The Effectiveness of Leniency Programs when Firms choose the Degree of Collusion

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Introduction

- A corporate leniency program reduces the sanctions for self-reporting cartel members.
- In 1993 the US Department of Justice revised its Corporate Leniency Program, committing itself to the lenient prosecution of the first confessor.
  - This revision is considered as the most significant policy innovation in antitrust.
  - It substantially increased the number of detected and convicted cartels.
- The apparent success led the EU to adopt its own leniency program in 1996.
- Other countries followed suit; for example, Switzerland introduced its leniency program in 2004.
The literature on leniency typically assumes that firms either fully collude or they do not collude at all:

- they set, for example, either the competitive or the monopoly price;
- or they collude on no or on all markets.

We give up this binary choice. Our firms choose the degree of collusion—a continuous variable.

- They may, e.g., pick the fraction of markets on which they collude;
- or they may set any price between the competitive and the monopoly one.
Firms’ profits are increasing in the degree of collusion, yet so is the probability of detection:
- the more markets firms collude on, the higher is the probability that the antitrust authority (AA) finds out the illegal behavior once it opened an investigation.

Firms thus trade-off higher profits against higher expected fines.
Introduction

- Legislation specifies the fine and full leniency for the first reporting firm.
- We focus on leniency granted before and after an investigation has started.
- The fine is proportional to the degree of collusion.
- The AA picks the probability with which it starts an investigation.
- For each probability of investigation we determine the corresponding degree of collusion.
We consider two collusive strategies which differ in firms’ behavior in case of an investigation.

- Either firms do not reveal the illegal behavior once an investigation started; they make the collusive profits, yet both firms pay the fine when detected.
- Or firms exploit leniency: if the AA opens an investigation, they simultaneously reveal and stop collusion during the investigation; both firms then have a 50% chance of receiving leniency. Firms continue collusion after the agreed upon reporting.
First we show that if firms are sufficiently patient, leniency does not increase deterrence.

- Either firms collude and do not reveal in case of an investigation: then the incentive to report the cartel and get leniency is too small for patient firms.
- Or firms collude and reveal in case of an investigation: then firms actually collude on all markets.
Next we look at the degree of collusion as a function of the probability of an investigation.

If an investigation is unlikely, firms collude and reveal in case of an investigation.
- Under this strategy firms collude on all markets. Increasing the probability of an investigation does not lower the degree of collusion.

By contrast, if an investigation is sufficiently likely, firms collude and do not report in case of an investigation.
- Here the degree of collusion decreases with the probability of an investigation.

Nevertheless, firms always choose a positive degree of collusion.
- The fine is proportional to the degree of collusion.
- Slightly colluding has no first-order effect on the fine, yet it raises profits.
Introduction

- Leniency thus produces mixed results in our set-up.
- With patient firms it has no bite and is, therefore, redundant.
- Moreover, it opens the door for the strategy collude and reveal in case of an investigation which, in turn, goes together with full collusion.
  - Firms actually play this strategy for low probabilities of investigation. Thus, in this case leniency induces full collusion.
Our basic set-up is related to Motta and Polo (2003).

Besides in the degree of collusion (binary versus continuous), our framework differs from theirs in another respect:

- Firms determine by their choice of the degree of collusion the probability that the investigation leads to a conviction.
- The AA, in turn, chooses the probability of an investigation.

Moreover, following Spagnolo (2004), we take the optimal deviation from collusion as “undercut and report;” the deviator thus gets the entire profits and avoids the fine.
The Model

- Consider two potentially colluding firms.
- The two firms face a continuum of identical markets with mass 1.
- The firms can collude on each market.
  - They choose the fraction $\nu \in [0, 1]$ of markets on which they collude.
  - $\nu$ thus measures the degree of collusion.
The Model

- If the firms do not collude on a market, they compete and make profit 0.
- If they collude on a market by setting the monopoly price, they make profit $\pi_M$ each.
- Thus, if they collude on $\nu$ markets, each firm makes profit $\nu \pi_M$.
- Firms support the collusive behavior with grim-trigger strategies.
  - If a firm deviates from collusion, Nash punishment, i.e., competition, starts and continues forever; each firm makes the static Nash profit 0,
  - If a firm deviates while the other firm colludes, the deviating firm reaps the entire monopoly profit $2\nu \pi_M$; the colluding firm’s profit is 0.
The Model

- At the outset the legislator announces the fine $F > 0$ that a convicted firm pays whenever it colluded with the other firm on a market in the period under consideration.
- The legislator grants full leniency to the first reporting firm while the other firm pays $F$.
- If both firms choose to report, nature determines with equal probability who is first.
- The fine is proportional to the degree of collusion. Accordingly, if the firms collude on $\nu$ markets and are convicted, they pay a fine $\nu F$.
- The AA starts an investigation with probability $\alpha \in [0, 1]$. 
The Model

