Inspecting Cartels over Time: with and without Leniency Program

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Outline

Most papers on cartel inspection in the literature

- assume constant or myopic policies by the regulator.

We allow that the antitrust authority (AA) can choose a dynamic pattern of cartel monitoring intensities from

1. **constant policies**
   detecting prob. is constant every period.
2. **fluctuating policies** (mean-preserving distributions)
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Our results Under a reduced Bertrand game,

- Without leniency: fluctuation does not matter! (**Prop. 1**)
- With leniency: it matters! ⇒ There is synergy between the two.
  i.e., leniency + fluctuating policy most effective! (**Prop. 2**)

⇒ Our results provide new scope for competition policy!!

Base Model: No Leniency

Following **Chen and Rey (2013)** "On the design of leniency programs" *Journal of Law and Economics*, 56(4), 917-957.

Model Infinitely repeated duopoly game with

- two identical firms: 1 and 2
- discrete time horizon: $t = 1, 2, \ldots$ w. common discount factor δ
- stage game: *reduced* Bertrand game
  - H: collusive action (High price)
  - L in (L, H): profitable deviation (slightly Lower price)
  - L in (L, L): competitive action (Low price)
- B: collusive stake $\Rightarrow$ varies across industries

	H	L
H	B, B	0, $2B$
L	$2B$, 0	0, 0

Table: Reduced Bertrand Game

- **Any action combination with** $H \rightarrow$ evidence of "collusion"

  Note L in (L, H) or $(H, L) \Rightarrow$ slight undercut of H

- Inspection by AA is not perfect.
  $\Rightarrow$ AA can choose only the probability $p \in (0, 1)$ of cartel detection (if there exists some evidence in that period).

- If a cartel is detected, each firm pays a fine F (fixed over time).

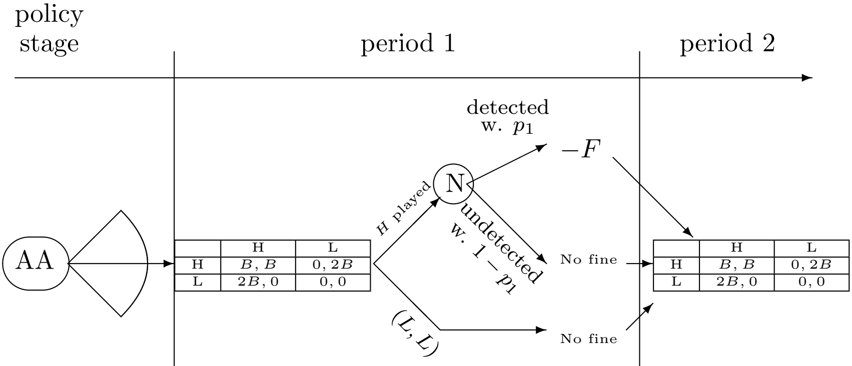
- After that, the firms can restart collusion, if they choose so.
  ($\leftarrow$ special feature of Chen-Rey model)

Remark We assume p is the same irrespective of whether cartels are symmetric (H, H) or asymmetric (L, H), (H, L).

$\Rightarrow$ Can be generalized to "constant gap" cases: $p(HH) = p(LH) + \Delta$.

(We assume $\Delta = 0$ in this talk.)

Timeline



AA can choose a detecting policy p_t for $t = 1, 2, \ldots$

$\Rightarrow$ We compare two policies: Constant or Switching.

Dynamic Investigation Policies

Constant Policies: CP

- $p_t = p \in (0, 1)$ for all t.

Switching Policies: SP (← the simplest fluctuating policy)

- $p_t = \begin{cases} \overline{p} & \text{with prob. } x \text{ (\textbf{risky} state)} \\ \underline{p} & \text{with prob. } 1 - x \text{ (\textbf{safe} state)} \end{cases}$

  where $\underline{p} < p < \overline{p}$.
- AA randomizes or visits industries alternatingly, etc.

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- AA randomizes or visits industries alternatingly, etc.

- To make a fair comparison between two policies, we assume

  Mean-preservation for two probabilities:

$$E[p_t] = x\overline{p} + (1 - x)\underline{p} = p$$

for each period t.

Full Collusion under CP

- **Full** collusion = play (H, H) for every period.
- The expected profit V for each firm:

$$V := B - pF + \delta(B - pF) + \delta^2(B - pF) + \cdots = \frac{B - pF}{1 - \delta}.$$

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Remark Firms may conduct **partial** collusion:

- play (H, H) for safe states, and
- play (L, L) for risky states.

We only focus on full collusion (in this talk).
($\Leftarrow$ Partial collusion is MORE difficult to sustain under certain conditions)

- Collusion is sustainable (by the trigger strategy) iff

$$V = \frac{B - pF}{1 - \delta} \geqq 2B - pF + \delta\{0 + \delta \cdot 0 + \delta^2 \cdot 0 + \cdots\}$$

$$\iff \delta \geqq \frac{B}{2B - pF} \left(\geqq \frac{1}{2}\right) \iff B \geqq \underline{B} := \frac{\delta pF}{2\delta - 1}.$$

- Assume $\delta > 1/2$: collusion is possible (for some B).

