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Distribution Channels and Collusion of Manufacturers: Common versus Independent Retailers

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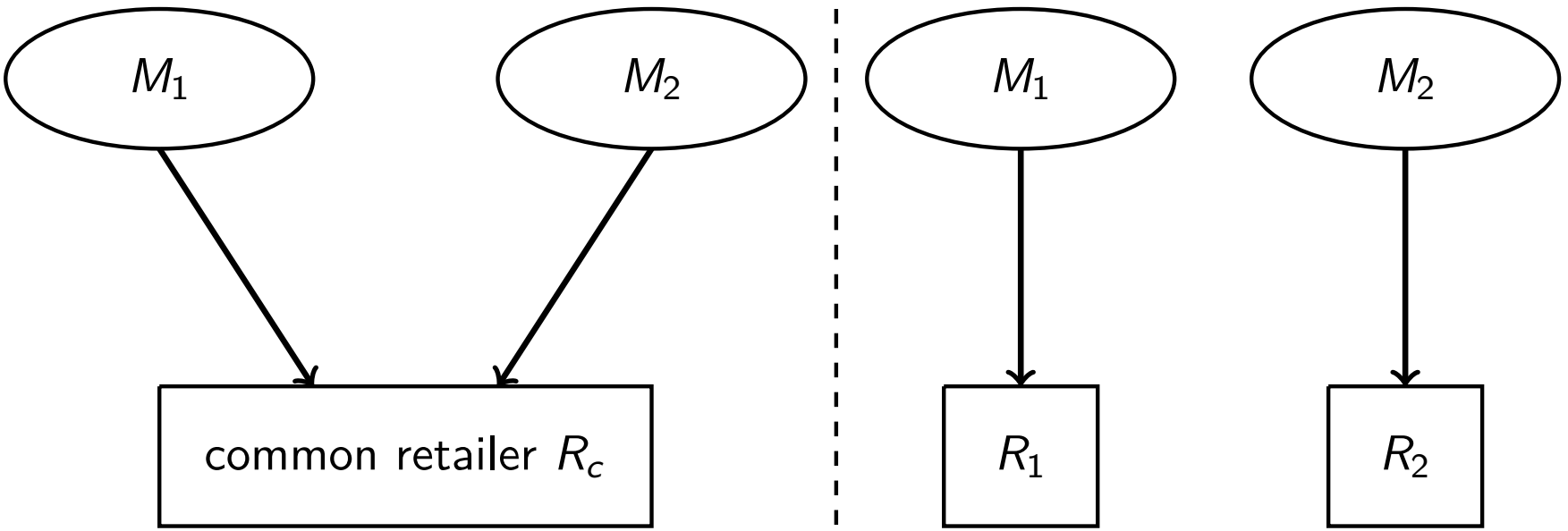
Motivation

- Distribution networks in which large manufacturers sell through retailers are widespread in several industries
- For example, automobile and personal computer industry

- Distribution channels: Common vs. independent (exclusive) retailing



Motivation

- In most industries with established distribution networks, manufacturers are long-time competitors
- It is very likely that competition is not of static (one period) nature but pricing decisions are based on dynamic considerations

$\Rightarrow$ Tacit collusion is relevant in such industries!

Some evidence.

- Bresnahan (1987) and Sudhir (2001a):
  - $\rightarrow$ Prices in the US car market are indicative of collusive behavior
- Sudhir (2001b):
  - $\rightarrow$ Pricing in some food categories of suburban retail stores is consistent with supplier cooperation

Motivation

Main questions.

i) Which distribution channel makes it easier for manufacturers to sustain tacit collusion? - Common or independent retailing

ii) Is observability of contracts always profitable for competing manufacturers?

