

Enforcement with heterogeneous cartels

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by

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Enforcement with heterogeneous cartels*

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Abstract

The purpose of this article is to analyze the minimum fines needed in order to prevent price fixing when there is heterogeneity in the potential for a cartel overcharge across industries. We show that the incentive constraint is typically binding in industries where cartels would lead to a high overcharge, while the participation constraint is typically binding in industries where the potential for overcharge is rather low. We show that a discriminatory fine should depend on the probability of detection, the discount factor and the gains from cartel deviation. We contrast our minimum fine schedule with the one we can derive from judicial practice, a fine schedule that is proportional to the gain in per period profits. Furthermore, it is shown that more private litigation can make the most harmful cartels more stable, while cartels with lower negative impact can become less profitable.

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1 Introduction

The empirical literature on cartels shows that the price increase following price fixing differs a lot from one industry to another. While price fixing has a negligible effect on prices in some industries, prices raise with 40% or even more in other.¹ In this article we discuss the implication of this heterogeneity for the fine policy against detected cartels. We derive the minimum fine schedule that is needed to deter or desist cartels, and confront this policy with the fine schedule that can be derived from the judicial practice and actual fine policy in EU and the US.

In theory, one could set a fixed cartel fine that is so high that all potential cartels are deterred and all existing cartels are desisted. In most industries the fine would be excessively high compared to what is needed in order to deter cartels from being formed or sustained. However, this would be in stark contrast to the present judicial practice in most countries. According to case law, for example in the EU, the punishment of firms that violates the law should be proportional to the damage they cause. An interpretation of this principle is that a cartel that has caused only limited harm should at least not pay a fine that is higher compared to a cartel that has caused serious harm. Indeed, fines for various cartels differ a lot in practice. Given that levying excessively high fines are not feasible, we examine the minimum fine schedule that ensures that all cartels are marginally deterred or desisted.² The fine schedule we derive is then compared to the judicial practice to try to predict which cartels that are excessively deterred, and which cartels that survive.

In a simple framework with a continuum of potential cartels that differ with respect to the ability to raise the cartel price relative to the competitive

¹See, for example, Connor and Lande (2006).

²This is in line with the proposal in Becker (1968), where the crime is punished in such a way that the expected costs of the crime marginally exceeds the gains. Note, though, that it has been shown (see, for example, Shavell (1991) and Mookherjee and Png (1994)) that if a firm chooses between various harmful activities (instead of between committing a crime or not) this might lead to a deviation from the stated principle.

price level, we characterize the minimal fine schedule that marginally deters or desists all cartels. That is, in some industries cartel formation is deterred because the participation constraint is violated, whereas in other industries cartels break down and cease to exist because the incentive constraint is violated. The optimal fine schedule we derive is increasing in the overcharge and is in that respect discriminatory. However, we show that the optimal fine schedule should depend not only on differences in per period profit levels for the different cartels but also on factors such as the probability of detection, the number of firms in the industry, the discount factor and the gain from deviating from the cartel. According to judicial practice, a proportional discriminatory fine schedule is defined as one that exactly captures the marginal differences in per period profits.³ We find that the minimum fine schedule we derive can be either steeper in the size of the overcharge (i.e., overproportional discriminatory) or flatter (i.e., underproportional discriminatory) than the proportional fine as it is defined from judicial practice.