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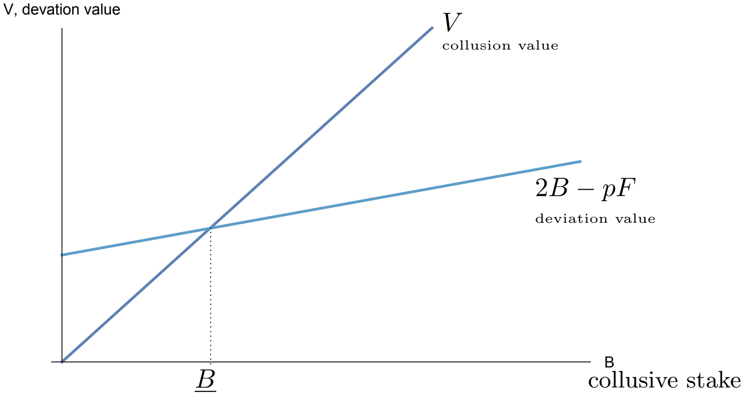


- B varies across industries:
  - $\underline{B} \uparrow \Rightarrow$ in **less** industries, full collusion sustainable

Collusion under SP with mean p

$$p_t = \begin{cases} \overline{p} & \text{w. prob. } x \text{ (\textbf{risky} state)} \\ \underline{p} & \text{w. prob. } 1-x \text{ (\textbf{safe} state)} \end{cases}, \text{ where } \underline{p} < p < \overline{p}.$$

- Firms learn the realization of p_t **before** choosing actions.
- Naivete: Harder to collude?
  - harder to collude in the risky state ($\Rightarrow$ reduce V as well)
    $\Leftarrow$ Frezal (2006, IJIO), Fujiwara-Greve and Yasuda (2014, WP)
  - Not in our model $\rightarrow$ See below!

- $V_r \setminus V_s$: expected payoff **starting in** the risky\safe state + always collude in the future.

$$V_r := B - \overline{p}F + \delta\{xV_r + (1-x)V_s\}$$
$$V_s := B - \underline{p}F + \delta\{xV_r + (1-x)V_s\}$$

- To sustain (H, H) for all t in both states,

$$V_r = B - \overline{p}F + \delta\{xV_r + (1-x)V_s\} \geqq 2B - \overline{p}F + \delta\{0 + \delta \cdot 0 + \cdots\},$$
$$V_s = B - \underline{p}F + \delta\{xV_r + (1-x)V_s\} \geqq 2B - \underline{p}F + \delta\{0 + \delta \cdot 0 + \cdots\}.$$

- Mean-preservation $\Rightarrow$ cont. value under SP $= V$ under CP

$$xV_r = x\big[B - \overline{p}F + \delta\{xV_r + (1-x)V_s\}\big]$$
$$(1-x)V_s = (1-x)\big[B - \underline{p}F + \delta\{xV_r + (1-x)V_s\}\big]$$

Add both sides

$$\begin{aligned}
\iff & xV_r + (1-x)V_s \\
&= B - [x\overline{p} + (1-x)\underline{p}]F + \delta\{xV_r + (1-x)V_s\} \\
&= B - pF + \delta\{xV_r + (1-x)V_s\} \\
\iff & xV_r + (1-x)V_s = \frac{B - pF}{1-\delta} = V
\end{aligned}$$

IC conditions for CP, risky state, and safe state are equivalent!

Incentive Conditions are actually identical!

$$V = B - pF + \delta V \geqq 2B - pF,$$
$$V_r = B - \overline{p}F + \delta V \geqq 2B - \overline{p}F,$$
$$V_s = B - \underline{p}F + \delta V \geqq 2B - \underline{p}F.$$

- Generalizes to any (possibly continuous) distribution.

Note Firms pay the fine with equal chance in (H, H) and (L, H).

$\Rightarrow$ Deviation does not reduce the risk of investigation.

Proposition 1

Collusion is sustained under a CP $\iff$ collusion is sustained under ANY of its mean-preserving SP.

Leniency Program

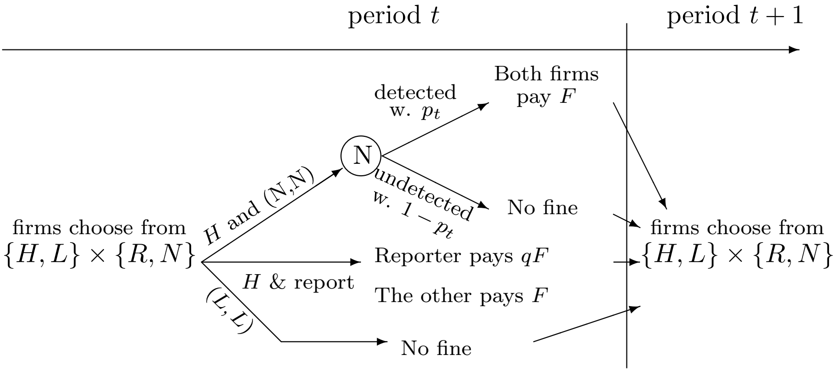
- Only the first informant gets a reduced fine at qF
  - The other firm must pay F.
- $0 < 1 - q \leqq 1$: amnesty rate (reduction of the fine)

New stage game

- Additional action choice: Report (R) to AA or Not (N)
- Firms simultaneously choose an action from $\{H, L\} \times \{R, N\}$

Note If (L, L), it is impossible to uncover collusion.
$\Rightarrow$ No difference between R and N.

