Retailer's product line choice with manufacturer's multi-channel marketing

Cong Pan

Graduate School of Economics, Osaka University

pge042pc@student.econ.osaka-u.ac.jp

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Outline

Motivation

The shifting channel power:

- Manufacturer → Retailer (Kadiyali et al., 2000);
- Buyer power: order for product line.

The bloom of internet:

- Upstream manufacturers recaptures channel power by **multi-channel marketing** (e.g. Tannenbaum, 1995): online channels + traditional wholesale channels;
- Online stores compete with retailers (Emerson, 2010): **intrabrand competition**.

"Product line decision": a retailer VS an online store (Lieber and Syverson, 2010)

- A physical retailer is disadvantageous in **inventory and display**

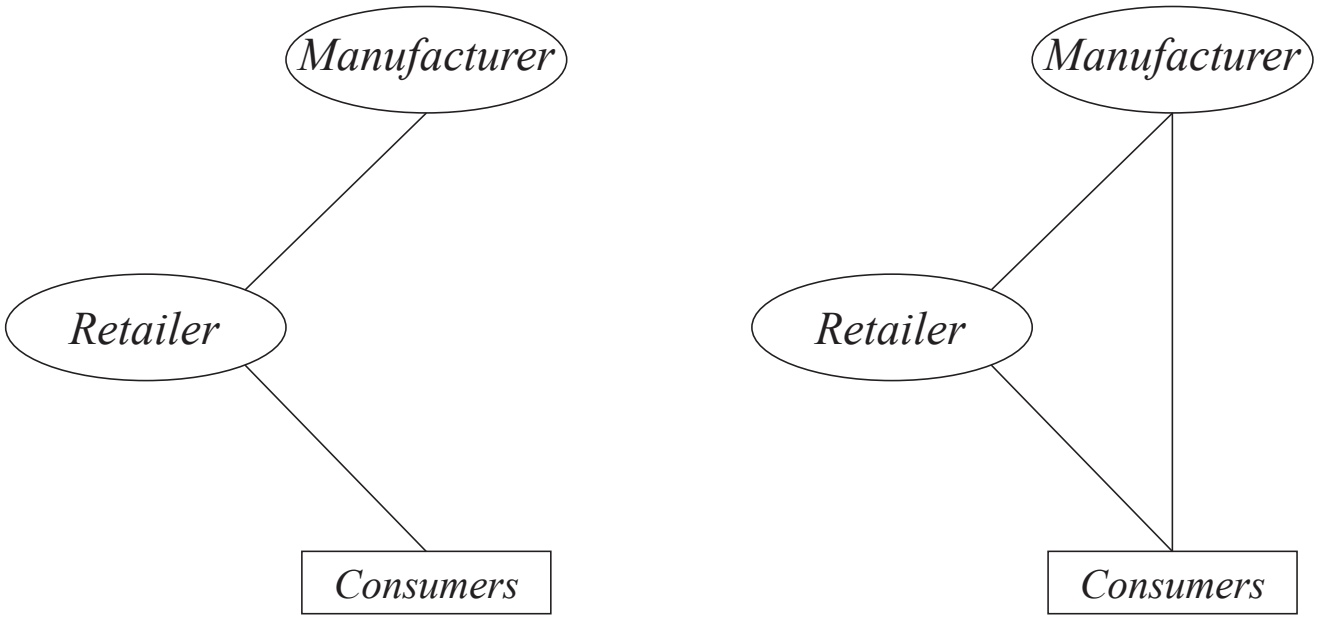
The retailer's **product line choice** is an important issue.

Objective

Retailer's **product line choice** + Manufacturer's **multi-channel marketing**

- Manufacturer (M): MPF;
  Retailer (R): orders variety(ies) from the manufacturer.
- Sale through online channel ≡ "encroachment" (Arya et al., 2007)

Market structure:



Main results

#: number of varieties.

When *M* is able to run its online store,

1. Even if without product line expansion cost,
   R may order less # so as to induce *M*'s less encroaching #;
2. *M* may benefit by committing not to open the online store;
3. social welfare may decrease, even though # increases.

Real world cases:

- Customized model sold by "JCCU" in main universities;
  (e.g. Panasonic's notebook PC, Casio's electronic dictionaries,
  Cannon's laser printers)
- Fashion magazines bundled with CDs, small examples or
  supplemental materials sold in physical stores.

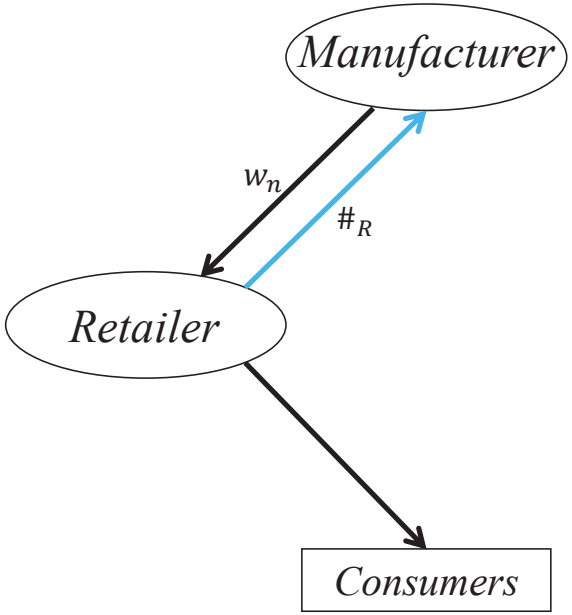
Existing literature

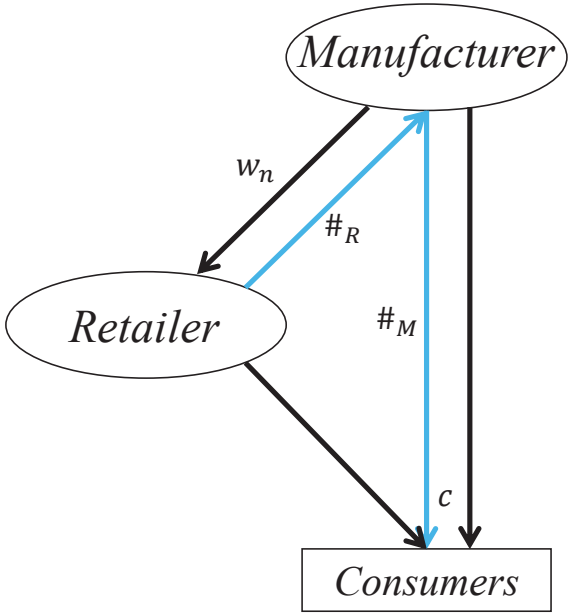
- Supplier power–manufacturer's encroachment:
  1. Arya et al. (2007, Marketing Sci): initial attempt; single product firms.
  2. Liao (2014, JER): asymmetric information.
  3. Mizuno (2012, JEMS): endogenous encroachment; *n* retailers.
  4. Li et al. (2015, IJPE): *n* exclusive supply chains.
- Buyer power–product line choice:
  1. Dukes et al. (2009, Marketing Sci):
     1 MPF manufacturer, duopoly retailers' product line expansion cost.
  2. Moner-Colonques et al. (2011, JEMS):
     2 SPF manufacturers, duopoly retailers decide single-sourcing or multi-sourcing.
  3. Inderst and Shaffer (2007, EJ): Single-sourcing and cross-border mergers.

This paper: Manufacturer's encroachment + Retailer's product line choice

Monopoly retailer case

Market structure:





- Product variety $n = X$ or Y;
- M's **variety choice**, $m = X$, Y, both (B), or nothing (N);
- R's **variety choice**, $r = X$, Y or both (B);
- Online retail cost: c ("encroachment" literature).

