Ringleader Discrimination in Leniency Policies

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Preliminary Version: May 2019

Abstract

Leniency Programs (LPs) reward colluding firms that come forward with evidence that can be used as a proof of the illegal conduct. A discriminatory LP prevents a cartel ringleader or instigator to benefit from leniency provisions. This paper studies the effects of introducing discriminatory policies on cartel deterrence. Our results indicate that ringleader discrimination can lead to lower or higher deterrence, depending on the degree of discrimination. A program that fails to distinguish spontaneous reporting also fails to encourage deviations and fosters cartel stability. A partially-discriminatory policy rewards a ringleader for spontaneous cartel denouncement while it excludes this firm from the possibility of being beneficiary once the authorities already possess related evidence. Such a perceptive scheme effectively manages to balance costs and benefits of discrimination and results in better deterrent outcome compared to the non-discriminatory LPs.

JEL Classification: K21, L12, L41

Keywords: Antitrust enforcement, Collusion, Leniency programs, Ringleader discrimination

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1. Introduction

Most jurisdictions have adopted Leniency Programs (LPs) or policies in an attempt to discourage cartel formation and to destabilize established cartels. LPs offer the possibility to cartel members to report the existence of an infringement, admitting their participation and to cooperate with authorities by offering evidence and/or information that can be used as a proof of the illegal conduct in the prosecution phase. In exchange, the fines that would be imposed on the cooperating firms are partially or completely waived.

The fact that LPs play a significant role on cartel detection and deterrence is consensus among practitioners and researchers. Wils (2016) quotes some statistics regarding the number of European Commission's cartel decisions indicating an increasing importance of the European LP on the frequency of cartel convictions. However, to conclude for an increasing effectiveness of antitrust policy due to leniency policies requires a reduced incentive for participation in a collusive agreement, *i.e.* the cost and benefits of antitrust policy should be properly balanced.

The present paper investigates the impact of introducing discrimination for cartel ringleaders on the frequency of cartel occurrence. There exist jurisdictions that exclude ringleaders from the possibility of receiving fine reductions with the prominent example of the United States (US) LP. The US Corporate Leniency Policy, excludes firms that coerce others to participate in the anticompetitive activity or they were the leader in (originator of) the activity. On the other hand, the European LP does not include such provisions, with the exemption of excluding coercers from immunity from fines.

Highly notable contributions on the LP-related literature are Motta and Polo (2003), Spagnolo (2004), Harrington (2008), and Chen and Rey (2013), among others. The related literature highlights possible adverse effects of LPs as well as proposes the LP's optimal design. For instance, Harrington (2008) identifies the ways in which leniency affects the sustainability of collusion and concludes in favor of the first informant rule (restricting eligibility to the first-in applicant).

Two works are relevant to the present as they also address the impact of ringleader discrimination (RD) on cartel deterrence. First, Chen et al. (2015) studies the implications of denying leniency to ringleaders under the assumption that participating firms are restricted to apply for leniency only after an investigation has been launched. They identify the impact of such exclusion on both cartel deterrence and detection and conclude that RD may render the ringleader less willing to instigate a cartel since this firm faces asymmetrically harsher punishment. At the same time, the incentive of others' to come forward is mitigated implying that reporting becomes more demanding. Cartel formation may be more or less frequent with a discriminatory LP, but once a cartel is created, reporting is less likely under RD.

The other related work is Blatter et al. (2018) which examines the impact of LP's features on cartel deterrence when firms (possibly) possess cumulative and asymmetric evidence. The later implies that reporting may not lead to certain conviction and that the gravity of confession differs between the market participants. They employ a timing of the stage game according to which the competition authority may start an investigation and then firms take their reporting and pricing decision either under investigation or given that no investigation will take place. They show that RD can be beneficial if firms' evidence is sufficiently symmetric in terms of the associated conviction-likelihood.

Further, Clemens and Rau (2019) experimentally find that a discriminatory LP reduces the probability that the cartel is reported. Consequently, it seems to enhance trust among infringers implying a positive effect on cartel sustainability (a negative effect on cartel deterrence).

Our departure from the previous theoretical literature is mainly twofold: first we examine the impact of the discriminatory LP considering that firms can report either spontaneously, before the start of an investigation or when the investigation is already underway. This captures a probably important but neglected effect of discriminatory policies: excluding the ringleader from receiving leniency may reduce its incentive to initially defect from the agreement, since an early deviation could have been more profitable if it could have been simultaneously paired with reporting.