- Then an infinitely repeated game starts.
- The stage game in each period \( t = 0, \ldots \) has the following structure:
- Knowing \( \alpha \), first each firm decides whether it wants to communicate with the other firm or not.
- Firms make this decision simultaneously.
- If both firms choose to communicate, they create evidence that—if detected—leads to a conviction by the AA.
- If at least one firm chooses not to collude, firms compete and the game ends for that period; otherwise, the stage game continues.
The Model

- Then firms choose whether they adhere to collusion or whether they deviate.
- Simultaneously, the firms decide whether they report any communication or not.
- If one or both firms report, the evidence of collusion is unveiled and the firms get convicted for sure.
- If no firm reports, the stage game continues.
The Model

- With probability \((1 - \alpha)\) the AA does not launch an investigation and the game ends for that period.
- With probability \(\alpha\) the AA starts an investigation and the game continues.
- Firms may reconsider their decision whether they collude or whether they deviate.
- Since the AA grants postinvestigation leniency, the firms also decide whether they report any communication or not.
The Model

- If at least one firm reports, the cartel is detected for sure.
- If firms do not report, the probability of conviction $p$ depends on the number of markets on which they collude:
  - $p(\nu) \in [0, 1]$ with $p(0) = 0$, $p' > 0$ for $\nu > 0$, and $p'(1)$ finite.
    - If firms do not collude on any market, the probability of conviction is zero.
    - The more markets the firms collude on, the higher is the probability of conviction.
    - Furthermore, $2p' + \nu p'' > 0$ to ensure the existence of interior solutions for $\nu$ where appropriate.
The Model

To summarize, the probability $P$ of detection and conviction if firms communicated,

$$P = \begin{cases} 
0, & \text{if there is no investigation and no firm reports;} \\
\rho(\nu), & \text{if there is an investigation and no firm reports;} \\
1, & \text{if one or both firms report.}
\end{cases}$$

Firms maximize profits with respect to their communication, price, and reporting decision.

We analyze the firms’ behavior for given levels of $\alpha$. 
Strategies

We consider the following two strategies:

- Firms agree to collude. Pre- and postinvestigation the firms adhere to collusion and do not report. Call this strategy $N$.
- Firms agree to collude. Preinvestigation they adhere to collusion and do not report. Postinvestigation firms stop collusion and report. After an investigation with agreed upon reporting, firms continue to play the collusive strategy. Call this strategy $R$. 
Collude and not reveal

- Let us first consider strategy $N$ under which firms never report collusion.
- With probability $(1 - \alpha)$ there is no investigation. Firms collude and make profit $\nu \pi_M$.
- With probability $\alpha$ there is an investigation. Firms collude, make profit $\nu \pi_M$, and face the expected fine $p(\nu)\nu F$. Next period firms continue with collusion.
- The expected profit per period is

$$\pi_N = \nu[\pi_M - \alpha p(\nu)F]$$

(1)

and the expected overall profit amounts to $\pi_N/(1 - \delta)$. 

Collude and not reveal

- Let us first determine the firms’ choice of $\nu$ absent any leniency.
- Maximizing (1) without any constraints yields

$$\tilde{\nu}_N = \frac{\frac{\pi_M}{\alpha} F - p(\tilde{\nu}_N)}{p'(\tilde{\nu}_N)}.$$ (2)

- Call $\tilde{\nu}_N$ the unconstrained choice under strategy $N$.
- $\tilde{\nu}_N$ is increasing with $\pi_M$ and decreasing with $\alpha$ and $F$: If the AA increases $\alpha$, the degree of collusion goes down.
- Increasing $\nu$ at $\nu = 0$ has no first-order effect on the expected fine while profits increase.
- Therefore, firms always choose a positive degree of collusion, i.e., $\tilde{\nu}_N > 0$. 

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Collude and not reveal

- Consider now the situation with leniency.
- Suppose the AA has started an investigation.
- If firms continue to play N, their profit is
  \[ \nu [\pi_M - p(\nu)F + \delta(\pi_M - \alpha p(\nu)F)/(1 - \delta)]. \]
- If a firm reports and deviates from collusion, it makes profit \(2\nu\pi_M\).
- Firms play N rather than report and deviate if
  \[ \nu [\pi_M - p(\nu)F + \delta(\pi_M - \alpha p(\nu)F)/(1 - \delta)] \geq 2\nu\pi_M. \] (3)

To support N with postinvestigation leniency firms choose the degree of collusion that satisfies the equality in (3). We have

\[ \hat{\nu}_N = \rho^{-1}((2\delta - 1)\pi_M/(1 - \delta + \delta\alpha)F). \] (4)