Demand side:

- Representative consumer's utility:

$$U(Q_X, Q_Y) = a(Q_X + Q_Y) - \frac{1}{2}(Q_X^2 + 2\gamma Q_X Q_Y + Q_Y^2),$$

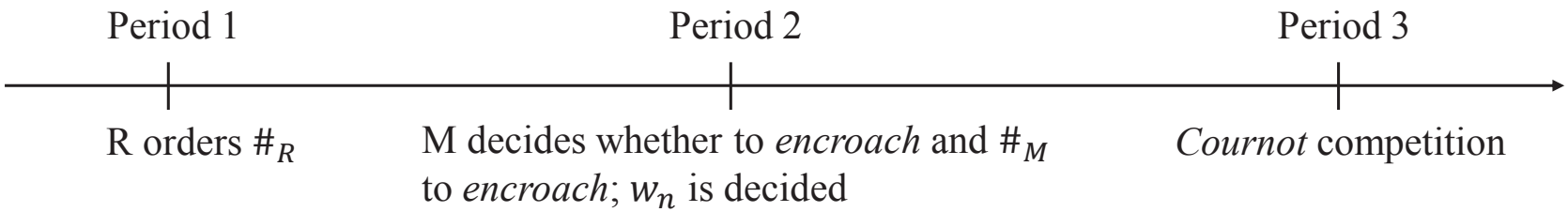
where Q_n is the total quantity of n;

- Inverse demand of n, $P_n(Q_n, Q_{-n}) = a - Q_n - \gamma Q_{-n}$,

where Q_n, P_n: total quantity and price of n.

Benchmark: one retailer case

Timing:



- Seven cases of product line systems, *rm*: *XN*, *XX*, *XY*, *XB*, *BN*, *BY*, *BB*;
- q_{nR} and q_{nM}: *R* and *M*'s quantity of *n*.

M's profit :

$$\pi_M = \sum_{n' \in L} [P_{n'}(Q_{n'}, Q_{-n'}) - c] q_{n'M} + \sum_{n \in K} q_{nR} w_n.$$

R's profit:

$$\pi_R = \sum_{n \in K} [P_n(Q_n, Q_{-n}) - w_n] q_{nR},$$

where $K \subseteq \{X, Y\} \setminus \emptyset$, $L \subseteq \{X, Y\}$.

Result: wholesale price and online variety

Games in period 2:

$$\max_{w_n, w_{-n}} \sum_{n' \in L} [P_{n'}(Q_{n'}(w_n, w_{-n}), Q_{-n'}(w_n, w_{-n})) - c] q_{n'M}(w_n, w_{-n}) + \sum_{n \in K} q_{nR}(w_n, w_{-n}) w_n.$$

Proposition 1

Given the retailer's variety order r, the wholesale prices decrease with more product varieties sold online ($w_n^{rB} < w_n^{rY} < w_n^{rN}$).

$\#_M \uparrow \Rightarrow \pi^{online} \uparrow$;
$\Rightarrow q_{nR} \downarrow \Rightarrow \pi^{wholesale} \downarrow$ (Business stealing effect) $\Rightarrow w_n \downarrow$

Because the **wholesale channel** is more efficient than the **online channel**, M decreases w to alleviate the **intrabrand competition** (Arya et al., 2007).

$*$ w reflects the **intensity** of **intrabrand competition**.

M's variety choice

Lemma 1

(1) When $r = X$, (i) $m = B$ if $c/a \leq \underline{\theta}^X(\gamma)$, (ii) $m = Y$ if $\underline{\theta}^X(\gamma) < c/a \leq \bar{\theta}^X(\gamma)$, (iii) $m = N$ if $c/a > \bar{\theta}^X(\gamma)$;
(2) When $r = B$, (i) $m = B$ if $c/a \leq \theta^B(\gamma)$, (ii) $m = N$ if $c/a > \theta^B(\gamma)$.

Some remarks:

1. When $r = X$, M does not sell X online (avoid direct encroachment).
   - Online sale of X is small;
   - Overly intensive **intrabrand competition**.
2. When $r = X$, M may sell Y online.
   When $r = B$, M does not sell only one variety online.
   - M intends to make variety distribution balanced (main logic).

Wholesale pricing effect when $r = X$

When $r = X$, variety distribution in **wholesale channel** is unbalanced.

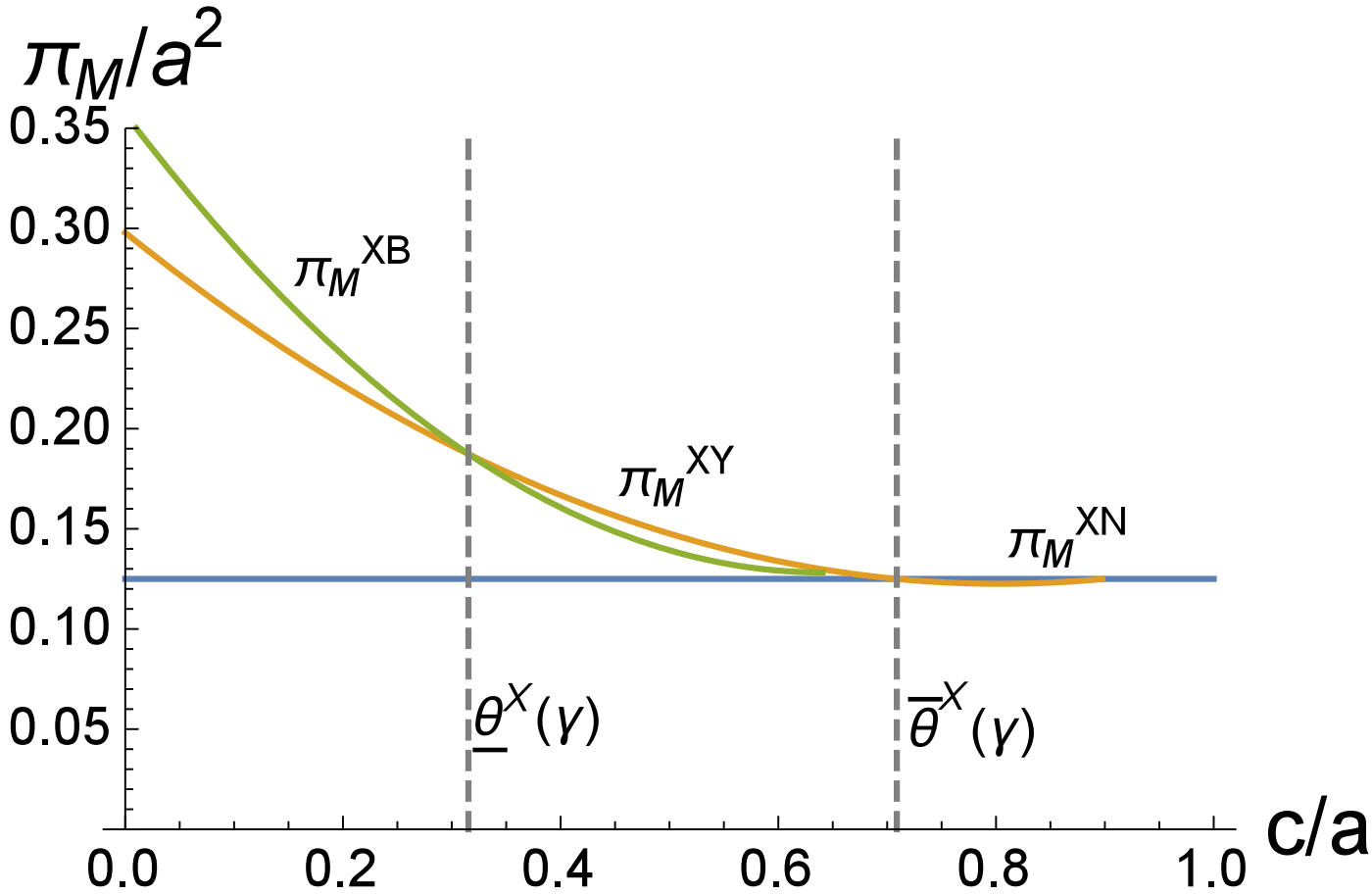
$\#_M(0 \to 1)$ (selling Y) *VS* $\#_M(1 \to 2)$ (additionally sell X),

$$0 < w_X^{XN} - w_X^{XY} < w_X^{XY} - w_X^{XB}.$$

Intuition: when $m = Y$, because the **intrabrand competition** is indirect and mild, M lowers w only a little; when $m = B$, because the **intrabrand competition** is direct and intensive, M largely lowers w.

$*$ M is less likely to sell both varieties online, when R's order is unbalanced.

