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The effect of leniency programs on endogenous collusion☆

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HIGHLIGHTS

- The effect of leniency programs on collusion is studied.
- This model extends the previous literature in two ways.
- First, the collusion degree depends on the detection probability.
- Second, the equilibrium selection in the reporting stage is endogenized.
- We reveal that the maximum reduction is the best policy without any condition.

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ABSTRACT

The objective of a leniency program is to reduce sanctions against collusion if a participant voluntarily confesses his behavior or cooperates with the public authority's investigation. Constructing a model in which the detection probability varies over time, Harrington (2008) pointed out that there are three channels through which the leniency program can affect the collusion amount; furthermore, he presented a sufficient condition under which the maximum leniency is optimal. After extending the model by endogenizing the degree of collusion as well as equilibrium selection in the self-reporting stage, we revealed that the Race to the Courthouse effect disappears and that the maximum reduction is always optimal.

1. Introduction

Collusion is an agreement to limit open competition among firms. In most countries, a great deal of public resource is used to detect and prevent collusion. The leniency program is one of the newly developed policies under which sanctions against collusion are to be reduced if a member voluntarily confesses his illegal behavior or cooperates extraordinarily with the investigation authority. Two types of reductions should be noted. One is offered to a firm which spontaneously self-reports a collusion even before the initiation of any investigation by the public authority. The other is applied to a firm which cooperates when investigation is underway, e.g. by providing hard evidence to the public authority.

Leniency programs were first introduced by the US and then spread out to the European Union and other countries, such as Japan, Korea and so on. The effect of the programs and the optimal design under various conditions have been the subject of recent research, such as by Motta and Polo (2003), Brisset and Thomas (2004), Buccirossi and Spagnolo (2006), Spagnolo (2000a,b, 2004, 2006), Harrington (2005, 2008, 2013) and Ishibashi and Shimizu (2010).

In particular, the most comprehensive analysis of self-reporting prior to an investigation is by Harrington (2008), who assumes that the chance of being detected by the public authority changes over time. It points out three effects—the Deviator Amnesty Effect, the Cartel Amnesty Effect, and the Race to the Courthouse Effect. The Deviator Amnesty Effect captures the reduction in fines by applying the leniency program right after a firm undercuts the collusive price. Because this effect helps the deviator, the collusion becomes more difficult to sustain. The Cartel Amnesty Effect arises

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as colluders utilize the leniency program when the chance of detection is high. Because more lenient programs reduce sanctions to colluders, this effect plays a pro-collusive role. The Race to the Courthouse Effect observes that it can be in equilibrium for no firms to confess when the reduction is minimal. With the more generous treatment, the reporting game becomes a Prisoner's Dilemma and it is the unique equilibrium for all firms to apply for amnesty. This effect is counter-collusive in that the expected present value of penalty from continuing to collude increases with transition from 'self-reporting by nobody' to 'self-reporting by everybody.' After presenting the three effects, Harrington (2008) provided a sufficient condition whereby the antitrust law should waive all penalties for the first firm to come forward.

By extending the previous model in the following ways, this paper proves that the Race to the Courthouse Effect disappears and maximum leniency is always optimal. First, we allow the collusion degree to be flexible depending on the detection probability. Second, the reporting strategy is a part of collusion and the colluders are assumed to select any equilibrium of the self-reporting game to maximize collusion profit.

2. Model

2.1. Set up

We adapt a standard model of repeated auction. There is one buyer and n sellers (firms) who repeatedly interact with each other. Each seller maximizes his/her life time profit and $\delta \in (0, 1)$ is the discount factor. The buyer wants to consume one unit of goods at each period. The cost of production is normalized to be 0 and the reservation price is denoted by $\overline{m}$. We take the standard tie-breaking rule of determining the winner so that equal probability will be given to all the highest bidders.

The firms are supposed to choose whether to apply for leniency as well as their bidding at each period. As to the timing of self-reporting to the public authority, two different assumptions have been made in the literature. Some assume that a firm can set the price and apply for leniency before other firms observe his bidding. In other models, leniency decisions are made after the bidding outcome is realized. To make a comparison with the result in Harrington (2008), we follow the assumption that it is possible for the firms to apply for leniency at the same time of presenting their bid. This reporting opportunity will be called the 'with-bidding stage' in this paper. The 'after-bidding stage', as it will be called in this paper, is one in which firms can also choose to self-report simultaneously after the bidding outcome is realized.

