entry cost 2k > 0

Firms are Bertrand competitors (compete in price)

Setting - Consumer utility

From vertical differentiation A goods are higher quality than B goods

Consumer utility $VB1 = VB2 = v > 0$

And $VA1 = VA2 = v + \alpha$. $\alpha > 0$ (alpha is degree of vertical differentiation)

Firms are also horizontally differentiated in standard Hotelling fashion

A located at 0 B located at 1 consumers uniformly distributed over [0,1] independently across goods

Consumer utility from A_j is $U = v + \alpha - tx_j$ (x is consumer location t is travel cost) minus payment to firm

Setting - Costs

Let Cj denote marginal production cost for product j = 1,2

We assume c is larger than t

If consumer buys bundle A they will not buy a single Bj even though it yields higher utility than Aj because the utility difference is smaller than t,

The price of B_j is no less than C, C>t

Setting - Parameters

$V > 3t > \alpha$ implies when both firms goods are offered markets are fully covered and each consumer buys one of good 1 and 2 (not necessarily from the same firm) ie goods 1 and 2 are compliments.

Stages of Game

After entry decisions A decides whether to offer its products A1, A2 separately or as a bundle.

If bundled each consumer buys A1 and A2 or neither (never just one)

Firm A then competes or acts as a monopolist

Γs Γg will denote the setting if the incumbent is facing specialists or a generalist

Stages of the Game - Γg

Stage one: B chooses enter or not enter

Stage two: After B's entry decision,

A offers separate sales: SS or Bundle: JS (joint sales)

Stage three: If firm B hasn't entered A is monopolist. If firm B has entered,

A and B compete under SS or JS

Stage Three - Γg

Given Entry & A chose SS:

Consumer chooses $x_j = A_j$ iff

$V + \alpha - tx_j - P_{Aj} > v - t(1-x_j) - P_{Bj}$

$X_j < (1/2t)(\alpha + +P_{Bj} - P_{Aj}) \equiv X^m_j$ (marginal consumer)

From uniform distribution firm's demands given $F(x_j)$ so profits:

$\pi_{Aj} = P_{Aj} * F(X^M_j)$ $\pi_{Bj} = P_{Bj} * (1-F(X^m_j))$ - entry cost

Stage Three - Γg

Given Entry & A chose JS:

Consumer chooses $x_j = A_j$ iff

$2v + 2\alpha - t(x_1+x_2) - P_A > 2v - t(1-x_1 + 1-x_2) - P_B$

$\bar{x} < (1/2t)(\alpha + t + P_B - P_A) \equiv \bar{x}^{gm}$ ($\bar{x}$ is average location $(x_1+x_2)/2$

From uniform distribution firm's demands given F(xj) so profits:

$\pi_A = P_A * F(\bar{x}^{gm})$ $\pi_B = P_B * (1-F(\bar{x}^{gm}))$ - entry cost

CDF of avg location

$$\bar{F}(x) = \begin{cases} 2x^2 & \text{if } 0 \le x \le \frac{1}{2} \\ 1 - 2(1-x)^2 & \text{if } \frac{1}{2} < x \le 1 \end{cases}$$

Lemma 1 - Γg given B entered

(1) *Under SS, the equilibrium prices and profits for firms A and B are:*

$$p^g_{A1} = p^g_{A2} = t + \frac{1}{3}\alpha \equiv p^*_A, \qquad p^g_{B1} = p^g_{B2} = t - \frac{1}{3}\alpha \equiv p^*_B :$$

$$\pi^g_A = \frac{(3t+\alpha)^2}{9t}, \qquad \pi^g_B = \frac{(3t-\alpha)^2}{9t}$$

(2) *Under JS, the equilibrium prices and profits for firms A and B are:*

$$P^g_A = \frac{5}{4}(\alpha - t) + \frac{3}{4}\beta^g, \qquad P^g_B = \frac{1}{4}(t - \alpha + \beta^g) \qquad \text{with} \quad \beta^g = \sqrt{(\alpha - t)^2 + 8t^2}$$

$$\Pi^g_A = \frac{(11t^2 + 2\alpha t - \alpha^2 + (\alpha - t)\beta^g)^2}{32t^2(t - \alpha + \beta^g)}, \qquad \Pi^g_B = \frac{(t - \alpha + \beta^g)^3}{128t^2}$$

(3) *If* $\alpha < \alpha^g_A$, *then* $\pi^g_A > \Pi^g_A$; *if* $\alpha > \alpha^g_A$, *then* $\pi^g_A < \Pi^g_A$, *with* $\alpha^g_A = 1.415t$.