Unbalanced variety distribution in wholesale channel



$\gamma = 0.4$

Wholesale pricing effect when $r = B$

When $r = B$, variety distribution in **wholesale channel** is balanced.

$\#_M(0 \to 1)$ (selling Y) *VS* $\#_M(1 \to 2)$ (additionally sell X),

$w_Y^{BN} - w_Y^{BY} > w_X^{BY} - w_X^{BB} > 0$ (direct encroachment),

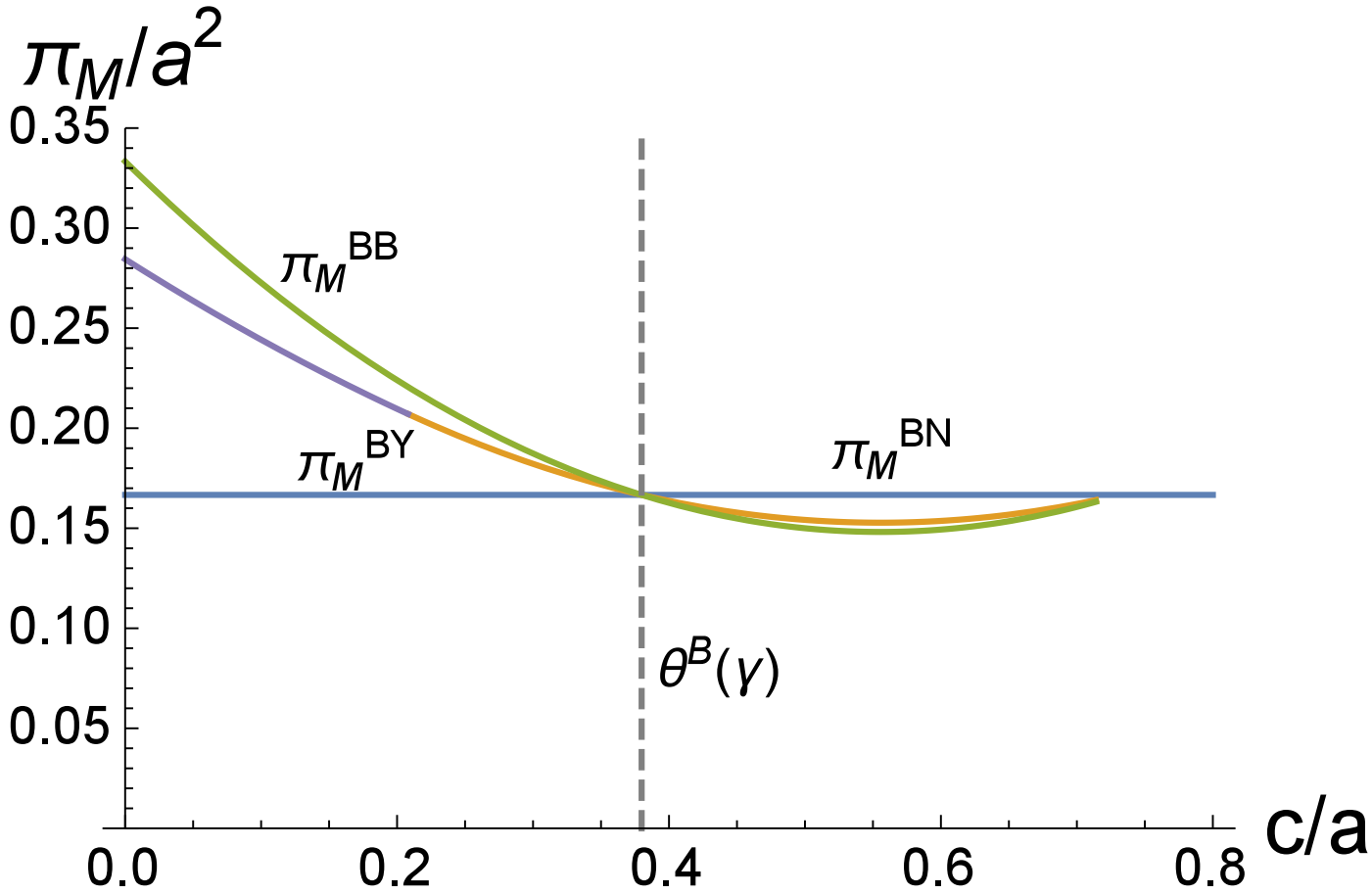
$w_X^{BN} - w_X^{BY} > w_Y^{BY} - w_Y^{BB} > 0$ (indirect encroachment).

$*$ $\#_M(0 \to 1)$ causes more **intrarand competition** than $\#_M(1 \to 2)$.

Intuition: when $\#_M(1 \to 2)$ (additionally sell X),
business stealing effect $\Rightarrow q_{rR} \downarrow$,
cannibalization effect $\Rightarrow q_{XM} \downarrow \Rightarrow q_{rR} \uparrow$.

$*$ M tends to avoid unbalanced variety distribution when R's order is already balanced.

Balanced variety distribution in wholesale channel

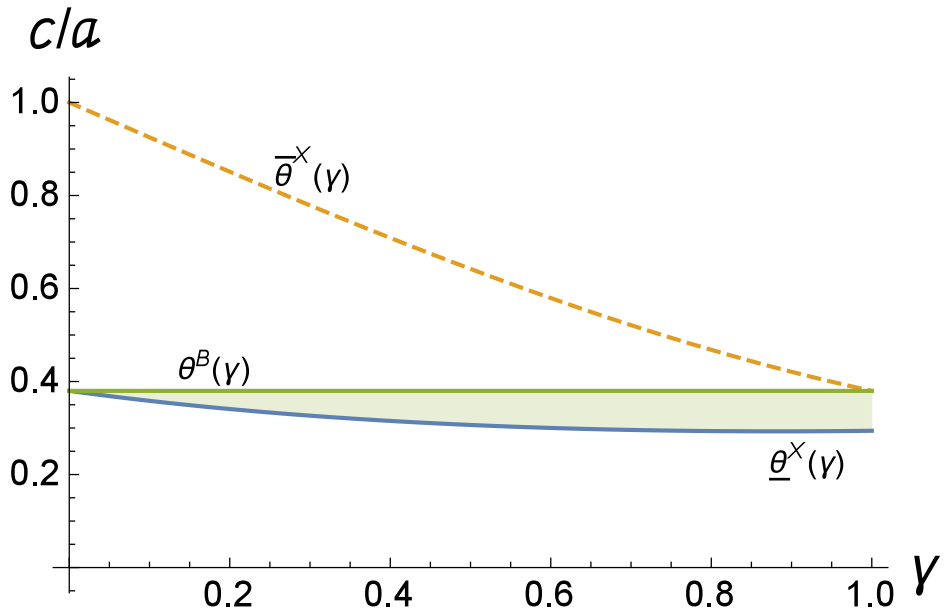


$\gamma = 0.4$

R's variety order

Proposition 2

The equilibrium variety outcome is
(i) $r = B$ and $m = B$ (BB) if $c/a \leq \underline{\theta}^X(\gamma)$ (the BB variety outcome);
(ii) $r = X$ and $m = Y$ (XY) if $\underline{\theta}^X(\gamma) \leq c/a \leq \theta^B(\gamma)$ (the XY variety outcome);
(iii) $r = B$ and $m = N$ (BN) if $c/a \geq \theta^B(\gamma)$ (the BN variety outcome).