In the case that nobody self-reports in two reporting stages, they face a risk of being detected by the public authority.[1] The detection occurs probabilistically, which varies period by period. Specifically, let ρ_t be the probability of successful detection at time t which is a random variable drawn independently from a continuous distribution at the start of every period. The distribution function is denoted by G which has the support of $[0, 1]$. The realization of ρ_t is public information and can be utilized by the collusion members. F is the fine against collusion imposed on every colluder. In the case of a confession before detection, only the first one to come forward receives amnesty and his penalty reduces to θF where $\theta \in [0, 1]$. If $k \geq 1$ firms confess together, then each firm has the expected fine of $\theta(k)F = \left(\frac{k-1}{k} + \frac{1}{k}\theta\right) F$. The following sums up the sequence of actions in each period.

- ρ_t is realized and observed by every seller.
- n sellers show their bid.
- At the time of presenting the bid, each firm has a chance of confessing to the public authority (with-bidding stage).
- If nobody confesses at the time of bidding, the colluders simultaneously choose 'confess' or 'no confess' after observing the bidding outcome (after-bidding stage).
- If nobody has confessed, the detection is made with probability ρ_t.

To describe the strategic situation in the reporting stage, the following simultaneous game, $RG(\rho)$, is defined. The colluders are the player and the set of their strategy is {confess, no confess}. Each player's payoff is $-\rho F$ if nobody chooses 'self-report'. If k players choose 'self-report', then the players with self-reporting strategy will get $-\theta(k)F$ and others will get $-F$.

In principle, collusion can be any anti-competitive agreement. However, we impose structures for a meaningful conclusion. Let $D(\theta)$ be the set of subgame perfect equilibrium with the following properties (a)–(g). The generic element of $D(\theta)$ is denoted by $d \in D(\theta)$.

(a) There are two states, a collusive state and a competitive state. The initial period is collusive.
(b) At a collusive state of t, the agreed winning bidder is determined with an equal probability. The agreed winner is supposed to bid $m_t(\rho_t)$ where $m_t(\rho_t) \in [0, \overline{m}]$. Every bidder other than the agreed winner bids strictly more than $m_t(\rho_t)$. Nobody applies for leniency at the with-bidding stage. If the bids are the same as the agreed ones, they do not self-report at the after-bidding stage.
(c) At a collusive state, if any bid is different from the agreed one and no self-report is made at the with-bidding stage, then any (pure strategy) equilibrium of $RG(\rho_t)$ is played at the after-bidding stage.
(d) Suppose that $t-1$ was a collusive state. If, at $t-1$, the agreed bids were presented, no self-report was made at the with-bidding and after-bidding stage, the public detection did not occur and $\rho_t \leq \overline{\rho}$, then t continues to be a collusive state. Otherwise, t becomes the competitive state.
(e) Suppose that $t-1$ was a collusive state but t has become a competitive state due to $\rho_t > \overline{\rho}$, Then at the with-bidding stage, any (pure strategy) equilibrium of $RG(\rho_t)$ will be played.[2]
(f) At a competitive state, the sellers present the stage Nash equilibrium bid which is 0. In addition, if $t-1$ was a competitive state, then t becomes a competitive state regardless of the outcome of $t-1$.
(g) If $t-1$ and t are competitive states, then nobody self-reports at the with-bidding and after-bidding stage of the t period.

We say that a collusion exists at time t if t is a collusive state of any $d \in D(\theta)$. Several remarks are worth mentioning.

First, a grim-trigger strategy is used. One deviational bid will trigger permanent competition. Theoretically, the players may organize another collusion in the future after finite punishment periods, and the argument will still be applied even with the revival of collusion; however, we exclude it for ease of exposition. Moreover, the permanent punishment provides the highest incentive to participate in the collusion. Not only a deviational bid but also a self-report or public detection causes a permanent transition to competition. Another possibility of collusion in the future is unlikely given that the market with a collusion history will be the subject of thorough monitoring by the public authority.

[1] Because we want to focus on an amnesty program for self-reporting before investigation is underway, the process of verifying at court is ignored and the detection immediately connects to the proof.

[2] If no self-report is made at the with-bidding stage, any (pure strategy) equilibrium of $RG(\rho_t)$ will be played at the after-bidding stage, again.