This paper addresses i) and ii) in a model of repeated interaction

Literature

- Common vs exclusive retailing. Lin (1990) and O'Brien/ Shaffer (1993)
  → static, we examine repeated interaction
- Competing distribution channels with independent retailing. Rey/ Stiglitz (1995), Bonanno/ Vickers (1988) and Pagnozzi/ Piccolo (2011)
  → we address how contract observability affects collusion
- Distribution channel coordination with common retailing. Choi (1991), O'Brien/ Shaffer (1997) and Cachon/ Kök (2010)
  → purely static perspective
- Tacit collusion in vertical relationships. Nocke/ White (2007), Normann (2009), Jullien/ Rey (2007) and Piccolo/ Reisinger (2011)
  → we examine how distribution networks affect tacit collusive agreements

The model

- Two manufacturers M_1 and M_2 selling imperfect substitute products
- Final demand for M_i's brand is $D^i(p_i, p_j)$ with retail prices p_i and p_j
- Costs are assumed to be zero for simplicity
- Infinitely repeated game with discrete time $\tau = 0, \cdots, +\infty$
  - $\rightarrow$ Manufacturers discount future profits at $\delta \in [0, 1]$, while the retailer (or retailers) are short-lived and maximize spot profits
- Timing of events in the stage game:
  - 1^{st} stage. Manufacturer M_i offers a two-part tariff contract $C(w_i, T_i)$ to either the common retailer R_c or its independent retailer R_i
  - 2^{nd} stage. Retailer(s) decide(s) whether to accept or to reject. Afterwards retailers set retail prices p_i and p_j $\rightarrow$ market clears

The model

- Common retailer can observe both contract offers
- If contract offers are secret to independent retailers
  - → Retailers hold passive beliefs: No revision of the belief about the contract offered to rival when the own offer is different from the one expected in equilibrium
  - → Equilibrium concept: Perfect Bayesian Equilibrium with the passive belief refinement
- Collusion is maintained through Nash-reversion trigger strategies
  - → Punishment of deviation from the collusive agreement by infinite play of the Nash-equilibrium
- Aim. Determination of the critical discount factor above which collusion can be sustained for each distribution regime

The model

1. Brand i's inverse demand function: $P^i(q_i, q_j) = \alpha - \beta q_i - \gamma q_j$
   - $\rightarrow$ $\alpha > 0$ and $\beta > \gamma \geq 0$
   - $\rightarrow$ Inverting yields

$$D^i(p_i, p_j) = \frac{\alpha(\beta - \gamma) - \beta p_i + \gamma p_j}{\beta^2 - \gamma^2}$$

2. When indifferent between accepting or rejecting an offer, a retailer will always accept the contract and secure input supply

Common retailing

- Objective function of the common retailer (R_c) when selling both brands:

$$\Pi_c(p_i, p_j) = D^i(p_i, p_j)(p_i - w_i) + D^j(p_j, p_i)(p_j - w_j) - T_i - T_j$$

- Retailer is not obliged to sell both brands

$\rightarrow$ Opportunity to pit one manufacturer against another $\rightarrow$ threat to drop e.g. manufacturer i's brand: $\Pi_c^j = \max_{p_j} D^j(p_j, \infty)(p_j - w_j) - T_j$

$\rightarrow$ Participation constraint. Manufacturer i can maximally extract its brand's marginal contribution to R_c's profit (O'Brien and Shaffer (1993))

Common retailing

A. Nash. M_i maximizes profit s.t. R_c's participation constraint

- Wholesale price equal to MC ($w_c^N = 0$) $\rightarrow$ M_i acts as if integrated with R_c and extracts its marginal contribution to Π_c entirely through T_i

B. Collusion. Manufacturers maximize joint profits

- w_c^C above MC $\rightarrow$ R_c increases retail prices and industry profits decrease

But. M_i and M_j mitigate R_c's threat of dropping their brands: Increase of w_i reduces R_c's profit from rejecting M_j's offer ($\partial \Pi_c^i / \partial w_i < 0$)

$\Rightarrow$ Manufacturers get a bigger share of a smaller pie

C. Deviation. M_i maximizes profit from deviation

- $w_c^D = 0 \rightarrow M_i$ acts as if integrated with R_c, profits are fully extracted via T_i
- Only accepting M_i's offer is most profitable for both M_i and R_c