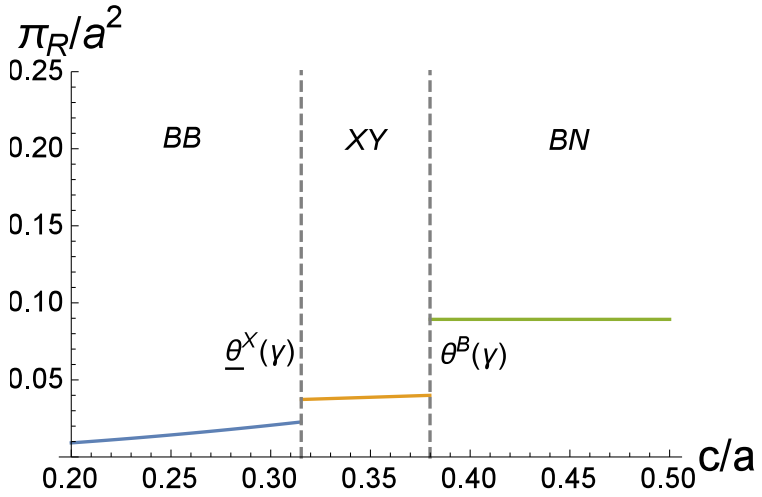
(*ii*) *XY*

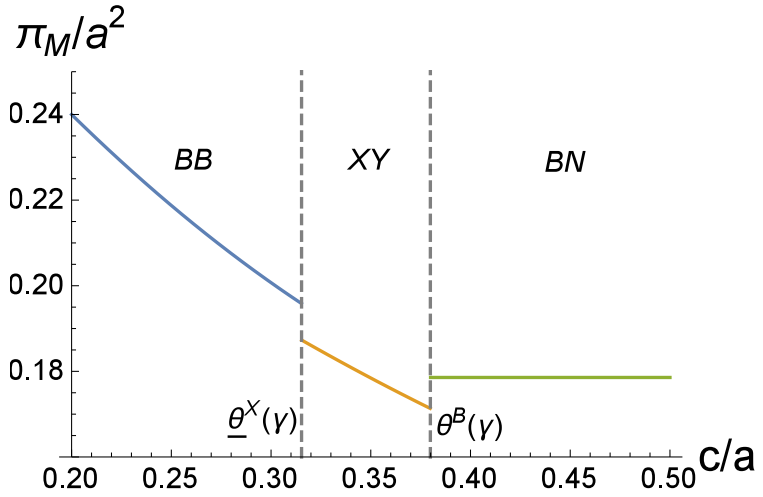
$*$ From (ii), R and M act as if they make an tacit commitment to balance the variety distribution.

Although R can order both varieties, it orders only one.
Intuition: when c is relatively low, encroachment is inevitable,

- $r = B \Rightarrow$ larger product range $(+)$
  $\Rightarrow m = B \Rightarrow$ direct encroachment $(-)$;
- $r = X \Rightarrow$ smaller product range $(-)$
  $\Rightarrow m = Y \Rightarrow$ indirect encroachment $(+)$.

Equilibrium profits





$$\gamma = 0.4$$

R: $c \downarrow \Rightarrow$ encroachment $\uparrow \Rightarrow \pi_R \downarrow$

M at $\bar{\theta}^X(\gamma)$: **intrabrand competition**$(\uparrow)$ + channel efficiency $\downarrow$

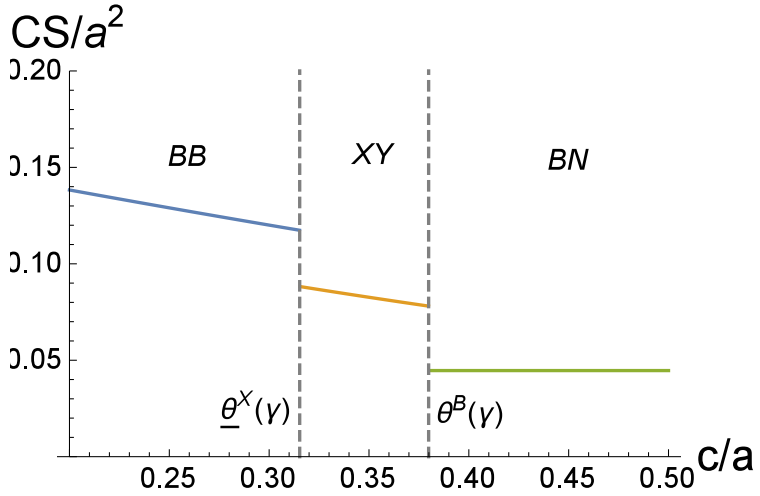
$$\Rightarrow \pi^{online}\uparrow, \pi^{wholesale}\downarrow \overset{\text{large } c}{\Rightarrow} \pi_M \downarrow$$

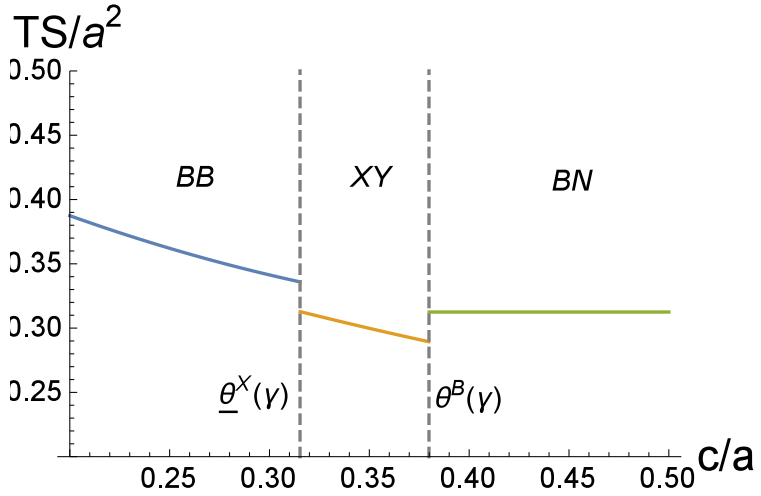
$*$ "loss-loss" consequence (in contrary to Arya et al., 2007)

Proposition 3

M may benefit by committing not to open online store.

Consumer surplus (CS) and total surplus (TS)





CS: $c \downarrow \Rightarrow$ competitiveness $\uparrow \Rightarrow CS \uparrow$

$$TS = U(Q_X, Q_Y) - c \sum_{n \in L} q_{nM}$$

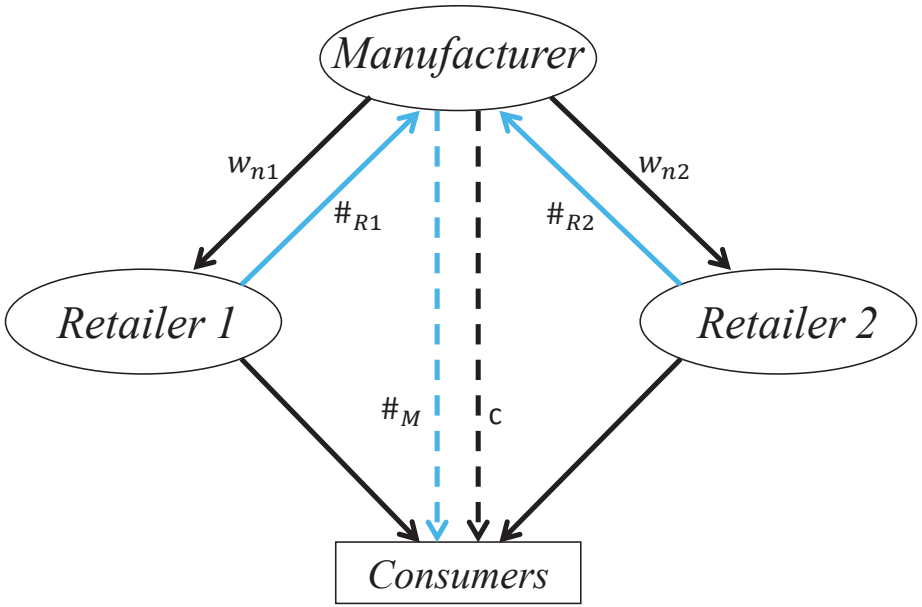
TS at $\theta^B(\gamma)$: competitiveness$\uparrow(+)$, $c \sum_n q_{nM} \uparrow(-) \Rightarrow TS \downarrow$

Proposition 4

Running an online store may harm the social welfare.