Second, we attempt to propose an alternative leniency scheme according to which leniency is available or not for cartel ringleaders depending on whether their reporting takes place before or during investigations. Allowing the ringleader to benefit in case of spontaneous confession does not lower its value stemming from deviation. At the same time, excluding these firms from receiving leniency when authorities already possess incriminating evidence, maintains the effect of asymmetric punishment. We show that a partially discriminatory LP does better than the fully exclusionary one, while it weakly dominates the non-discriminatory LP.

The paper proceeds as follows: section 2 contains the model specifications. Section 3 presents the analysis of the model and section 4 concludes.

2. The model

In a duopoly firms produce homogeneous good and compete in prices for an infinite number of periods. They maximize the expected sum of future discounted profits using a common discount factor $\delta \in (\frac{1}{2}, 1)$.[1] During each period a competition *vs.* collusion game takes place. If all firms set the collusive price, each one earns an amount of profit denoted with π. When one firm unilaterally deviates from the agreed price, it receives 2π while the other firm gets zero. The competitive gross profits are zero. In order to lighten the analysis and without loss of generality we normalize $\pi = 1$.

The Antitrust Authority (AA) investigates the industry with probability $a \in (0,1)$. Even when firms are guilty, the start of an investigation does not necessarily imply conviction; AA's actions (dawn-raids etc) uncover a portion of the total evidence which corresponds to a probability of conviction equal to $\rho_0 \in \left[\frac{1}{2}, 1\right]$. At the outset the AA announces the fine that convicted firms pay. The fine is proportional to the profits earned from collusion and the fine multiplier is denoted with $\mu > 1$.[2]

A LP absolves from any fine responsibility the first cartel member that provides information and/or evidence related to the existence of the cartel either before or after the investigation's opening. A common feature among LP-related legislation in different countries is that it restricts leniency to only a limited number of applicants. Usually, the eligible firms are selected on a first-come-first-served basis, subject to the requirement of providing sufficient amount of evidence.[3] Even in jurisdictions

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[1] For $\delta < 0.5$ collusion is not sustainable even in the absence of antitrust policy.

[2] The US (federal) fines correspond to no more than double damages while other jurisdictions allow for up to treble damages, see Harrington (2014). A reasonable assumption for the value of μ is $\mu \in [2,3]$. However, as Harrington (2014) points out, in practice firms found guilty pay fines that "are probably more on the order of single rather than treble damages". Katsoulakos et al. (2015) shows that fines based on illegal profits are welfare superior to fines on revenues.

[3] For instance, the US system grants leniency to a single applicant, subject to the condition that it provides substantial evidence. The EU system allows for many applicants, however, it offers them asymmetric treatment, with leniency being more generous for those that come out early and decreasing for subsequent informants.

where all the applicants are eligible, their treatment is asymmetric, with the "early birds" receiving substantially more generous treatment.

Firms may differ with respect to the quality and/or quantity of the evidence they possess. We name one firm the ringleader of the conspiracy or firm h. Firm h possesses perfect evidence; this implies that the ringleader's confession under the LP is enough to convict the cartel with certainty. The other firm (firm l) may possess cartel-related evidence of lesser quantity and/or lower quality resulting in a conviction-likelihood $\rho_1 \in [\rho_0, 1]$ when this firm is the unique that reports.[4]

After the AA has announced the policy parameters, the timing of the game is as follows:

Stage 1 Firm h can act as a ringleader of the conspiracy and propose the creation of the cartel. Firms receive zero profit in the period because either h does not instigate or firm l refuses to collude.

Stage 2 If a cartel agreement is reached, in all subsequent periods firms choose whether to set the agreed price or to defect. A deviation from the collusive price implies that the market will be competitive ever after (trigger strategies). Firms can opt for denouncing the agreement. In case of successful prosecution, the first firm that reports the cartel before the start of an inspection is absolved from any fine imposition.

Stage 3 After firms have set their prices and made the current period profit and given that no firm reports at stage 2, the AA randomly investigates with probability a. In case of no investigation the probability of cartel conviction is zero and the game ends for this period.

Stage 4 If the cartel is investigated both firms take the reporting decision simultaneously. If both firms report the name of the eligible is determined randomly, each one has 0.5 probability of being the eligible. The other firm pays the full fine.

Stage 5 The cartel members are convicted with probability ρ_0 if no firm reports, $\rho_1 \in [\rho_0, 1]$ if only firm l confesses and 1 if at least h reports.

[4] Consider that the amount and the quality of evidence that firm l possesses is such that the probability of conviction generated by l's single confession is ρ_1 in every period.

> The permanent interruption of cartel activity is the result of either deviation at stage 2 or successful prosecution. If the cartel survives (even if firm l reports), the cartel activity continues for at least one more period. Firms cannot be convicted for past violations, *i.e.* evidence created in a period becomes obsolete by the end of it. Conviction also uncovers the role of firm h as the ringleader.