(4) *If* $\alpha < \alpha^g_B$, *then* $\pi^g_B > \Pi^g_B$; *if* $\alpha > \alpha^g_B$, *then* $\pi^g_B < \Pi^g_B$, *with* $\alpha^g_B = 2.376t$.

Subgame - B doesn't enter *Applies to both Γg and Γs

When A is monopolist under SS

Consumer x_j buys A_j iff

$V + \alpha - tx - P_A > 0$ so demand is:

$F((v+\alpha-P_A)/t)$ where π max $P_{Aj} = v + \alpha - t$

Monopolist A under JS

Consumer buys A iff $2v+2\alpha - t(x_1+x_2) - P_A > 0$

If $[2v+2\alpha - P_A] /(2t) > \bar{x}$ demand is:

(avg CDF) $F((2v+2\alpha - P_A)/(2t))$

Lemma 2

(1) *If firm A is a monopolist under SS, then the optimal price in market j is* $p_{Aj} = v + \alpha - t$, *for* $j = 1, 2$, *and A's total profit is* $2(v + \alpha - t)$.

(2) *If firm A is a monopolist under JS, then the optimal price for the bundle is slightly greater than* $2(v + \alpha - t)$, *and A's profit is greater than* $2(v + \alpha - t)$.

Price increases can occur under bundling since under JS consumers are forced to buy bundle or nothing at all

Stage Two - Γg

Based on entry Firm A's best response follows from Lemma 1

Lemma 3 *In game Γ^g, at stage two*

(1) *if firm B has entered at stage one, then A's best action is SS if $\alpha < \alpha_A^g$, and is JS if $\alpha > \alpha_A^g$;*

(2) *if firm B has not entered, then A's best action is JS.*

Stage One - Γg

Based on Lemmas 1 and 3 entry decision follows:

Proposition 1 *In game Γ^g, the unique SPNE is such that*

(1) *when $\alpha < \alpha_A^g$, at stage one firm B enters if and only if $k < \pi_B^g/2$;*
(2) *when $\alpha_A^g < \alpha$, at stage one firm B enters if and only if $k < \Pi_B^g/2$;*

the rest of the SPNE strategies (relative to stages two and three) is obtained from Lemmas 1–3.

A’s bundling is only effective entry deterrence when α is sufficiently large and entry cost is sufficiently low

Stage Three - Γs

Given B1 and B2 have entered

Subgame if incumbent chooses SS

Analysis is the same as generalist

$P_{A1}^* = P_{A2}^* = t + (⅓)\alpha$ $P_{B1}^* = P_{B2}^* = t - (⅓)\alpha$

Subgame if incumbent chooses JS

Consumer chooses A's bundle if $\bar{x} < (1/2t)(\alpha + t + .5P_{B1} + .5P_{B2} - .5P_A) = \bar{x}$

π_A : CDF of avg location $F(\bar{x}^{sm}) * P_A$

$\pi_{\mathbf{B1}} = P_{B1}[1 - F(\bar{x}^{sm})]$ - entry cost , $\pi_{B2} = P_{B2}[1 - F(\bar{x}^{sm})]$ - entry cos

Stage Three - Γs

Lemma 4 (HJM) *In game Γ^s, suppose that firms $B1$ and $B2$ have entered. Then*

(1) *Under SS, the equilibrium prices and profits for firms A and $B1$, $B2$ are:*

$$p^s_{A1} = p^s_{A2} = p^*_A, \qquad p^s_{B1} = p^s_{B2} = p^*_B \quad \text{from (5)}$$

$$\pi^s_A = \frac{(3t+\alpha)^2}{9t} = \pi^g_A, \qquad \pi^s_{B1} = \pi^s_{B2} = \hat{\pi}$$

(2) *Under JS, the equilibrium prices and profits for firms A and $B1$, $B2$ are:*

$$P^s_A = \frac{1}{5}(6\alpha - 6t + 4\beta^s), \qquad P^s_{B1} = P^s_{B2} = \frac{1}{5}(t - \alpha + \beta^s) \qquad \text{with } \beta^s = \sqrt{(\alpha - t)^2 + 10t^2}$$

$$\Pi^s_A = \frac{2(19t^2 - \alpha^2 + 2\alpha t + (\alpha - t)\beta^s)^2}{125(t - \alpha + \beta^s)t^2}, \qquad \Pi^s_{B1} = \Pi^s_{B2} = \frac{(t - \alpha + \beta^s)^3}{250t^2}$$