Extension: duopoly retailer case

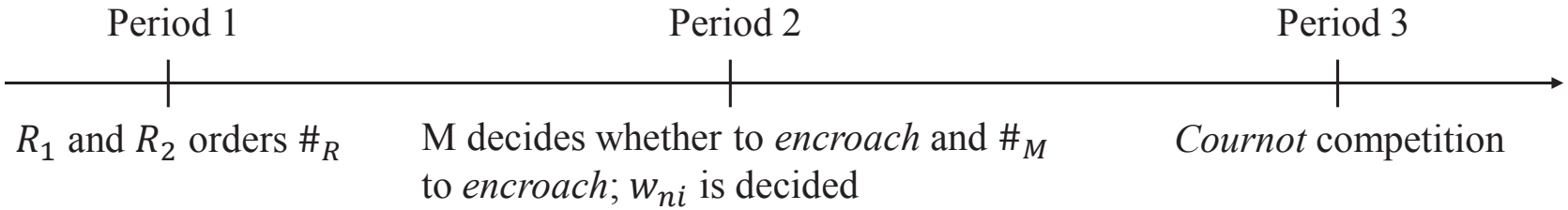
Market structure:



Remark:

- Fourteen cases of product line system, $r_1 r_2 m$: *XXN*, *XXX*, *XXY*, *XXB*, *XYN*, *XYY*, *XYB*, *XBN*, *XBX*, *XBY*, *XBB*, *BBN*, *BBX BBB*;

Timing:



Unbalanced variety distribution in wholesale channel

$r_1 r_2 = XX$ or XB:

- X is over distributed, but Y is less distributed ($r = X$ in monopoly case);
- M does not sell only X online.

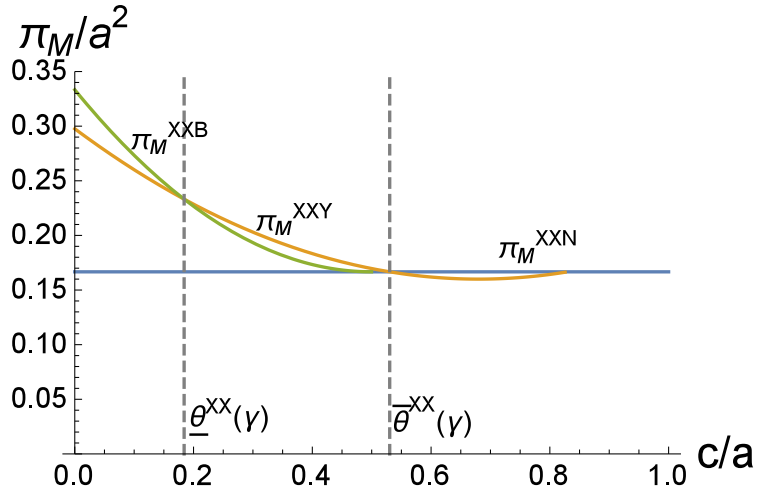
$*$ Selling only Y enables M to alleviate the **intrabrand competition**.

$\Rightarrow$ M is less likely to sell both varieties online, when variety distribution in **wholesale channel** is unbalanced.

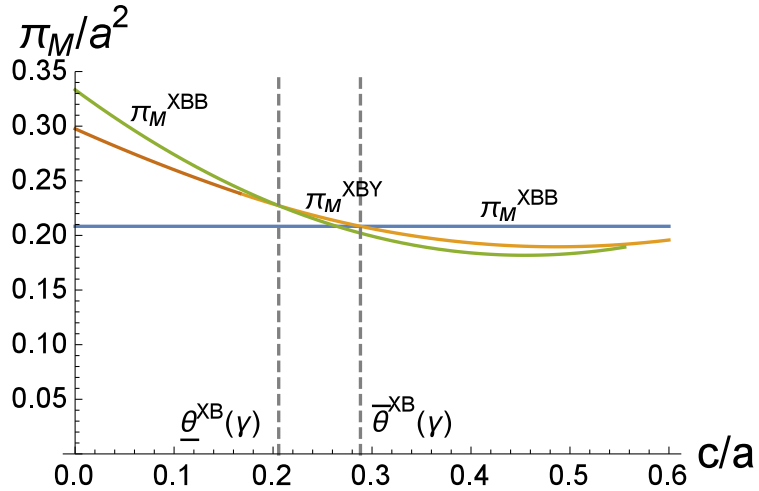
Lemma 2

(1) When $r_1 r_2 = XX$, (i) $m = B$ if $c/a \leq \underline{\theta}^{XX}(\gamma)$, (ii) $m = Y$ if $\underline{\theta}^{XX}(\gamma) < c/a \leq \bar{\theta}^{XX}(\gamma)$, (iii) $m = N$ if $c/a > \bar{\theta}^{XX}(\gamma)$;
(2) When $r_1 r_2 = XB$, (i) $m = B$ if $c/a \leq \underline{\theta}^{XB}(\gamma)$, (ii) $m = Y$ if $\underline{\theta}^{XB}(\gamma) < c/a \leq \bar{\theta}^{XB}(\gamma)$, (iii) $m = N$ if $c/a > \bar{\theta}^{XB}(\gamma)$.

Unbalanced variety distribution in wholesale channel



$r_1 r_2 = XX$



$r_1 r_2 = XB$

$$\underline{\theta}^{XX}(\gamma) < \underline{\theta}^{XB}(\gamma) < \overline{\theta}^{XB}(\gamma) < \overline{\theta}^{XX}$$

$*$ $m = Y$ is less profitable when $r_1 r_2 = XB$ than $r_1 r_2 = XX$.

Balanced variety distribution in wholesale channel

$r_1 r_2 = XY$ or BB:

- Both varieties are evenly distributed ($r = B$ in monopoly case);
- $\#_M(0 \to 1)$ *VS* $\#_M(1 \to 2)$ (additionally sell X),

  $w_Y^{r_1 r_2 N} - w_Y^{r_1 r_2 Y} > w_X^{r_1 r_2 Y} - w_X^{r_1 r_2 B} > 0$ (direct encroachment),

  $w_X^{r_1 r_2 N} - w_X^{r_1 r_2 Y} > w_Y^{r_1 r_2 Y} - w_Y^{r_1 r_2 B} > 0$ (indirect encroachment).
- $\#_M(0 \to 1)$ causes more **intrarand competition** than $\#_M(1 \to 2)$.

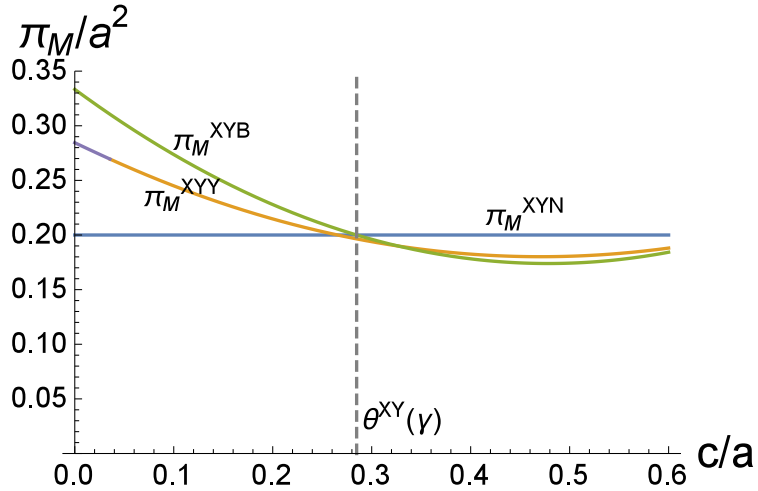
$*$ If $m = Y$ is more profitable than $m = N$, so is $m = B$.

$\Rightarrow$ M tends to keep balance of variety distribution when that in **wholesale channel** is already balanced.

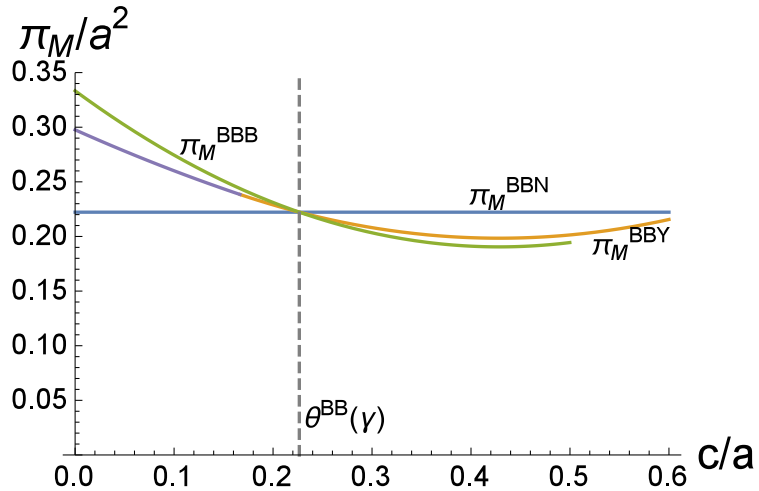
Lemma 2

(3) When $r_1 r_2 = XY$, (i) $m = B$ if $c/a \leq \theta^{XY}(\gamma)$, (ii) $m = N$ if $c/a > \theta^{XY}(\gamma)$;
(4) When $r_1 r_2 = BB$, (i) $m = B$ if $c/a \leq \theta^{BB}(\gamma)$, (ii) $m = N$ if $c/a > \theta^{BB}(\gamma)$.