In the benchmark case (no discrimination) both firms can be eligible for leniency with equal probability when they both report. Then, we remove the possibility of receiving lenient treatment from the ringleader either if its reporting happens before or after the start on the investigation. Finally, we allow the ringleader to benefit from leniency if its reporting is spontaneous at stage 2, while we keep excluding this firm from post-investigation leniency.

3. Analysis

3.1 No discrimination (NRD)

When an investigation is underway each firm faces the dilemma of reporting or not. We assume that if a firm is indifferent between reporting and remaining silent it chooses the former. If no firm selects to report each one expects to be convicted with probability ρ_0 while in case of non-conviction firms keep colluding for at least one more period. Since no firm confesses in subsequent periods as well, the payoff of universal non-reporting for each firm is:

$$B = \rho_0(1-\mu) + (1-\rho_0)(1+\delta V_0) = \frac{1-\rho_0[\mu-(1-a)(\mu-1)\delta]}{1-\delta(1-a\rho_0)} \qquad (1)$$

where V_0 denotes the cartel value when no firm confesses. In case of non-conviction with probability $[(1-a)+\alpha(1-\rho_0)]$ each firm expect to keep receiving the collusive profits, and with probability $a\rho_0$ to pay the fine μ, and receive the competitive profit thereafter:

$$V_0 = (1-a)(1+\delta V_0) + \alpha[(1-\rho_0)(1+\delta V_0) + \rho_0(1-\mu)] = \frac{1-a\rho_0\mu}{1-\delta(1-a\rho_0)}$$

If the ringleader selects to confess while the other firm remains silent the former receives the collusive profits 1 and pays zero fine while the latter receives $1-\mu$. If the only firm that applies is firm l then its reporting results in cartel conviction with probability ρ_1, in which case l is fully absolved from any fine imposition. Using (1), firm l unilaterally reports if

$$\Gamma = \rho_1 + (1-\rho_1)\left(1+\delta w_1^l\right) = \frac{1-\rho_1(1-a)\delta}{1-\delta(1-a\rho_1)} \geq B$$

where $w_1^l = (1-a)\left(1+\delta w_1^l\right) + \alpha\left[(1-\rho_1)\left(1+\delta w_1^l\right) + \rho_1(1-0)\right] = \frac{1}{1-\delta(1-a\rho_1)}$ is the value of the cartel for l when firm h never reports while l always applies for leniency. Rearranging $\Gamma \geq B$ yields that l unilaterally reports if leniency is sufficiently generous, that is $\mu \geq \mu_0^l(\rho_1)$ where

$$\mu_0^l(\rho_1) = \frac{\delta(\rho_1-\rho_0)}{\rho_0[1-\delta(1-a\rho_1)]} \tag{3}$$

If only l reports, the ringleader expects to be convicted with probability ρ_1 in which case it pays the full fine. Otherwise firms keep colluding and the ringleader gets a payoff equal to

$$w_1^h = (1-a)\left(1+\delta w_1^h\right) + \alpha\left[(1-\rho_1)\left(1+\delta w_1^h\right) + \rho_1(1-\mu)\right] = \frac{1-a\rho_1\mu}{1-\delta(1-a\rho_1)}$$

The ringleader's payoff when the cartel is investigated and this firm remains silent while the other reports, is

$$A = \rho_1(1-\mu) + (1-\rho_1)\left(1+\delta w_1^h\right) = \frac{1-\rho_1[\mu-(1-a)(\mu-1)\delta]}{1-\delta(1-a\rho_1)}$$

When both report under investigation the cartel is certainly convicted and the cartel activity is permanently interrupted. The payoff of each firm when both report is $1-\frac{\mu}{2}$, since each one receives leniency with equal probability. Table 1 summarizes the investigation subgame:

firm $h\downarrow$ / firm $l\rightarrow$	Report (R)	Not report (NR)
Report (R)	$1-\frac{\mu}{2}, 1-\frac{\mu}{2}$	$1, 1-\mu$
Not report (NR)	A, Γ	B, B

Table 1

Note that (R, R) is an equilibrium if $1-\frac{\mu}{2} \geq A$ which yields

$$\mu \geq \hat{\mu}(\rho_1) = \frac{2\delta(1-\rho_1)}{2\rho_1 - 1 - \delta[(2-a)\rho_1 - 1]} \tag{4}$$

If however $\mu < \mu_0^l(\rho_1)$ or equivalently $\Gamma < B$ then (NR, NR) prevails since we allow firms to select the Pareto superior equilibrium and $1-\frac{\mu}{2} \geq B$ requires

$$\mu \geq \frac{2\delta(1-\rho_0)}{2\rho_0 - 1 - \delta[(2-a)\rho_0 - 1]} > \mu_0^l(\rho_1)$$