Firms fix prices if (i) it is profitable compared to a competitive outcome (participation constraint) and (ii) there is no incentive for any cartel member to deviate from the collusive arrangement (incentive constraint). Let us for the moment assume that the participation constraint is binding for a particular cartel, i.e., that this cartel is just indifferent between forming and not. If the probability of being detected is sufficiently low, we show that the additional fine for an infinitesimal more harmful cartel must be larger than the additional per period profits for this cartel. If the detection probability is low the more harmful cartel will take only to a limited extent into account the additional fine they must pay if they are detected. The addition in the fine must therefore be larger than the additional per period profits to deter a more harmful cartel, *i.e.*, the fine must be overproportional discriminatory

³This follows from a straight forward interpretation of the judicial requirement of proportionality. It is in line with the interpretation made in Smith, Vaughan and Formby (1987), where they ask a similar question as we do but the approach is quite different. In particular, they do not consider asymmetries between cartels as is the heart of our analysis. Admittedly, as noted in Connor (2006) it can be questioned whether there is any proportionality at all in fine practice in many jurisdictions. If so, actual fine policy can be even more in conflict with the minimum fine schedule. We comment on this later on.

to achieve cartel deterrence. Private enforcement can be helpful when the participation constraint is binding, since compensation paid to customers can be discriminatory as well and thereby help deterring the most harmful cartels.

We observe that leniency programs have led many cartel members to deviate from the cartel and to report, which suggests that the incentive constraint is binding for these cartels. Assume for the moment that the incentive constraint is binding for a particular cartel, i.e., that the members of this cartel is just indifferent between deviating and not. If the detection probability is low, we show that cartel desistence also calls for a fine that is overproportional discriminatory. However, besides the probability of detection other factors will also influence the addition in the fine for an infinitesimal more harmful cartel. The number of firms in the cartel, the gains from deviating as well as the discount factor will also influence the optimal fine schedule. Further, we show that a discriminatory leniency fine can be detrimental to deterring the worst cartels, because higher leniency fines for more harmful cartels may imply that the members of the more harmful cartels are more reluctant to deviate and report. Finally, we show that private enforcement has a distinct different effect on the optimal fine schedule when the incentive constraint is binding rather than the participation constraint. Under the presence of private litigation, a firm that deviate and report the cartel to the competition authority knows that it will with certainty pay damage to the customers. If the firm sticks to the cartel on the other hand, there is a probability less than one for paying damage to consumers, and discriminatory damages to consumers can therefore undermine a discriminatory fine.

We find that if the fine schedule we derive is enforced, potential cartels with a limited harm are typically deterred by the participation constraint while potential cartels with a large harm are typically deterred by the incentive constraint. The intuition is quite obvious. Potential cartels that are able to have a large overcharge are typically profitable to form, but their main problem is to avoid cartel breakdown (incentive constraint). On the other hand, the main problem for cartels with a low overcharge is to make them

profitable to form given that they then would risk being detected and fined. This has important implications for cartel policy. For example, more private litigation - all else equal - can make the potential cartels with limited harm less profitable but at the same time make the potential cartels with large harm more stable. It illustrates that any fine policy revision that is general for all industries must take into account that it might destabilize cartels in some industries while at the same time stabilizing cartels in other industries.

Studies aiming at estimating the probability of cartel detection find this to be very low, suggesting that the annual probability might be less than 15%. This supports our prediction that fines should not only be discriminatory, but overproportional discriminatory, might be relevant. Unfortunately, actual fines are not in line with such a prediction. On the contrary, actual fines are seemingly not even discriminatory along the lines we propose in several jurisdictions. In the US, for example, the guidelines for setting fines does not require that the actual gain or losses from a cartel is determined but recommend to set the fine as a percentage of the volume of commerce. In EU, the upper limit on the fines will - if it binds - make it difficult to deter the worst cartels.

In theory, one could argue that the size of the overcharge has an impact on the probability of detection. We show that if the size of the overcharge has a sufficiently large and positive impact on the probability of detection, the minimum fine schedule would be such that cartels with a high overcharge should face a lower fine than cartels with a low overcharge. We show that this is more likely if the probability of detection is either very low or very high, which illustrates that there can be a non-monotonic relationship between the probability of detection and the minimum fine schedule. In reality, though, it is difficult for the competition authorities to focus on the potential cartels with the highest overcharges simply because they are difficult to observe. Due to this, in the main part of our analysis we assume that the overcharge has no effect on the probability of detection.