- The collusion profit under the linear demand specification is

$$\pi_c^C = \frac{\alpha^2 \beta}{4(\beta + \gamma)^2}$$

- **Lemma 1.** *With a common retailer, manufacturers realize a profit from collusion that is given by* π_c^C *and they can sustain their collusive agreement for all values of the discount factor that are above*

$$\delta_c = \frac{3\beta + \gamma}{2(\beta + \gamma)}. \tag{1}$$

Independent retailing

- Independent (exclusive) retailers R_i and R_j with $i, j = 1, 2$ and $i \neq j$
  - Simultaneously receive contracts from their respective manufacturer
  - Unobservability of the contract proposed to the rival retailer
  - Passive beliefs (R_i's belief about R_j's contract does not depend on C_i)
- R_i's maximization program is

$$\max_{p_i} D^i\left(p_i(p_j^e, w_i), p_j^e\right)\left(p_i(p_j^e, w_i) - w_i\right) - T_i$$

Independent retailing

A. Nash. M_i extracts all profits from R_i since R_i has no outside option (PC holds with equality $T_i = D^i(p_i - w_i)$)

- Expectations are fulfilled in equilibrium and M_i sets $w_I^N = 0$
  $\rightarrow$ M_i acts as if integrated with R_i

B. Collusion. Manufacturers maximize joint profits

- w_I^C is chosen so that retailers set the monopoly price

C. Deviation. M_i maximizes profit from deviation

- M_i sets $w_I^D < w_I^C \rightarrow$ R_j's choice of p_j is unaffected by the deviation!
- R_j' demand becomes negative for $\gamma > \widehat{\gamma}$, with $\widehat{\gamma} \approx 0.732\beta \rightarrow$ if $\gamma \in [\widehat{\gamma}, \beta]$, M_i chooses $\widehat{w}_I^D$ so that M_i monopolizes the DS market

- The collusion profit under the linear demand specification is

$$\pi_I^C = \frac{\alpha^2}{4(\beta+\gamma)}$$

- **Lemma 2.** *With independent (exclusive) retailers, manufacturers realize a profit from collusion that is given by* π_I^C*. The critical discount factor above which they can sustain collusion is*

$$\delta_I = \begin{cases} \frac{(2\beta-\gamma)^2}{8\beta(\beta-\gamma)+\gamma^2} & \text{for} \quad \gamma \in [0, \widehat{\gamma}] \\ \frac{\gamma^2-(2\beta-\gamma)^2(\beta(\beta-\gamma))}{4\beta^3(2\gamma-\beta)-\gamma^2\left(\beta^2+3\gamma\beta-2\gamma^2\right)} & \text{for} \quad \gamma \in (\widehat{\gamma}, \beta). \end{cases} \tag{2}$$

Comparison

Proposition 1. *Manufacturers can realize higher profits from collusion with independent retailing than with common retailing. In addition, distribution through independent retailers facilitates collusion compared to distribution through a common retailer, i.e.,* $\delta_I < \delta_c$.

Comparison

a) Collusion profits are higher with IR than with CR ($\pi_I^C > \pi_c^C$)

- R_c can credibly threaten to drop one manufacturer's brand and retain part of the DS profits [no such outside option for R_i and R_j]

b) Deviation incentives higher with CR than with IR ($\delta_c > \delta_I$)

- M_i and M_j set a high collusive wholesale price w_c^C to lower R_c's threat option to drop one brand $\rightarrow$ R_c's threat option to reject M_i's offer & to accept M_j's offer at w_c^C remains unchanged if M_i deviates
- M_i deviates so that R_c only accepts its offer $\rightarrow$ M_i monopolizes the retail market in this period at low cost!
- With independent retailing, the rival retailer does not observe the deviation and stays a competitor

$\Rightarrow$ Main difference between CR and IR: When deviating, M_i affects R_c's decision to accept M_j's contract!