The following lemma summarizes the equilibrium of the reporting subgame when no firm has deviated or reported at stage 2:

Lemma 1

For $\mu < \mu_0^l(\rho_1)$ *no firm reports; for* $\mu \geq max\{\hat{\mu}, \mu_0^l\}$ *both firms report; for* $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$ *only firm* l *reports.*

Observe that, using (3) and (4), $\frac{\partial \hat{\mu}(\rho_1)}{\partial \rho_1} = \frac{-2\delta[1-\delta(1-a)]}{[2\rho_1 - 1 - \delta[(2-a)\rho_1 - 1]]^2} < 0$ while $\frac{\partial \mu_0^l(\rho_1)}{\partial \rho_1} = \frac{\delta[1-\delta(1-a\rho_0)]}{\rho_0[1-\delta(1-a\rho_1)]^2} > 0$, therefore $\hat{\mu}(\rho_1) > \mu_0^l(\rho_1)$ can hold when ρ_1 is low. For ρ_1 close to 1 $\hat{\mu}(\rho_1) < \mu_0^l(\rho_1)$ and $\hat{\mu}(1) = 0 < \mu_0^l(1) = \frac{\delta(1-\rho_0)}{\rho_0[1-\delta(1-a)]}$.[5]

Lemma 1 defines the equilibrium in the investigation stage given that no firm reports or defects at stage 2. If one firm has defected (without reporting) at stage 2, and given that an investigation has opened, the loyal firm earns zero profits and therefore is indifferent between reporting or not (it will get zero anyway). If the ringleader has defected and an investigation has opened this firm receives $2\left(1-\frac{\mu}{2}\right)$ and $2(1-\mu\rho_1)$ in cases of post-investigation reporting and non-reporting respectively. Since $2\left(1-\frac{\mu}{2}\right) > 2(1-\mu\rho_1)$ for $\rho_1 > \frac{1}{2}$ the defecting ringleader reports if an investigation is underway. If firm l unilaterally deviates in the product market, it receives $2\left(1-\frac{\mu}{2}\right)$ and $2(1-\mu)$ in cases of post-investigation reporting and non-reporting respectively, and clearly selects to confess. Therefore, if a single firm defects and no reporting takes place at stage 2, then both firm report in case of investigation.

At stage 2 firms decide whether to respect the agreement or to defect. At the same time they choose whether to report the cartel or not. Each firm has four possibilities: to deviate and report (DR), to deviate and remain silent (DNR), to respect and report (NDR) and to respect and remain silent (NDNR). If both firms select NDNR the

[5]Note that $\mu_0^l < \hat{\mu}$ yields $\rho_0 < \frac{\rho_1[2\rho_1 - 1 + \delta(1-(2-a)\rho_1)]}{1-\delta[1-a\rho_1(3-2\rho_1)]}$. Firm l can be the only reporting firm under investigation when, for given ρ_1, ρ_0 is sufficiently low (or ρ_1 is high enough). For $\rho_1 = 1$, $\mu_0^l > \hat{\mu}$ is the case and the ringleader reports whenever the other firm reports.

period proceeds to stage 4 (investigation) with probability a. The following lemma states that one out of the first three options dominates the other two:

Lemma 2

Both firms prefer to pair pre-investigation deviation with reporting rather than to deviate without reporting or to report without defecting.

Proof

See the Appendix.■

Lemma 2 implies that collusion involves no pre-investigation reporting and that collusion is sustainable if it escapes unilateral deviations paired with reporting. Therefore, each firm's payoff from unilateral deviation is 2. If no firm defects and $\mu \geq max\{\hat{\mu}, \mu_0^l\}$ from lemma 1, that is both firms confess when investigated, each firm's collusive value is

$$V^{NRD} = (1-a)(1+\delta V^{NRD}) + \alpha\left[\frac{1}{2}+\frac{1}{2}(1-\mu)\right] = \frac{2-a\mu}{2[1-\delta(1-a\rho_1)]}$$

If no investigation takes place, they escape conviction with certainty, while if an investigation opens the cartel is convicted and they have equal probability of being the eligible for leniency.