(3) *If $\alpha < \alpha^s_A$, then $\pi^s_A > \Pi^s_A$; if $\alpha > \alpha^s_A$, then $\pi^s_A < \Pi^s_A$, with $\alpha^s_A = 0.307t$.*
(4) *If $\alpha < \alpha^s_{B12}$, then $\hat{\pi} > \Pi^s_{B1}$; if $\alpha > \alpha^s_{B12}$, then $\hat{\pi} < \Pi^s_{B1}$, with $\alpha^s_{B12} = 2.092t$.*

Stage Three - Γs

Subgames only one specialist enters

If SS then A is monopolist in one industry competitor in other and prices are ready from Lemma1 and Lemma2

If JS then consumer buys bundle A iff

$2v + 2\alpha - tx_1 - tx_2 - P_A > v - t(1 - tx_1) - P_B$

Demand for A is 1 if $P_A - P_{B1} < v + 2\alpha - 2t$, 0 if $P_A - P_{B1} > v + 2\alpha + t$ if between then:

$$D_A(P_A, P_{B1}) = \begin{cases} 1 - \frac{1}{4t^2}(2t - v - 2\alpha - P_{B1} + P_A)^2 & \text{if } v + 2\alpha - 2t \leq P_A - P_{B1} \leq v + 2\alpha - t \\ \frac{1}{4t}(2v + 4\alpha + t + 2P_{B1} - 2P_A) & \text{if } v + 2\alpha - t < P_A - P_{B1} \leq v + 2\alpha \\ \frac{1}{4t^2}(v + 2\alpha + t + P_{B1} - P_A)^2 & \text{if } v + 2\alpha < P_A - P_{B1} \leq v + 2\alpha + t \end{cases}$$

Stage Three - Γs (1 entrant)

Lemma 5 Moving to JS is ambiguous

(1) *Under SS, the equilibrium prices and profits for firms A and B1 are*

$$p_{A1}^{s1} = p_A^*, \qquad p_{A2}^{s1} = v + \alpha - t, \qquad p_{B1}^{s1} = p_B^*$$

$$\pi_A^{s1} = \frac{1}{18t}(3t + \alpha)^2 + v + \alpha - t, \qquad \pi_{B1}^{s1} = \hat{\pi}$$

Stage Three - Γs (1 entrant)

Lemma 5 Moving to JS is ambiguous

(2) *Under JS, the equilibrium prices and profits for firms A and B1 are*

$$P_A^{s1} = \frac{5}{8}(v + 2\alpha) - \frac{5}{4}t + \frac{3}{8}\beta^{s1}, \quad P_{B1}^{s1} = \frac{1}{8}\beta^{s1} - \frac{1}{8}(v + 2\alpha) + \frac{1}{4}t \quad \text{with } \beta^{s1} = \sqrt{(v + 2\alpha - 2t)^2 + 16t^2}$$

$$\Pi_A^{s1} = P_A^{s1} D_A(P_A^{s1}, P_{B1}^{s1}), \qquad \Pi_{B1}^{s1} = P_{B1}^{s1}[1 - D_A(P_A^{s1}, P_{B1}^{s1})]$$

(3) *For each* $v \geq 3t$, *there exist* $\alpha_A^{s1}(v), \alpha_{B1}^{s1}(v)$ *such that if* $\alpha < \alpha_A^{s1}(v)$, *then* $\pi_A^{s1} > \Pi_A^{s1}$; *if* $\alpha > \alpha_A^{s1}(v)$, *then* $\pi_A^{s1} < \Pi_A^{s1}$; *if* $\alpha < \alpha_{B1}^{s1}(v)$, *then* $\pi_{B1}^{s1} > \Pi_{B1}^{s1}$; if $\alpha > \alpha_{B1}^{s1}(v)$, *then* $\pi_{B1}^{s1} < \Pi_{B1}^{s1}$.

Moreover, $\alpha_A^{s1}, \alpha_{B1}^{s1}$ *are increasing, and* $\alpha_A^{s1}(3t) = 2.1t$, $\alpha_{B1}^{s1}(3t) = 2.776t$.