- Call \( \hat{\nu}_N \) the constrained choice under strategy N. \( \hat{\nu}_N \) is increasing in \( \pi_M \) and decreasing in \( \alpha \) and \( F \).
Collude and not reveal

- Under strategy \( N \) firms choose either the unconstrained \( \bar{\nu}_N \) or the constrained degree of collusion \( \hat{\nu}_N \).
- Clearly, they do better with \( \bar{\nu}_N \) than with \( \hat{\nu}_N \).
- Consequently, they will choose \( \hat{\nu}_N \) only when it is smaller than \( \bar{\nu}_N \).
- Taking into account that \( \nu \in [0, 1] \), we have

\[
\nu^*_N = \min\{\bar{\nu}_N, \hat{\nu}_N, 1\}. \tag{5}
\]
Collude and not reveal

- If firms are sufficiently patient, under strategy $N$ the incentive to deviate plays no role: it is not attractive to give up the future profits from collusion for a onetime profit increase.
- By contrast, if they are sufficiently impatient, the incentive to deviate alone determines the degree of collusion.

**Lemma 1:**

a) For $\delta$ close to 1, $\bar{\nu}_N < \hat{\nu}_N \forall \alpha > 0$;

b) for $\delta$ close to 1/2, $\hat{\nu}_N < \bar{\nu}_N \forall \alpha > 0$. 

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Collude and reveal

- With probability $(1 - \alpha)$ there is no investigation.
- Firms collude and make profit $\nu \pi_M$.
- With probability $\alpha$ there is an investigation.
- Firms report, stop collusion in this period by playing the static Nash equilibrium, make 0 profit, and pay the fine $\nu F / 2$.
- Next period firms return to collusion.
- The expected profit per period is

$$\pi_R = \nu [(1 - \alpha) \pi_M - \alpha F / 2]$$

(6)

and the expected overall profit $\pi_R / (1 - \delta)$.
Collude and reveal

- Preinvestigation if firms play $R$, they collude and do not report; their profit is $\nu[((1 - \alpha)\pi_M - \alpha F/2)/(1 - \delta)]$.
- If a firm reports and deviates from collusion, it makes profit $2\nu\pi_M$.
- Firms play $R$ rather than report and deviate if
  \[
  \nu[((1 - \alpha)\pi_M - \alpha F/2)/(1 - \delta)] \geq 2\nu\pi_M. 
  \] (7)
- Hence,
  \[
  \nu_R = \begin{cases} 
  0, & \alpha > \pi_M(2\delta - 1)/(F/2 + \pi_M); \\
  1, & \text{otherwise}. 
  \end{cases} 
  \] (8)
- $\pi_R$ is linear in $\nu$. Therefore, the optimal degree of collusion is either zero or one.
Deterrence

- **Proposition 1:** For $\delta$ close to one, leniency does not increase deterrence.
- With sufficiently patient firms the introduction of leniency is not a good idea.
  - Given firms play collude and not reveal, the option of getting leniency does not induce them to blow the whistle.
  - Furthermore, leniency introduces the possibility to play collude and reveal.
  - If firms opt for this strategy, they collude on all markets.
Proposition 2:

a) For $\alpha$ small and $F \geq \pi_M / (p(1) - 1/2)$, firms play $R$ and $\nu^* = \nu_R = 1$;
b) for $\alpha > \pi_M (2\delta - 1)/(F/2 + \pi_M)$, firms play $N$ and $\nu^* = \nu_N^* > 0$.

In case a) slightly increasing $\alpha$ does not lower the degree of collusion: firms continue to collude on all markets playing $R$. However, it increases cartel desistence, i.e., firms interrupt their collusion more often and the AA collects the fine more often.

In case b) increasing $\alpha$ lowers the degree of collusion (though never to zero). Whether the AA collects more fines is unclear.
For small values of $\alpha$ introducing leniency is not a good idea: firms may switch from collude and not reveal with $\nu_N^* < 1$ to collude and reveal with $\nu_R^* = 1$, i.e., collusion goes up.

For large values of $\alpha$ firms choose collude and not reveal.

- Suppose already without leniency firms are constrained by the incentive to deviate.
- Then leniency reduces collusion because it reinforces the incentive to deviate.
- Nevertheless, with and without leniency firms may pick the unconstrained $\bar{\nu}_N$, so that leniency has no effect on collusion.
Conclusions

The purpose of this paper is to study leniency programs when firms choose the degree of collusion, a continuous variable. It turns out that this affects the effectiveness of leniency programs. To assess leniency it seems thus a good idea to keep the firms’ collusion possibilities in mind.

- If the probability of an investigation is small or if firms are sufficiently patient, leniency is ineffective and may even increase collusion.
- In all other cases leniency may or may not reduce collusion. Firms, choose, however, always a positive degree of collusion.
- Complete deterrence is not possible in our framework.