For $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$, only firm l reports under investigation. If an investigation starts the ringleader is convicted with probability ρ_1. If the investigation is unsuccessful despite the other's reporting, the ringleader expects to collude for one more period. The cartel value for the ringleader is

$$V_h^{NRD} = w_1^h = \frac{1-a\rho_1\mu}{1-\delta(1-a\rho_1)} \tag{5}$$

The cartel value for firm l which pays zero fine in case of successful investigation, is

$$V_l^{NRD} = w_1^l = \frac{1}{1-\delta(1-a\rho_1)} \tag{6}$$

which is greater than V_h^{NRD}. For $\mu_0^l(\rho_1) > \mu$, no firm reports under investigation and each one's collusive value is V_0. Lemma 3 determines the conditions under which collusion is sustainable in the benchmark (no discrimination) case:

Lemma 3

For $\mu \geq max\{\hat{\mu}, \mu_0^l\}$ *collusion is sustainable if* $\delta \geq \delta^{NRD} \equiv \frac{2+a\mu}{4(1-a)}$*; for* $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$ *collusion is sustainable if* $\delta \geq \delta_h^{NRD} \equiv \frac{1+a\rho_1\mu}{2(1-a\rho_1)}$*; for* $\mu < \mu_0^l(\rho_1)$ *collusion is sustainable if* $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$.

Proof

Setting V^{NRD}, $V_h^{NRD}(\leq V_l^{NRD})$ and V_0 equal or greater than the defecting value (2) yields $\delta \geq \delta^{NRD}$, $\delta \geq \delta_h^{NRD}$ and $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$ respectively. Note that for $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$ we compare the ringleader's value V_h^{NRD} with the value of deviation, since both constraints must be met for collusion sustainability.■

3.2 Ringleader discrimination

When the ringleader is exempted from leniency it has no incentive to report under investigation. Regardless of whether firm l reports, the reporting ringleader pays the full fine while if the ringleader remains silent it will get A or B depending on whether the other firm reports or not. Hence, for the ringleader NR dominates R when an investigation has started and no firm has reported or defected at stage 2.

At stage 4, firm l selects to confess or to remain silent and in the former case it receives Γ while if it reports its payoff is B. This firm is the only reporting firm if $\Gamma \geq B$ or if $\mu \geq \mu_0^l(\rho_1)$ which is given by (3). When the ringleader is fully exempted from leniency and no firm reports and/or deviates at stage 2, firm l is the only that reports when $\mu \geq \mu_0^l(\rho_1)$ while no post-investigation reporting takes place otherwise.

Consider for instance that no reporting took place at stage 2. If firm h has defected it receives $2(1-\mu)$ and $2(1-\mu\rho_1)$ in cases of post-investigation reporting and non-reporting respectively. For all $\rho_1 \leq 1$, the defecting ringleader remains silent if an investigation is underway. If firm l unilaterally deviates at stage 2 and selects to report it receives 2 while remaining silent implies a payoff of $2(1-\mu)$, since the loyal ringleader is indifferent between reporting or not. Therefore, if firm h deviates, only the other firm confesses under investigation while if firm l unilaterally defects, conviction is certain if an investigation starts.

At stage 2 and since no leniency is available, the dilemma that the ringleader faces is whether to respect the agreement or not. If firm l colludes, the defecting ringleader earns the respective payoff reduced by $\rho_1\mu$ if the marker is investigated:

$$2(1-a) + a[2\rho_1(1-\mu) + 2(1-\rho_1)] = 2(1-a\rho_1\mu)$$

Since h never reports in either stage, firm l recognizes that DR has a payoff equal to 2 and if it selects DNR it may pay the full fine in case of investigation since the ringleader will get zero profits anyhow (the firm that recognizes that the other has defected gets zero profits regardless of the investigation's outcome). NDR has a payoff equal to $\frac{1}{1-\delta(1-\rho_1)}$ and similar to the no discrimination case, firm l selects to pair unilateral deviation with reporting in the pre-investigation stage if 2 exceeds the cartel value. Therefore, when h unilaterally reports, no firm confesses at stage 2 and only firm l confesses under investigation. If l unilaterally reports, it also confesses at stage 2.

If no firm defects and $\mu \geq \mu_0^l$, that is firm l confesses under investigation, the ringleader's collusive value is given by (5)

$$V_h^{RD} = (1-a)(1+\delta V_h^{RD}) + \alpha[\rho_1(1-\mu) + (1-\rho_1)(1+\delta V_h^{RD})] = V_h^{NRD}$$

The cartel value for firm l which pays zero fine in case of successful investigation, is also similar to that under NRD when only one investigated firm reports and it is given by (6)

$$V_l^{RD} = (1-a)(1+\delta V_l^{RD}) + \alpha[\rho_1 + (1-\rho_1)(1+\delta V_l^{RD})] = V_l^{NRD}$$

For $\mu < \mu_0^l(\rho_1)$, no firm reports under investigation and each one's collusive value is V_0. Lemma 4 determines the conditions under which collusion is sustainable when the ringleader is fully exempted from leniency:

Lemma 4

For $\mu \geq \mu_0^l$ collusion is sustainable if $\delta \geq \delta^{RD} \equiv \frac{1}{2(1-a\rho_1)}$; for $\mu < \mu_0^l(\rho_1)$ collusion is sustainable if $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$.