Balanced variety distribution in wholesale channel



$r_1 r_2 = XY$



$r_1 r_2 = BB$

$$\theta^{BB}(\gamma) < \theta^{XY}(\gamma)$$

$*$ $m = B$ is less profitable when $r_1 r_2 = BB$ than when $r_1 r_2 = XY$ (*ex-ante* competitiveness).

R's variety order

Proposition 5

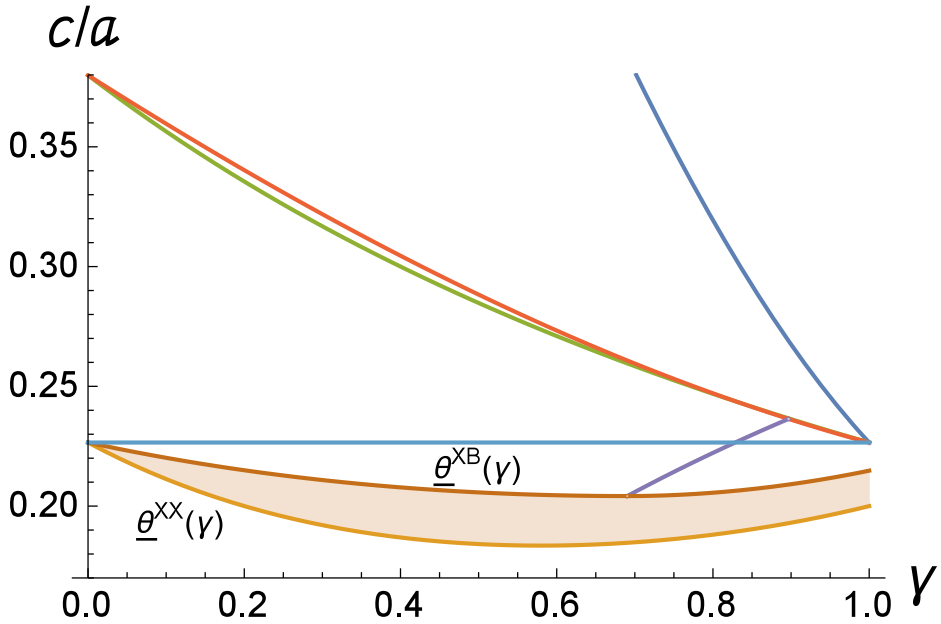
The equilibrium variety outcome is
(i) $r = BB$ and $m = B$ (BBB) if $c/a \leq \underline{\theta}^{XB}(\gamma)$;
(ii) $r_1 r_2 = XX$ and $m = Y$ (XXY) if $\underline{\theta}^{XX}(\gamma) < c/a \leq \underline{\theta}^{XB}(\gamma)$,
or if $\underline{\theta}^{XB}(\gamma) < c/a \leq \min\{\bar{\theta}^{XB}(\gamma), \theta^{XB}(\gamma)\}$;
(iii) $r_1 r_2 = XB$ and $m = Y$ (XBY) if $\max\{\underline{\theta}^{XB}(\gamma), \theta^{XB}(\gamma)\} < c/a \leq \theta^{BB}(\gamma)$;
(iv) $r_1 r_2 = XY$ and $m = N$ (XBY) if $\theta^{XY}(\gamma) < c/a \leq \bar{\theta}^{XB}(\gamma)$;
(v) $r_1 r_2 = BB$ and $m = N$ (BBN) if $c/a > \theta^{BB}(\gamma)$.

$*$ (i) and (v) are extreme cases (c is too large or too small):
$\#_{R1}$ and $\#_{R2}$ do not affect $\#_M \Rightarrow r_i = B$.

(ii), (iii), (iv):
$r_i \neq B \Rightarrow \#_M \downarrow \Rightarrow$ alleviate encroachment.

$*$ **Enlarging product line** *VS* **Alleviating encroachment**

(ii) XXY, $\underline{\theta}^{XX}(\gamma) < c/a \leq \underline{\theta}^{XB}(\gamma)$

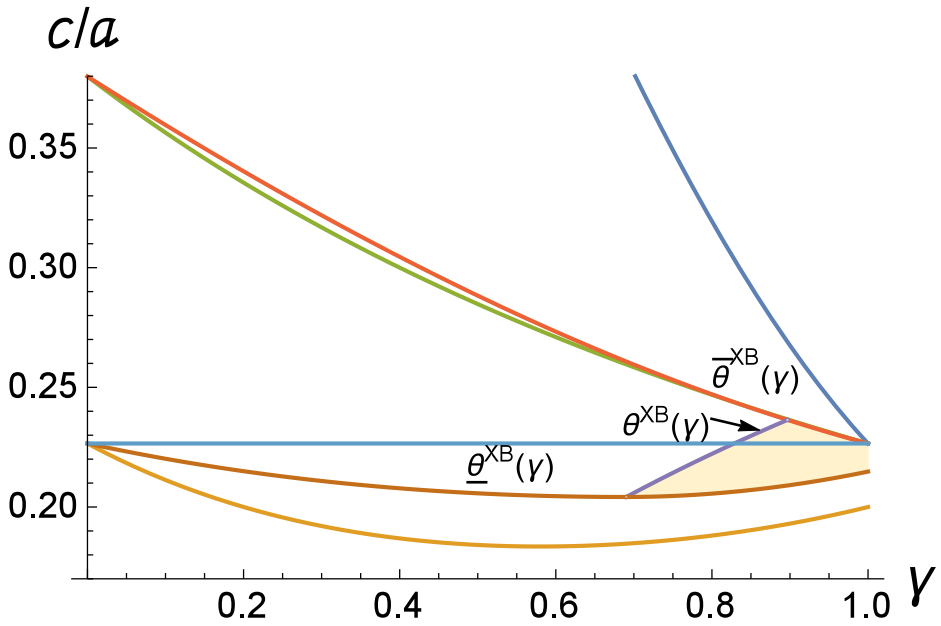


$r_1 r_2$	XX	XB	XY	BB
m	Y	B	B	B

Intuition: when c is relatively low, encroachment is inevitable,

- $r_i = B \Rightarrow$ larger product range $(+)$
  $\Rightarrow m = B \Rightarrow$ direct encroachment $(-)$;
- $r_i = X \Rightarrow$ smaller product range $(-)$
  $\Rightarrow m = Y \Rightarrow$ indirect encroachment $(+)$.

(*ii*) XXY, $\underline{\theta}^{XB}(\gamma) < c/a \leq \min\{\bar{\theta}^{XB}(\gamma), \theta^{XB}(\gamma)\}$

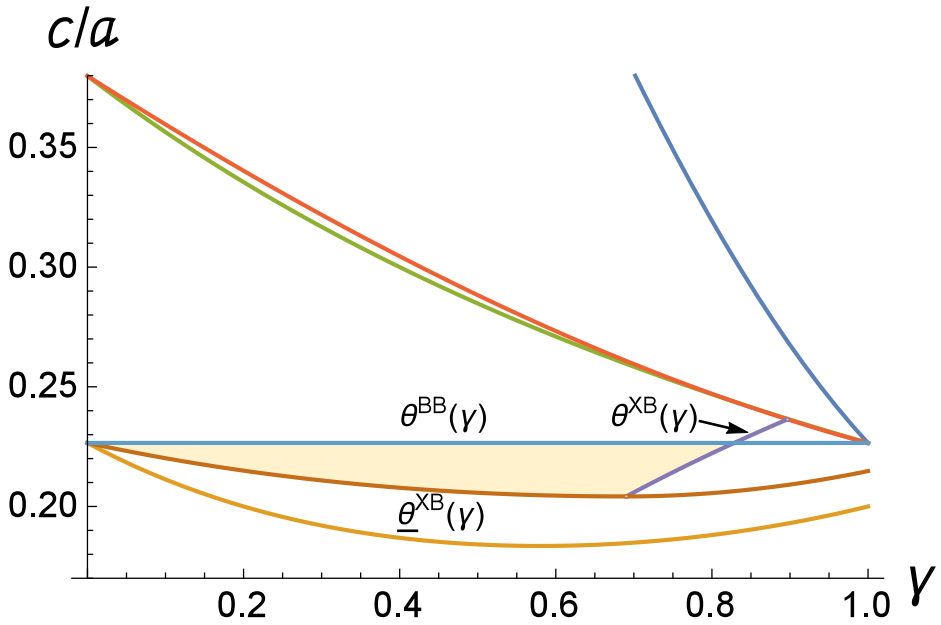


$r_1 r_2$	XX	XB	XY	BB
m	Y	Y	B	B

∗ XBY is impossible (R_2 cannot order Y).