The article is organized as follows. In the next section we introduce our model

and the rules of the game. In Section 3 we analyze the optimal fine schedule in the presence of heterogeneous cartels, given that either the participation or the incentive constraint is binding. In Section 4 we confront the predictions from our model with the actual policy for fines for cartels in the US and EU. Finally, we offer some concluding remarks in Section 5.

2 The model

Let us assume that there is a population of Y potential cartels. We interpret this as if there are Y different markets, and in each market there is a potential for a cartel to be formed. In the absence of antitrust policy, we assume that cartels are formed in all these markets. There can be various reasons for different cartels to have different effects on welfare. One way to interpret this could be that all Y markets are identical, except for the price elasticity of demand. If a market is cartelized, the price increase is higher the lower the price elasticity is.

A cartel that raises prices substantially are typically more profitable than a cartel that chooses only a modest price increase. In order to simplify our framework we let the Y different markets be characterized by how much the cartel is able to raise the price relative to the competitive price in this market. It implies that each market is characterized by the cartel overcharge $k = (p^C - p^N)/p^N$, where p^C is the cartel price and p^N is the non-collusive price under competition. We assume that the overcharge is not affected by the fine.⁴

⁴This is an assumption made in several other studies of fine policy towards cartels, see for example Cyrenne (1999), Motta and Polo (2003) and Rey (2003). As shown in Block, Nold and Sidak (1981), the fine will not have any effect on the optimal cartel price if the probability of detection is independent of the overcharge. This is the assumption we use in the main part of our analysis. We also investigate the case where the probability of detection is influenced by the overcharge. In such a setting it has been shown that the optimal cartel price is decreasing in the fine and decreasing over time, see for example Harrington (2001). As already mentioned, there is no empirical evidence supporting such a cartel price profile. This raises the question whether it is plausible to assume that the cartel overcharge is influenced by the fine. Moreover, joint profit maximization might not

We assume that there is an active antitrust policy, where competition authorities (CA) detect cartels and give fines (or leniency) to detected or reported cartels. Let p denote the probability of detection.⁵ At the outset we assume that $p = p(k)$, *i.e.* the cartel overcharge can have an impact on the probability of detection. However, in the main part of our analysis we assume that the cartel overcharge has no impact on the probability of detection.

Let F denote the fine for a detected cartel member and L the fine for the cartel member if leniency is admitted. We assume that $F > L \geq 0$. Finally, we allow for private litigation where a party that has suffered a damage from the cartelization can ask for a compensation. If the cartel is detected or it reports to CA, we assume that private litigation leads to a payment S .

Let us consider a game with the following sequence of moves:

Stage 1 CA sets fines (F and L).

Stage 2 Firms decide to form cartels or not, or to apply for leniency.

Stage 3 CA detects cartels, gives fines and/or leniency, and firms pay fines F or L and compensation S .

At stage 3 cartels are detected and fined, and those that report to CA (leniency) are given a lower or zero fine. We assume that detected cartels are randomly drawn from the population of cartels. At stage 3 there is then a probability p for a cartel being detected, where the probability may depend on the cartel overcharge. If detected, it must pay a fine. We allow the fine to depend on the cartel overcharge, *i.e.*, $F(k)$. Those who apply for leniency pay a lower fine, and we allow for the possibility that the fine under leniency depend of the cartel overcharge by letting $L(k) = \lambda F(k)$, $0 \leq \lambda < 1$. Furthermore, we assume that the amount paid in private litigation may also

be reasonable if firms are asymmetric and transfers are not allowed. The cartel members would then disagree on what would be the optimal cartel price. Due to this, we assume that there are other factors than the fine that determines the cartel overcharge.