Stage Two - Γs

Lemmas 2,4, and 5 lead to Firm A's choice SS or JS

Lemma 6 *In game Γ^s, at stage two:*

(1) *if B1 and B2 have entered, then A's best action is SS if $\alpha < \alpha_A^s$, and is JS if $\alpha > \alpha_A^s$;*
(2) *if only one specialist has entered, then A's best action depends on α and v: for each $v \geq 3t$, A plays SS if $\alpha < \alpha_A^{s1}(v)$, plays JS if $\alpha > \alpha_A^{s1}(v)$;*
(3) *if no specialist has entered, then A's best action is JS.*

Stage One - Γs

Assume B1 and B2 are strategically independent

However, B1 entry decision affects B2 profits

When A SS=> In, In is Nash Equilibrium

$B1\backslash B2$	In	Out
In	$\hat{\pi}-k, \hat{\pi}-k$	$\hat{\pi}-k, 0$
Out	$0, \hat{\pi}-k$	$0, 0$

Stage One - Γs

Proposition 2a *In game Γ^s, suppose that $\alpha < \alpha_A^s$. Then the unique SPNE of Γ^s is such that firms B1 and B2 both enter if $k < \hat{\pi}$, and neither B1 nor B2 enters if $\hat{\pi} < k$.*

When $\alpha > \alpha_A^s$ A chooses JS when both enter and SS when only one enters

When one firm is better off when the other doesn't enter a Hawk Dove game results

$B1\backslash B2$	*In*	*Out*
In	$\Pi_{B1}^s - k, \Pi_{B1}^s - k$	$\hat{\pi} - k, 0$
Out	$0, \hat{\pi} - k$	$0, 0$

Stage One - Γs

Proposition 2b *In game Γ^s, suppose that $\alpha > \alpha^s_A$. Then neither $B1$ nor $B2$ enters if $k > \max\{\hat{\pi}, \Pi^s_{B1}\}$. If instead $k < \max\{\hat{\pi}, \Pi^s_{B1}\}$, then the stage one entry game is such that:*

(1) *for $\alpha \in (\alpha^s_A, \alpha^s_{B12})$, (In, In) is the unique NE if $k < \Pi^s_{B1}$; the unique symmetric NE is (12) if $\Pi^s_{B1} < k < \hat{\pi}$;*

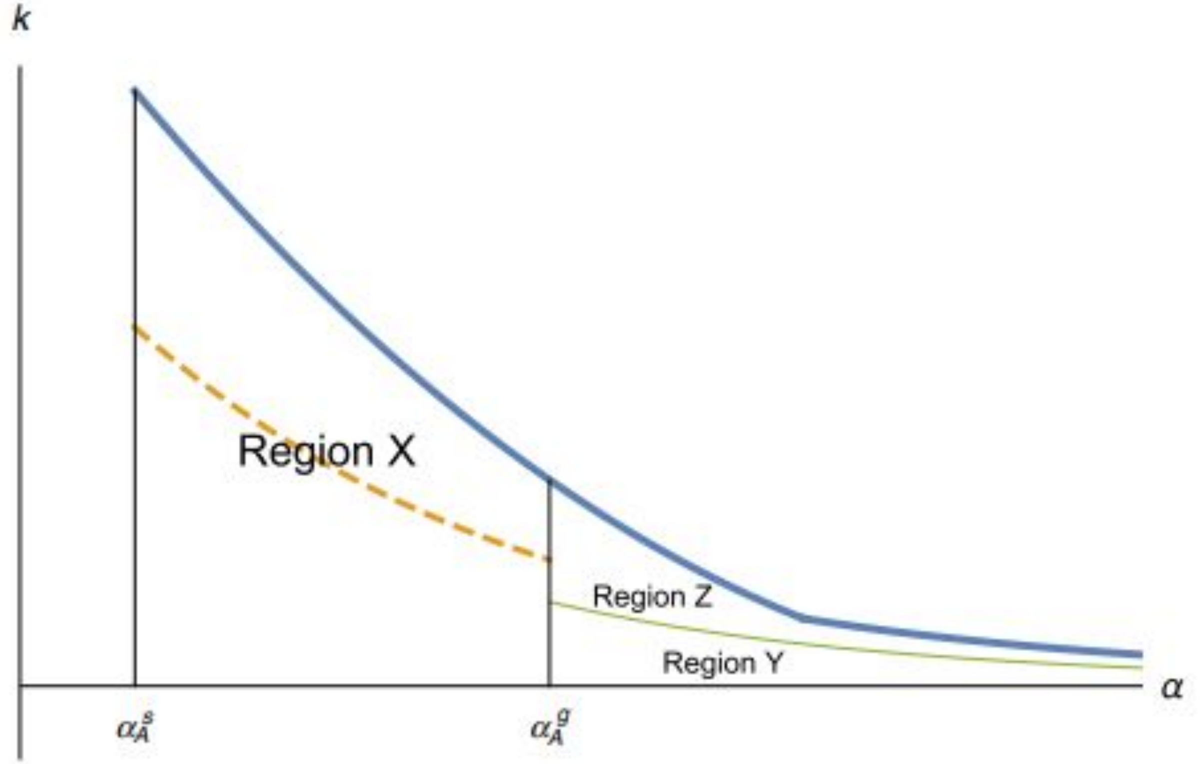
(2) *for $\alpha > \alpha^s_{B12}$ and for each $k < \Pi^s_{B1}$, (In, In) is either the unique NE or the unique Pareto dominant NE.*