Proof

For $\mu < \mu_0^l(\rho_1)$, both $V_h^{RD} \geq 2(1-a\rho_1\mu)$ and $V_l^{RD} \geq 2$, yield $\delta \geq \delta^{RD}$. For $\mu < \mu_0^l(\rho_1)$ firms have symmetric collusive values (no firm confesses under investigation) but they have asymmetric defecting values, since firm l pairs deviation with reporting while the ringleader deviates and remain silent. We compare the common collusive value with firm l's defecting value, that is $V_0 \geq 2$ which yields the same critical discount factor as in the benchmark case.■

Using lemma 3 and lemma 4 we compare the effectiveness of LP under no discrimination (NRD) to its effectiveness under ringleader discrimination (RD):

Proposition 1

Fully excluding the ringleader from LP hurts deterrence for $\mu > \mu_0^l(\rho_1)$. Otherwise it does not affect deterrence.

Proof

It is easy to verify that $\delta^{NRD} \equiv \frac{2+a\mu}{4(1-a)} > \delta^{RD} = \frac{1}{2(1-a\rho_1)} \Leftrightarrow \rho_1 < \frac{2+\mu}{2+a\mu}$ and $\frac{2+\mu}{2+a\mu} > 1$. Also, $\delta_h^{NRD} \equiv \frac{1+a\rho_1\mu}{2(1-a\rho_1)} \geq \delta^{RD}$ for all $\rho_1 \in (\frac{1}{2}, 1]$. For $\mu < \mu_0^l(\rho_1)$ the critical discount factors are equal.■

Proposition 1 states that the introduction of ringleader discrimination produces perverse effects on cartel deterrence. Excluding ringleader from receiving leniency may have desirable effects on the collusive value, since it creates an asymmetry in the collusive payoffs reducing the profitability of collusion for the ringleader. At the same time post-investigation reporting becomes weaker particularly when ρ_1 is not close to 1. More importantly, it weakens the ringleader's incentive to initially deviate and this effect is strong enough to completely offset the positive one of reducing the ringleader's collusive value.

3.3 Partial discrimination (PRD)

When the ringleader is exempted from post-investigation leniency NR dominates R as it the previous case. Similarly, firm l reports and receives Γ if $\mu \geq \mu_0^l(\rho_1)$. The following lemma states that when the ringleader is partially exempted from leniency, no pre-investigation reporting is included in firms' collusive strategy:

Lemma 5

As in the NRD case, no firm deviates without reporting or reports without defecting at stage 2. The defecting payoff is 2 for both firms.

Proof

See the Appendix.■

If no firm defects and firm l confesses under investigation, the ringleader's collusive value is given by (5), $V_h^{PRD} = V_h^{NRD} = V_h^{RD} = \frac{1-a\rho_1\mu}{1-\delta(1-a\rho_1)}$. Since the ringleader does not confess under investigation, its collusive payoff in cases of NRD when $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$, RD and PRD for $\mu_0^l(\rho_1) \leq \mu$ coincide. The cartel value for firm l which pays zero fine in case of successful investigation, is similarly

$$V_l^{PRD} = V_l^{RD} = V_l^{NRD} = \frac{1}{1-\delta(1-a\rho_1)} \geq V_h^{PRD}$$

Lemma 6 determines the conditions under which collusion is sustainable when the ringleader is partially exempted from leniency:

Lemma 6

For $\mu \geq \mu_0^l$ *collusion is sustainable if* $\delta \geq \delta_h^{PRD} \equiv \frac{1+a\rho_1\mu}{2(1-a\rho_1)}$*; for* $\mu < \mu_0^l(\rho_1)$ *collusion is sustainable if* $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$.

Proof

Setting $V_h^{PRD} = \frac{1-a\rho_1\mu}{1-\delta(1-a\rho_1)} \geq 2$ yields $\delta \geq \delta_h^{PRD}$. For $\mu < \mu_0^l(\rho_1)$, $V_0 \geq 2$ yields $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$.■

The following proposition compares the effectiveness of the partially-discriminatory LP with the effectiveness of the fully- and non-discriminatory LPs:

Proposition 2

Consider that $\mu \geq \mu_0^l(\rho_1)$*. Partially excluding ringleader (PRD) from LP improves deterrence compared to full exclusion; PRD improves deterrence compared to no discrimination if further* $\mu \geq \hat{\mu}(\rho_1)$*; for* $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$ *both systems have similar effects; for* $\mu < \mu_0^l$ *all systems have similar effects.*