⁵Obviously, the probability of detection can be increased by a more active policy (higher activity level) by antitrust authority. In this article we focus on the optimal use of fines, and we leave the issue concerning an optimal activity level for future research.

depend on k . The profit of each firm when they all stick to collusion with overcharge k is given by $\pi^C = \alpha(k)\pi_N$ where $\alpha(k) > 1$ ($\alpha(k) \rightarrow \infty$ when $\pi_N \rightarrow 0$). π^N is the profit per firm when all firms chose the non-cooperative Nash strategy. If all other firms are colluding, the profit a firm earns by deviating is $\beta\alpha(k)\pi_N$, where $\beta > 1$. We simplify the notation by dropping subscript N . If we for instance assume that the cartel is able to coordinate on a price that maximizes joint profit (monopoly price), then $k \in [\underline{k}, \bar{k}]$, where \underline{k} is the cartel overcharge when the competitive price is high, for instance due to products being differentiated, and \bar{k} is the cartel overcharge when the competitive price approaches marginal cost.

At stage 2 the firms decide to form cartels, or deviate from a cartel. We assume that a firm deviating will also report to CA and thereby apply for leniency. This implies that we rule out deviation followed by no reporting to CA. Deviations with reporting is a more profitable strategy than deviating and not reporting if the sum of L and S is sufficiently low.

At stage 1 the fines are set. Obviously, all cartels can be deterred if the fine is set so high that even the worst cartel is deterred. But such a fine policy would imply that in most industries the fine is excessively high compared to what is needed in order to deter cartels from being formed and sustained. We are concerned about how fines can be set in a discriminatory way that marginally deter all cartels.

3 Cartel Stability

As explained in Buccirosi and Spagnolo (2007) and Spagnolo (2006), a cartel is sustainable only if the (i) participation constraint and (ii) the incentive constraint is met. This means that we have to check how both constraints are affected by F and L in order to be able to investigate how fines set by CA influence how many and which cartels that are formed and sustained. We first discuss each of those two constraints (Section 3.1 and 3.2), and then we make a comparison (Section 3.3).

3.1 Participation constraint: Cartel deterrence

The participation constraint for a cartel, *i.e.*, for all cartel members, is met if the expected profit from forming a cartel is positive. Let us assume that detection leads to competition in the period the cartel is detected and in all future periods.

The discounted net present value for the firms of forming a cartel with overcharge k is:

$$V^C(k) = (1 - p(k))[\alpha\pi + \delta V^C(k)] + p(k)\left[\frac{\pi}{1 - \delta} - F(k) - S\right] \quad (1)$$

where δ is the discount factor for the cartel members. Solving with respect to $V^C(k)$, we have the discounted net present value for the firms of forming a cartel:

$$V^C(k) = \frac{(1 - p(k))\alpha\pi + p(k)\left(\frac{\pi}{1 - \delta} - F(k) - S\right)}{1 - \delta(1 - p(k))} \quad (2)$$

Comparing with the net present value if a cartel is not formed we find that a cartel is profitable if

$$V^C(k) > \frac{\pi}{1 - \delta} \quad (3)$$

Solving for $F(k)$ in the participation constraint in (3) gives the fine that is necessary in order to deter a cartel with overcharge k :

$$F \geq \frac{1 - p(k)}{p(k)}(\alpha(k) - 1)\pi - S \quad (4)$$

We assume that there exists a marginal cartel, *i.e.*, a cartel that is indifferent between forming or not. We define the marginal cartel as k^{PC} . The participation constraint is then binding for $k^{PC} \in [0, \bar{k}]$ and the fine that just deter the cartel is:

$$F_{PC} = \frac{1 - p(k^{PC})}{p(k^{PC})}(\alpha(k^{PC}) - 1)\pi - S. \quad (5)$$

We see that the cartel overcharge k will influence both the probability of

detection and the profits from colluding. A marginal change in the overcharge has then the following effect:

$$\frac{\partial F_{PC}}{\partial k} = \frac{1-p}{p} \frac{\partial \alpha}{\partial k} \pi - \frac{(\alpha-1)}{p^2} \frac{\partial p}{\partial k} \pi$$

There are two opposing effects on the fine from a marginal change in the overcharge. First, a cartel will be more profitable. This is the first term, suggesting that the fine should be increasing in k . Second, a higher cartel overcharge will lead to a higher probability for detection. This is the second term, and suggests that the fine should be decreasing in k .