- M compete directly with R_2 in Y;
- $c/a \leq \theta^{XB}(\gamma) \Rightarrow$ unacceptable $w_{Y2} \Rightarrow q_{YR2} = 0$;
- $XBY \Rightarrow XXY$.

(*iii*) XBY, $\max\{\underline{\theta}^{XB}(\gamma), \theta^{XB}(\gamma)\} < c/a \leq \theta^{BB}(\gamma)$

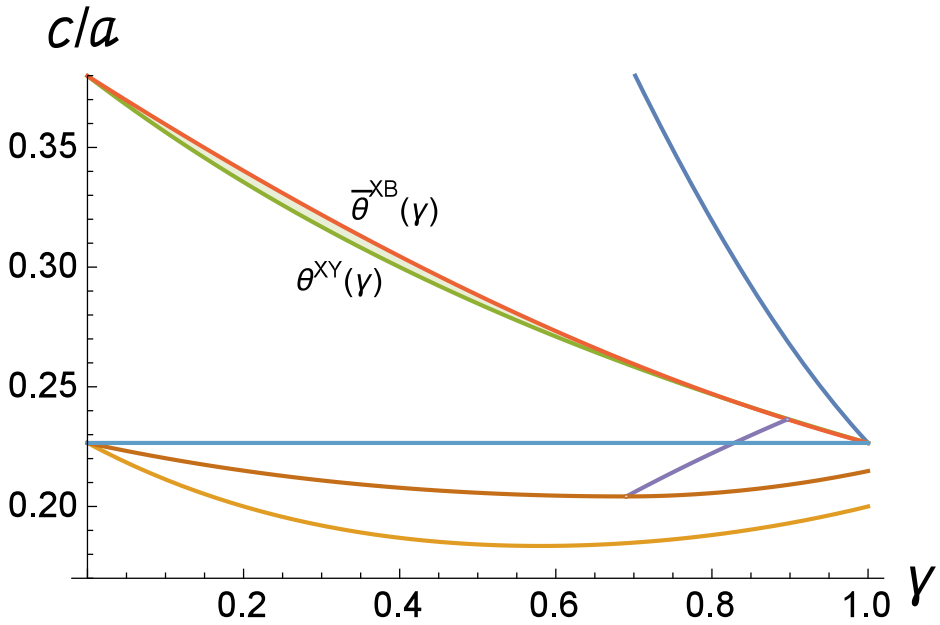


$r_1 r_2$	XX	XB	XY	BB
m	Y	Y	B	B

$* \ \#_{R1} < \#_{R2} \Rightarrow \pi_{R1} < \pi_{R2}$

- c is still relatively low, alleviating encroachment is prior to enlarging the product range.

(iv) XYN, $\theta^{XY}(\gamma) < c/a \leq \overline{\theta}^{XB}(\gamma)$

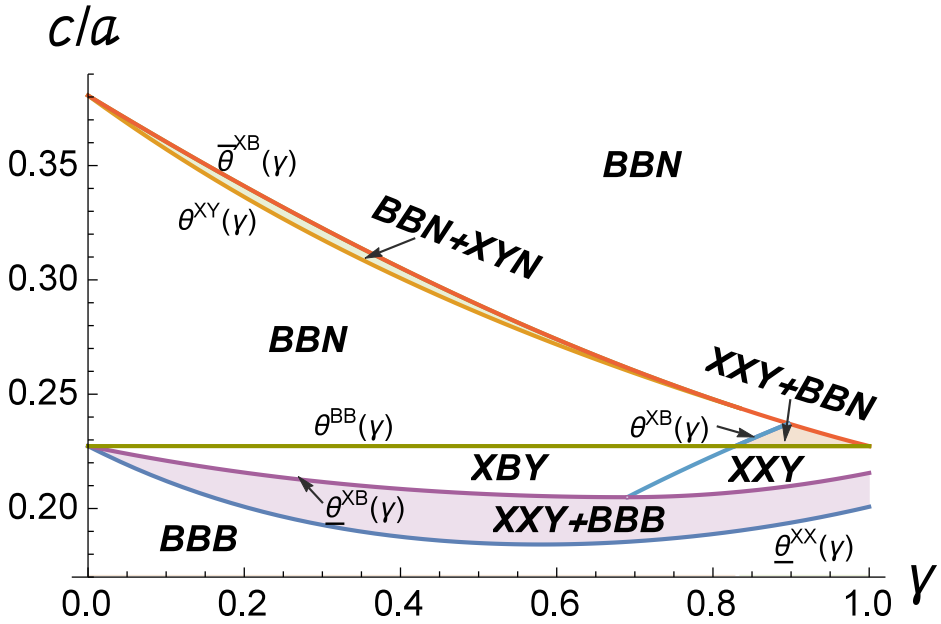


$r_1 r_2$	XX	XB	XY	BB
m	Y	Y	N	N

Intuition: when c is relatively high, encroachment can be deterred if variety distribution in the **wholesale channel** is balanced.

- e.g. R_2 gives up X, otherwise it directly compete with M in Y.

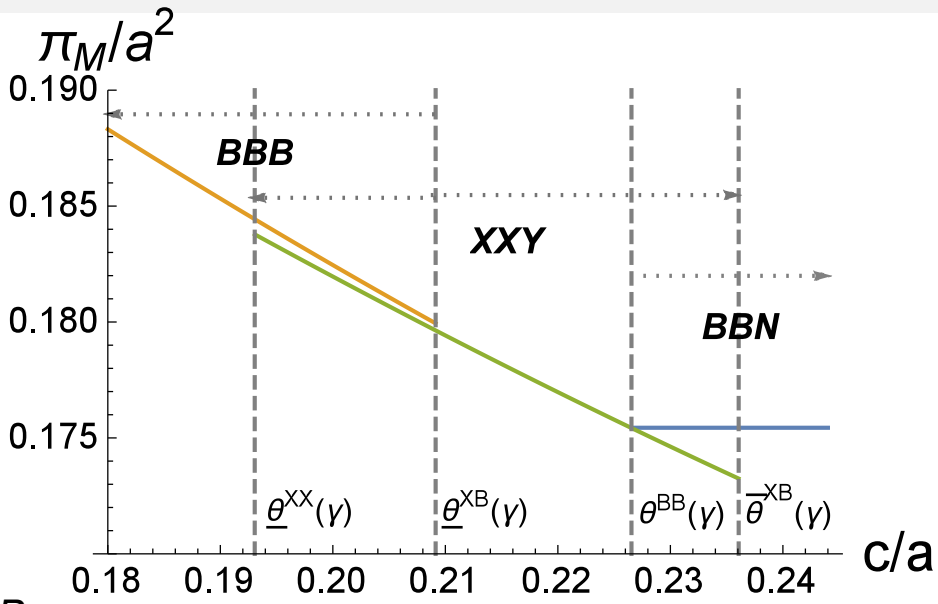
Coordination failure



Corollary 1

The retailers' coordination failure may occur in the following ranges:
(i) If $\underline{\theta}^{XX}(\gamma) < c \leq \underline{\theta}^{XB}(\gamma)$, *XXY* and *BBB* coexist;
(ii) If $\theta^{BB}(\gamma) < c \leq \min\{\theta^{XB}(\gamma), \bar{\theta}^{XB}(\gamma)\}$, *BBN* and *XXY* coexist;
(iii) If $\theta^{XY}(\gamma) < c \leq \bar{\theta}^{XB}(\gamma)$, *XYN* and *BBN* coexist.