Public contracts

- R_i and R_j observe the proposed contracts before entering competition
- R_i's maximization program is

$$\max_{p_i} D^i(p_i(w_i, w_j), p_j(w_i, w_j))(p_i(w_i, w_j) - w_i) - T_i$$

- R_i's best response functions $p_i(w_i, w_j)$: $\partial p_i(\cdot)/\partial w_i > 0$ & $\partial p_i(\cdot)/\partial w_j > 0$
- *M_i can increase w_i above MC, inducing R_i to increase p_i $\rightarrow$ Increasing w_i has a strategic effect on R_j who reacts by increasing p_j*
- *Retail prices are strategic complements: Reduction of DS competition with public contracts (Rey/ Stiglitz (1995))*

Public contracts

- We solve the upstream game in the same way as before

$\rightarrow$ Derivation of the relevant Nash-, collusion- and deviation-equilibrium

$\rightarrow$ *Collusion profit is the same as with unobservable contracts as M_i and M_j chose w_{IO}^C so that retailers set the monopoly price*

$\rightarrow$ Determination of the resulting critical discount factor δ_{IO}

Comparison

Visualized critical discount factors

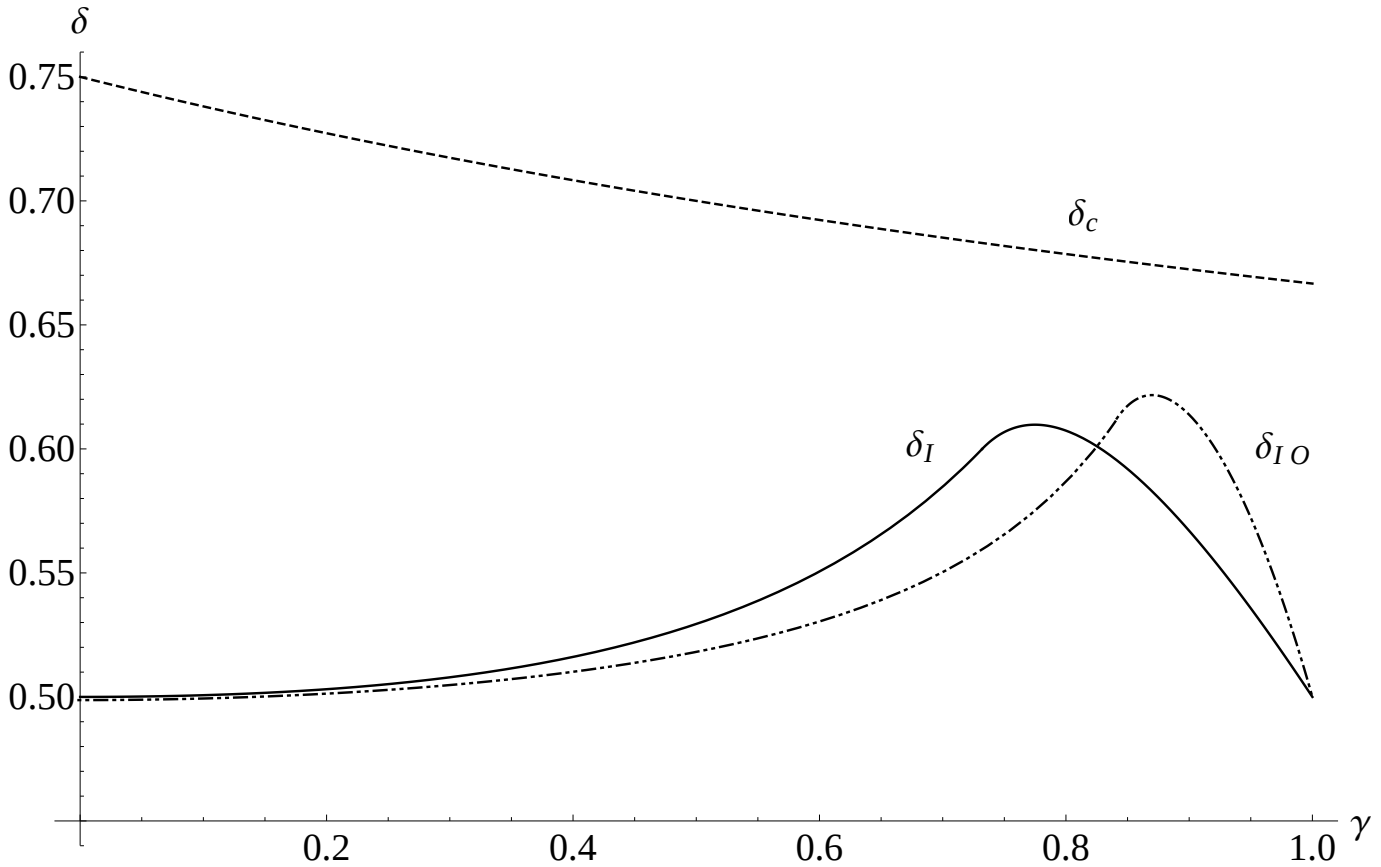


Figure: Critical discount factors ($\beta = 1$)