Proof

See the Appendix.■

A discriminatory program can be effective in deterring cartels when it allows the ringleader to spontaneously report preserving its incentive to betray the agreement and consequently reducing its willingness instigate the cartel. At the same time, excluding ringleaders from post-investigation leniency maintains an asymmetry of the collusive payoffs which is destabilizing for the agreement. Unless firm l's reporting is sufficiently weak, a partially discriminatory LP always renders collusion harder to be sustained. If ρ_1 is such that $\mu_0^l(\rho_1) < \hat{\mu}(\rho_1)$ holds, then only for $\mu_0^l(\rho_1) \leq \mu < \hat{\mu}(\rho_1)$ PRD produce equivalent deterrence compared to NRD. Note that for $\mu \geq \mu_0^l$, even if PRD allows for at most equal frequency of collusion compared to NRD, if collusion is sustainable under both regimes, that is $\delta \geq max\{\delta^{NRD}, \delta_h^{PRD}\}$, then NRD exhibits better desistence: under NRD both investigated firms are convicted with probability 1 while under PRD only firm l reports, resulting in a conviction-likelihood $\rho_1 \leq 1$. Indeed, if ρ_1 is sufficiently large PRD keeps resulting in better deterrent results and if $\rho_1 = 1$ both PRD and NRD have equivalent desistence while PRD produce better deterrence.

4. Concluding remarks

The discrimination for cartel ringleaders is an important feature of LPs, adopted by major jurisdictions and neglected by others. The present paper aims to examine how the introduction of such discrimination in leniency policies affects their effectiveness to deter collusive arrangements.

Assuming that firms may be asymmetric with respect to the quality and/or quantity of the evidence they possess, we first find that excluding ringleaders loosens the incentive compatibility constraint for both the ringleader and the non-ringleader. This happens because the payoff from respecting the cartel agreement for the non-ringleader is increased, since this firm aware of the fact that the ringleader will not be eligible for leniency if an investigation begins. At the same time, this firm's incentive to defect from the agreement is not affected by discrimination. For the ringleader, such discrimination reduces its payoff from collusion (no possibility for fine's reduction under investigation) but it also reduces its incentive to deviate, since the ringleader is discouraged from reporting and defecting simultaneously. The latter effect is strong enough to offset the former resulting in a higher incentive of cartel participation.

Second, we show that the distinction between reporting in the pre- and post-investigation period provides a possibility for a more effective design of the discriminatory policy. The partially- discriminatory LP provides the possibility for a ringleader to benefit from leniency provision if this firm is the first that denounces the cartel before the AA has any related information or evidence on its disposal. A scheme that provides this possibility to a ringleader while it prevents this firm to benefit from fine reductions later seems to properly balance the costs and benefits of discriminatory leniency policies. The incentive to defect from the agreement is kept strong while the collusive payoff is lessened. The result of the latter is to hurt cartel sustainability and consequently to reduce the incentive of the ringleader to initially instigate cartel formation.

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Appendix

Proof of *lemma 2*

Consider that firm l does not defect and that the ringleader chooses whether to deviate or not and whether to report or not. The following table contains the ringleader's payoffs in each case conditional to the reporting decision of firm l:

$l\downarrow$ / $h\rightarrow$	DR	DNR	NDR	NDNR
R	$2\left(1-\frac{\mu}{2}\right)$	$2(1-\mu\rho_1)$	$1-\frac{\mu}{2}$	$\frac{1-\mu\rho_1}{1-\delta(1-\rho_1)}$
NR	2	$2\left(1-\alpha\frac{\mu}{2}\right)$	1	

Table A1

If firm h selects DNR receives $2\left(1-\alpha\frac{\mu}{2}\right)$ if the other firm does not report in the pre-investigation stage, since they both confess if the investigation opens. It also receives

$$w^{NDNR}=\rho_1(1-\mu)+(1-\rho_1)(1+\delta w^{NDNR})=\frac{1-\mu\rho_1}{1-\delta(1-\rho_1)}$$

if it respects the agreement and remains silent (pre-investigation) while the other respects the agreement and reports. It is easy to verify that $2\left(1-\frac{\mu}{2}\right) > 2(1-\mu\rho_1) > w^{NDNR}$ for all $\rho_1 > \frac{1}{2}$ and that $2 > 2\left(1-\alpha\frac{\mu}{2}\right)$, therefore regardless of whether firm l reports or not, firm h prefers to deviate and report.