M's unprofitable encroachment



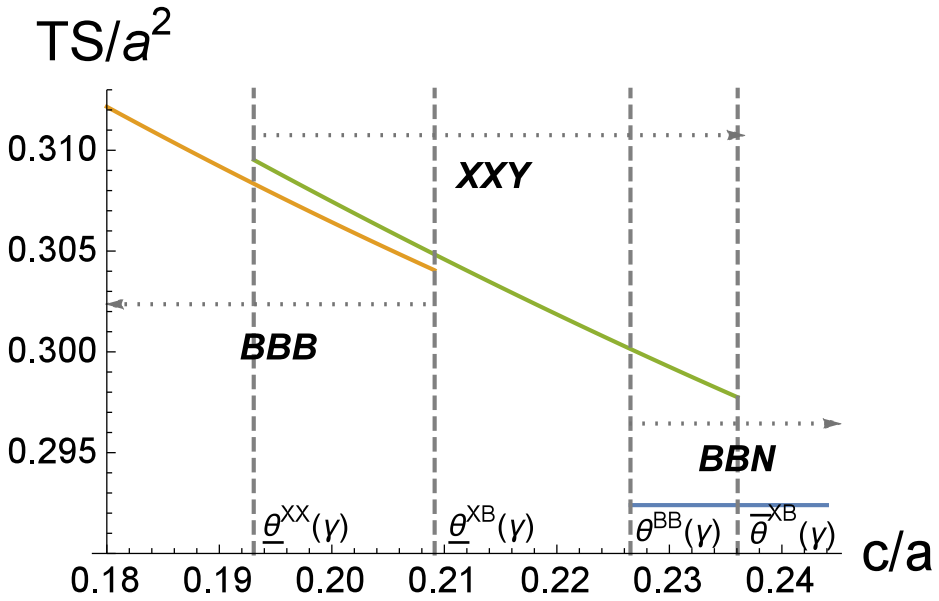
$\theta^{BB}(\gamma) < c/a \leq \overline{\theta}^{XB}(\gamma)$:

1. $\pi^{online}\uparrow$, $\pi^{wholesale}\downarrow \overset{\text{large } c}{\Rightarrow} \pi_M \downarrow$ (channel efficiency$\downarrow$)
2. $\#_R\downarrow + \#_M\uparrow \Rightarrow \pi_M \downarrow$ ($\# \downarrow$) (in monopoly retailer case, $\#$ does not change)

Proposition 6

M benefits by committing not to open the online store when $\theta^{BB}(\gamma) < c/a \leq \overline{\theta}^{XB}(\gamma)$.

↑ may harm social welfare



Proposition 7

When $\gamma > 0.751$, *TS* downward jumps at $\underline{\theta}^{XX}(\gamma)$, where *XXY* changes to *BBB*.

Intuition: $\gamma \uparrow$ in $c \sum_n q_{nM}$

$$TS = U(Q_X, Q_Y) - c \sum_{n \in L} q_{nM}$$

- Social loss depends only on c;
- $\gamma \uparrow \Rightarrow U(Q_X, Q_Y) \downarrow (-)$;
- XXY: when $\gamma = 0 \Rightarrow M$ monopolizes in $Y \Rightarrow$ large cq_{YM}.
  $\gamma \uparrow \Rightarrow q_{YM} \downarrow \Rightarrow cq_{YM} \downarrow (+)$;
- BBB: M and R_i always direct compete in both varieties.
  $\gamma \uparrow$ slightly decreases cq_{nM} $(+)$.

$*$ Although $\# \downarrow$, it shifts more business from M to R_i.

Concluding remarks

Conclusions:

1. Order the more the better? No
2. Online store always benefits? No
3. More varieties the better for the social welfare? No

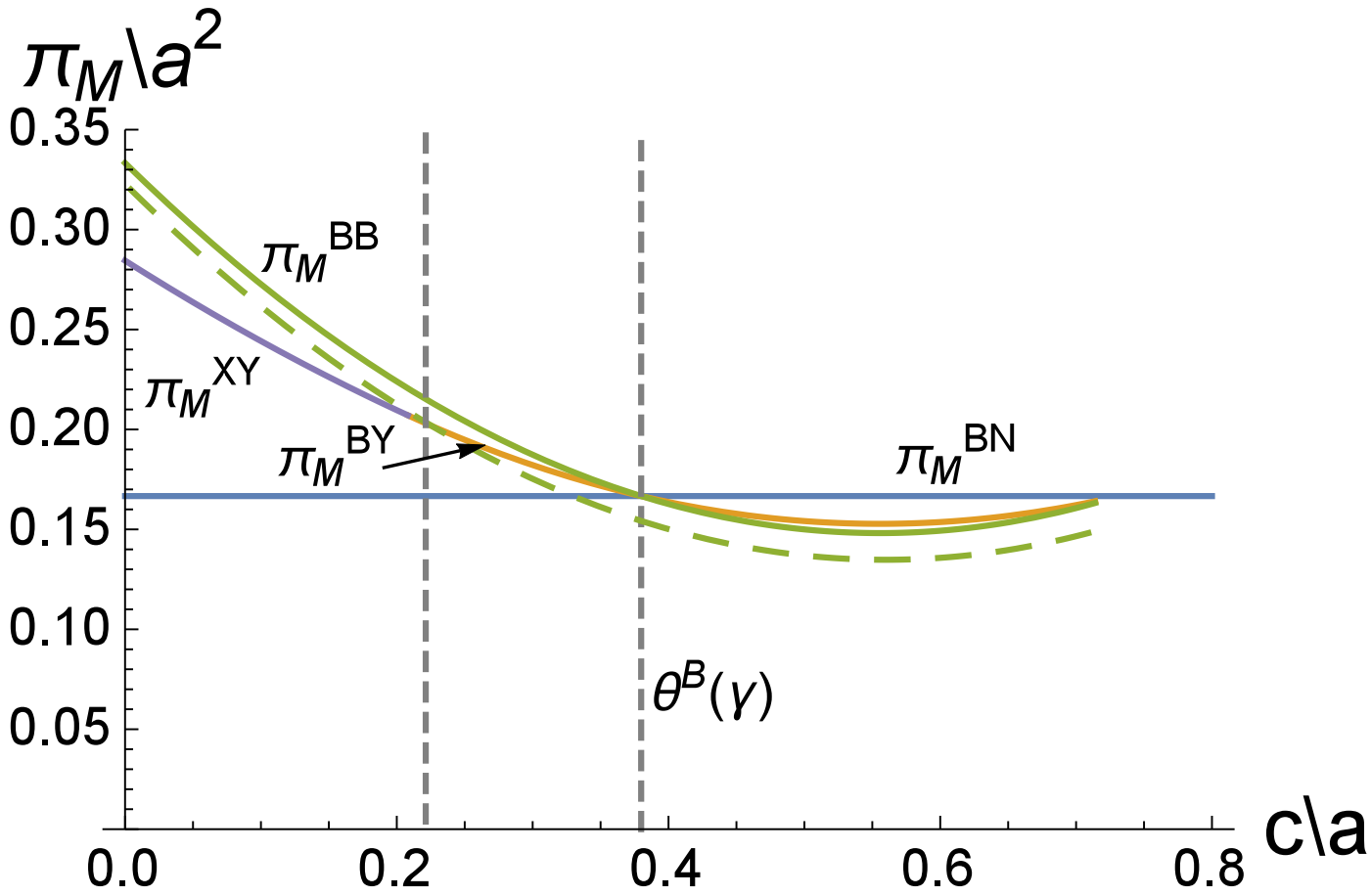
Discussions:

- Technically difficult for more than two varieties.
- Retailer *VS* Online store in product quality: vertically differentiated products.

Thank you!

If you have any questions or comments, please contact me via
pge042pc@student.econ.osaka-u.ac.jp

Asymmetric online retailing costs



- If $\Delta\, c$ is small enough, the results still hold.