New Timeline



Under Constant Policies, collusion is sustainable iff

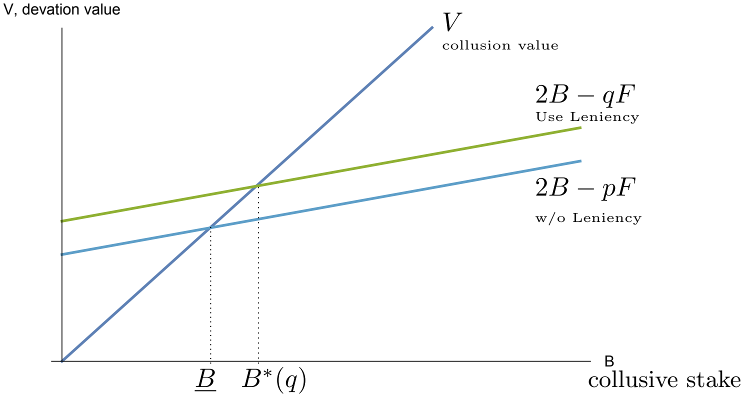
$$V = \frac{B - pF}{1 - \delta} \geqq 2B - \min\{pF, qF\}. \tag{1}$$

Constant Policy with Leniency

- Attractive leniency: detection prob. > fine reduction

$$p > q \iff q > p. \tag{2}$$

$\Rightarrow$ deviation payoff increases to $2B - qF (> 2B - pF)$
$\Rightarrow$ makes collusion more difficult to sustain



$B^*(q)$ decreasing in $q \Rightarrow$ Amnesty rate $\uparrow$ makes collusion difficult!

Switching Policy with Leniency

Focus on a symmetric case:

$$p_t = \begin{cases} p+\alpha & \text{w. prob. } 1/2 \text{ (\textbf{risky} state)} \\ p-\alpha & \text{w. prob. } 1/2 \text{ (\textbf{safe} state)} \end{cases}$$

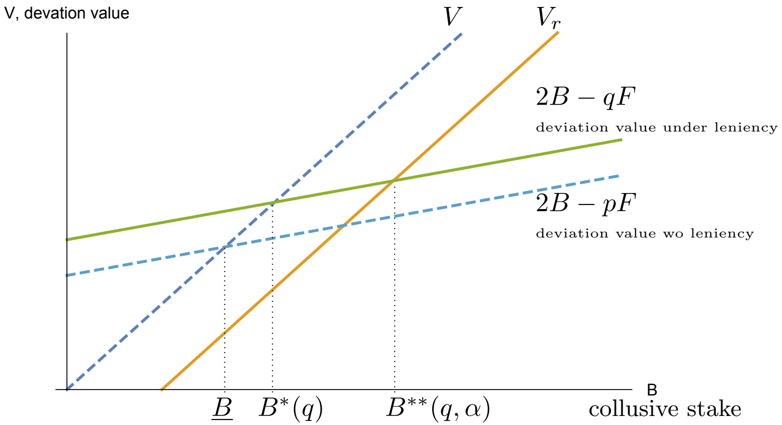
- Firms learn the realization of p_t **before** choosing actions.
- Collusion in both states (full collusion) is sustained iff

$$V_r := B - (p+\alpha)F + \delta\frac{V_r + V_s}{2} \geqq 2B - \min\{(p+\alpha)F, qF\} \quad (3)$$

$$V_s := B - (p-\alpha)F + \delta\frac{V_r + V_s}{2} \geqq 2B - \min\{(p-\alpha)F, qF\} \quad (4)$$

- Continuation value of collusion:
  $V_s > V > V_r$ (This generalizes to any distributions)

Switching & Leniency Most Effective



Proposition 2

Leniency programs and switching (fluctuating) cartel investigation policies complement each other, i.e., $\underline{B} \leqq B^* \leqq B^{**}$.

Concluding Remarks

- Without leniency program: two policies are identically effective.
  → **Proposition 1**
- With leniency program: SP can outperform CP, since colluding in risky states becomes more difficult under SP.
  → **Proposition 2**
- Another interpretation: actual p_t's are fluctuated, and AA
  - Switching: reveals p_t before the investigation
  - Constant: does not provide any information

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Possible extensions

- n firms & generalized stage games → analogous
- Non-binary fluctuating policies → analogous (see our paper)
- Generalize detection probability structure:
  - This model: $p(H, H) = p(L, H)$
  - Alternative: $p(H, H) - p(L, H) = \Delta(\neq 0)$

    ⇒ does not qualitatively change our results!
- Partial collusion → work in progress...

Thank you!

Gracias!!

Any comments and questions are appreciated :)