Consider that firm h does not defect and that firm l takes its pre-investigation decision. The following table contains the firm l's payoffs conditional to the reporting decision of firm h:

$h\downarrow$ / $l \rightarrow$	DR	DNR	NDR	NDNR
R	$2\left(1-\frac{\mu}{2}\right)$	$2(1-\mu)$	$1-\frac{\mu}{2}$	$1-\mu$
NR	2	$2\left(1-\alpha\frac{\mu}{2}\right)$	$\frac{1}{1-\delta(1-\rho_1)}$	

Table A2

Firm l receives $\frac{1}{1-\delta(1-\rho_1)}$ as long as it respects the agreement and reports (pre-investigation) while the ringleader respects the agreement and remains silent. It is easy to verify that regardless of firm h's reporting behavior, firm l prefers to deviate and report for all $\rho_1 > \frac{1}{2}$.

Proof of *lemma 5*

At stage 2 and given that l has not defected, DR dominates DNR, NDR, NDNR (if the other firm reports) for the ringleader, since $2 > 2(1-\alpha\mu\rho_1)$ and

$$2\left(1-\frac{\mu}{2}\right) > max\left\{2(1-\mu\rho_1), 1-\frac{\mu}{2}, \frac{1-\mu\rho_1}{1-\delta(1-\rho_1)}\right\}$$

The following table contains the ringleader's payoffs for each possible reporting decision of firm l:

$l\downarrow$ / $h \rightarrow$	DR	DNR	NDR	NDNR
R	$2\left(1-\frac{\mu}{2}\right)$	$2(1-\mu\rho_1)$	$1-\frac{\mu}{2}$	$\frac{1-\mu\rho_1}{1-\delta(1-\rho_1)}$
NR	2	$2(1-\alpha\mu\rho_1)$	1	

Table A3

Since the ringleader would never confess at stage 2 without defecting (the collusive strategy "collude and report at stage 2" yields a maximum payoff of 1 and it is never sustainable as DR pays 2) when firm l consider its decision at stage 2 it knows that the loyal ringleader will never report. Therefore, if firm l selects DR it gets 2 while DNR, NDR and NDNR yield a payoff equal to $2(1-\mu)$, $1-\frac{\mu}{2}$ and $1-\mu$ respectively.

Proof of *Proposition 2*

For $\mu \geq \mu_0^l(\rho_1)$ and under RD, collusion is sustainable for $\delta > \delta^{RD} = \frac{1}{2(1-a\rho_1)}$, see lemma 4. Under PRD collusion is sustainable for $\delta > \delta_h^{PRD} = \frac{1+a\rho_1\mu}{2(1-a\rho_1)}$, see lemma 6. Setting $\delta_h^{PRD} > \delta^{RD}$ yields $\rho_1 > 0$.

For $\mu \geq max\{\hat{\mu}, \mu_0^l\}$ and under NRD collusion is sustainable for $\delta^{NRD} = \frac{2+a\mu}{4(1-a)}$, see lemma 3. Setting $\delta_h^{PRD} < \delta^{NRD}$ yields $\mu < \frac{2(1-\rho_1)}{\rho_1(2-a)-1}$. Rearranging (4) gives that $\mu \geq \hat{\mu}$ is equivalent to $\delta \leq \hat{\delta} = \frac{\mu(2\rho_1-1)}{\mu[(2-\alpha)\rho_1]+2(1-\rho_1)}$. Setting $\delta^{NRD} < \hat{\delta}$ as well as $\delta_h^{PRD} < \hat{\delta}$ yields $\mu > \frac{2(1-\rho_1)}{\rho_1(2-a)-1}$, therefore $\mu < \frac{2(1-\rho_1)}{\rho_1(2-a)-1}$ implies $\hat{\delta} < \delta_h^{PRD} < \delta^{NRD}$. The latter entails that for $\delta < \hat{\delta}$ ($\mu \geq \hat{\mu}$) under both PRD and NRD collusion is deterred. If $\delta^{NRD} < \delta_h^{PRD} < \hat{\delta}$, which is the case when $\mu > \frac{2(1-\rho_1)}{\rho_1(2-a)-1}$, for $\delta^{NRD} < \delta < \delta_h^{PRD} < \hat{\delta}$ collusion is deterred under PRD but not under NDR.

For $\mu_0^l(\rho_1) < \mu < \hat{\mu}(\rho_1)$ and under NRD collusion is sustainable for $\delta \geq \delta_h^{NRD} = \frac{1+a\rho_1\mu}{2(1-a\rho_1)} = \delta_h^{PRD}$. For $\mu < \mu_0^l(\rho_1)$, all systems allow collusion for $\delta \geq \frac{1+a\rho_0\mu}{2(1-a\rho_0)}$, see lemmata 3, 4 and 6.