Proposition 2. *The collusion profits with private and public contracts are the same. Public contracts make manufacturers' collusion harder to sustain compared to private contracts if and only if competition is fierce, i.e., if and only if* $\gamma > 0.825\beta$.

Comparison

- The strategic effect of M_i's wholesale price on p_j has countervailing effects on the deviation incentives if contracts become observable
  - i) Nash equilibrium: M_i and M_j set wholesale prices above MC, thus realizing higher Nash profits
  - $\rightarrow$ *Punishment phase less severe with public than with private contracts*
  - ii) If M_i deviates, R_j immediately reacts by lowering p_j
  - $\rightarrow$ *Deviation less profitable with public contracts*
- When competition gets fiercer ($\gamma \rightarrow \beta$), R_j is constrained by its high wholesale price (w_{IO}^C) and cannot react to obtain positive sales
  - $\rightarrow$ ii) loses significance relative to i)
  - $\rightarrow$ Deviation incentives with public contracts increase and exceed those with private contracts if $\gamma > 0.825\beta$

Concluding Remarks

- Main results of the paper.
  - Producers prefer independent retailing over common retailing to sustain tacit collusive agreements
  - Contract observability is detrimental for collusion if competition is relatively fierce!
  - Introducing linear wholesale price contracts yields the same qualitative results as with two-part tariffs
- Implications.
  - Supply chain managers should be aware that the structure of the supply chain has long-term effects on the competitive environment
  - Interesting for antitrust authorities:
    "Guidelines on Vertical Restraints" treat exclusive distribution by a block exemption regulation. But "(when) most or all of the suppliers apply exclusive distribution this may (...) facilitate collusion."
    $\rightarrow$ Paper provides a rationale for this statement

Thank you!

Extension - Linear ws prices

- Downstream market. Best response functions of the common and the independent retailers (private and public contracts) identical to those with two-part tariffs
- Upstream market. Familiar procedure for each type of distribution channel, i.e., CR, IR (private) and IR (public)
  - $\rightarrow$ Calculate Nash-, collusion- and deviation profits to determine the critical discount factor above which M_i and M_j can sustain collusion

Extension - Linear ws prices

A. Comparison common vs independent retailing (private contracts)

- Collusion profits with IR higher than those with CR ($\pi_I^C > \pi_c^C$) **but** collusion facilitated with CR ($\delta_I > \delta_c$)
- But collusion profit with IR exceeds collusion profit with CR!
- Partial collusion. Adjust w_I^C so that the collusion profit with IR equals the collusion profit with CR
- Calculation of the critical discount factor with IR above which the same profit like the full collusion profit with CR can be maintained

$\Rightarrow$ Following the familiar procedure shows that with partial collusion IR facilitates manufacturers' collusion ($\delta_c > \delta_I$)

Extension - Linear ws prices

B. Comparison common vs independent retailing (public contracts)

- Similar problem as in A.: $\pi_{IO}^{C} > \pi_{c}^{C}$ **but** collusion is facilitated with IR ($\delta_{IO} > \delta_{c}$) only if $\gamma < 0.869\beta$
- Same procedure as in A.
- Calculation of the critical discount factor with partial collusion and IR

$\Rightarrow$ With partial collusion IR facilitates manufacturers' collusion ($\delta_{c} > \delta_{IO}$)