Compare Γg and Γs

Same outcome when $\alpha < \alpha^s_a$ and when $k >$ max π where A chooses SS

So inspect $\alpha > \alpha^s_a$

Compare Γg and Γs



Compare Γg and Γs

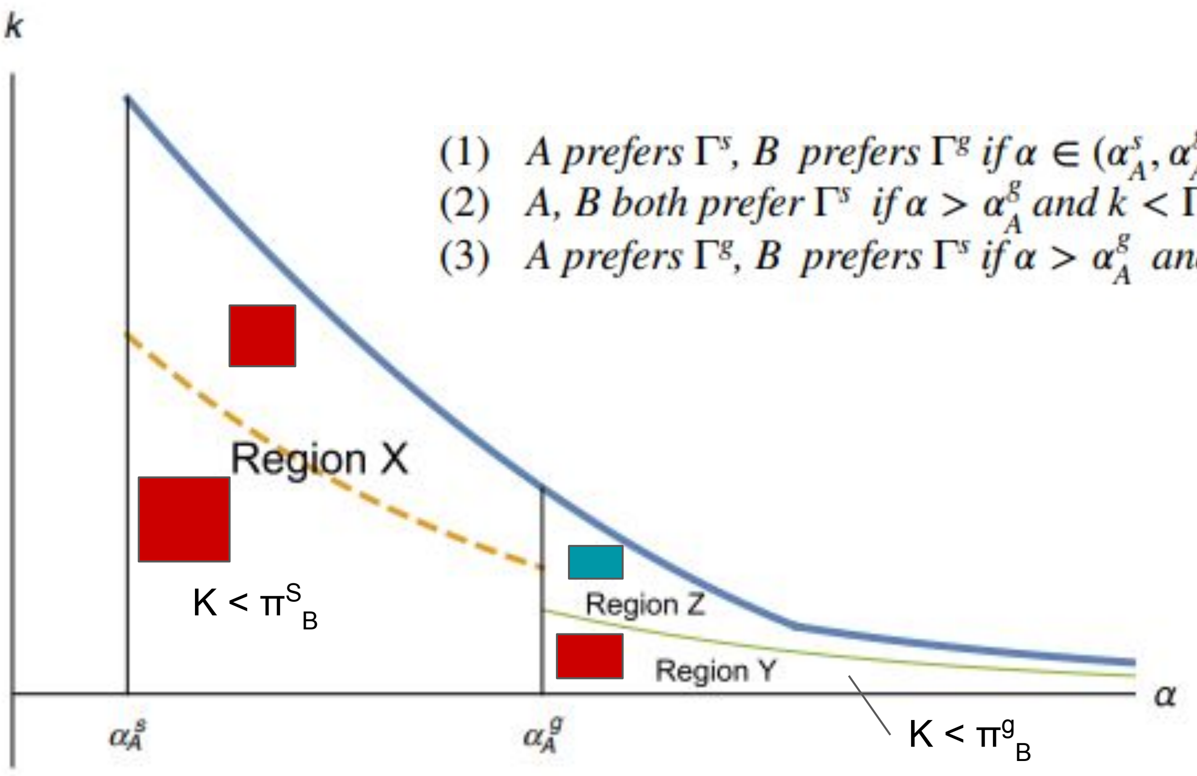
A pref Γs

A pref Γg

(1) *A prefers* Γ^s, *B prefers* Γ^g *if* $\alpha \in (\alpha_A^s, \alpha_A^g)$ *(Region X in Fig. 2)*;

(2) *A, B both prefer* Γ^s *if* $\alpha > \alpha_A^g$ *and* $k < \Pi_B^g/2$ *(Region Y in Fig. 2)*;

(3) *A prefers* Γ^g, *B prefers* Γ^s *if* $\alpha > \alpha_A^g$ *and* $\Pi_B^g/2 < k$ *(Region Z in Fig. 2)*.



Conclusion

Main question: “How does vertical differentiation affect a firm’s ability to deter entry by bundling?”

Depending on the kind(s) of entry threat and their associated entry costs and A’s severity of vertical differentiation bundling can be effective entry deterrence