Extension - Linear ws prices

C. Comparison independent retailing private vs public contracts

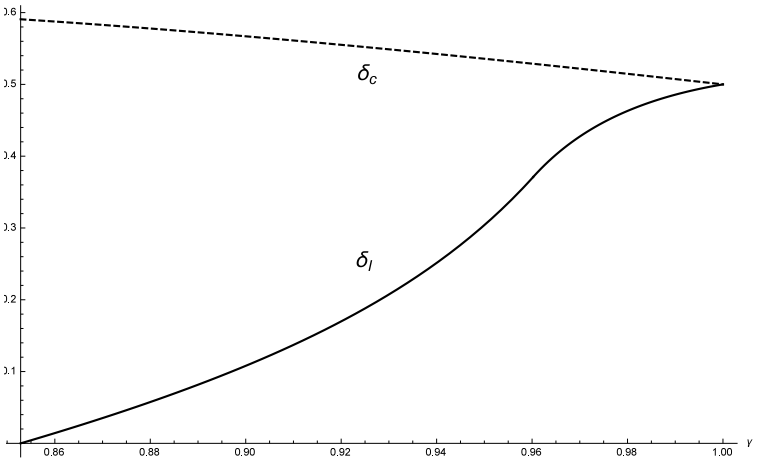
- In contrast to two-part tariffs, collusion profits with public contracts exceed those with private contracts ($\pi_{IP}^{C} > \pi_{I}^{C}$) **but** observability only facilitates collusion if $\gamma < 0.908\beta$
- Partial collusion for $\gamma \in [0.908\beta, \beta] \rightarrow$ bias of the collusion profit (IR public) so that it equates the collusion profit (IR private)
- Calculation of the critical discount factor (IR public) above which the same profit like the full collusion profit (IR private) can be sustained

$\Rightarrow$ IR (public) facilitates collusion compared to IR (private) if $\gamma < 0.978\beta$ and the opposite holds true if $\gamma \geq 0.978\beta$

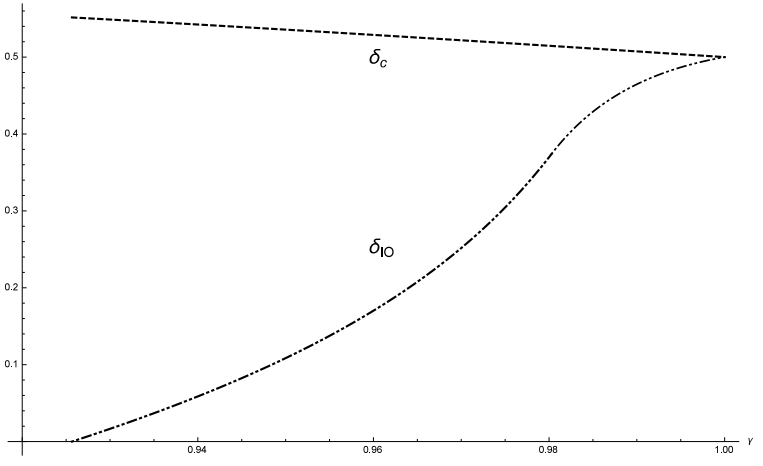
$\Rightarrow$ Same qualitative results as with two-part tariffs!

Extension - Linear ws prices

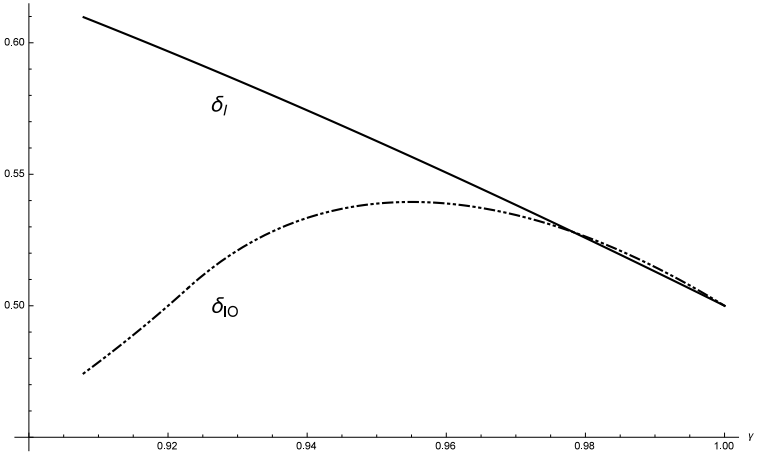
- Visualized comparison of CDFs with partial collusion



A. common vs independent private



B. common vs independent public



C. independent private vs public