Let us define a discriminatory fine as one that is increasing in k . It will imply that the fine is higher for cartels with higher overcharges.

We can then easily show the following result:

Proposition 1 *Let us assume that the incentive constraint for each cartel member is met and non-binding. If*

$$\frac{(1-p)p}{\alpha-1} > \frac{\frac{\partial p}{\partial k}}{\frac{\partial \alpha}{\partial k}}$$

then

$$\frac{\partial F^{PC}}{\partial k} > 0.$$

We see from the Proposition above that the larger effect an increase in the overcharge has on per-period cartel profit and the more limited effect it has on the detection probability, the more likely is it that the fine has to be discriminatory in order to deter a cartel with an infinitesimal larger overcharge as long as $p \neq 0$ and $p \neq 1$. The term $p'(k)/\alpha'(k)$ approaches zero when $p'(k) \rightarrow 0$ and/or $\alpha'(k) \rightarrow 1$. This is exactly what we expect.

More surprisingly, we see that if the per-period profits with cartel relative to the per-period profits in the non-collusive outcome is large, the less likely is it that the fine has to be discriminatory. The intuition is that this difference

in profits is of relevance through the effect on the probability of detection as well. The higher the profit difference, the larger the change in expected present value from an increase in k and thereby an increase in p .

Interestingly, we also see from the proposition that the absolute probability of detection has a non-monotonic effect on the fine. To see this, notice that for extreme values of p it will be less likely that the fine has to be discriminatory. When the probability of detection approaches one, all cartels will be deterred by an infinitesimal small fine and there is no need for a discriminatory fine. When the probability of detecting approaches zero, there is no need for a discriminatory fine neither.

The absolute probability of detection influence the effect of a change in k on cartel formation through the change in cartel profit and also through the change in the probability of detection. The lower is the probability of detection, the larger are each of these two effects. In the extreme, when $p \rightarrow 0$ the effects cancel each other out. When the probability of detection is very high, on the other hand, the latter effect dominates since the profit gain from cartel formation becomes irrelevant if it is almost certain that it will be detected. However, as long as there is a strictly positive gain ($\alpha > 0$) an infinitesimal change in k will result in a strict increase in the probability of detection. Potential cartels with a higher overcharge will have larger probability of detection, and they therefore decides not to form. Therefore, if p is very large the fine will actually be decreasing in the cartel overcharge.

In reality, it can be difficult to reveal a priori which cartels are the ones with the highest overcharge. Although prices are observed, it is difficult to observe marginal costs and thus to conclude on which industries have the highest potential overcharge. Obviously, competition authorities can monitor some industries more intense than other industries and thereby ensure that the probability of detection is higher in some industries than others. For example, in many countries the building and construction industry is monitored more than other industries, simply because we have observed many cartels historically in this industry. But this does not necessarily imply that

the industries with the highest potential overcharge are the ones that have the highest probability of detection.

If not otherwise stated, we now assume that detection probability is identical for all industries. We have the following result:

Proposition 2 *Let us assume that the incentive constraint for each cartel member is met and non-binding and that the members of the cartel with overcharge k^{PC} is indifferent between forming or not. If*

$$\frac{\partial F}{\partial k} > \frac{1-p}{p} \left(\frac{\partial \alpha}{\partial k} \right) \pi \quad \forall k \in (0, \bar{k})$$

then all potential cartels $k \in (0, k^{PC})$ are formed while all potential cartels $k \in [k^{PC}, \bar{k})$ are deterred (not formed).

Proof: Follows straightforwardly by differentiating (5) with respect to k , noting that this describes the increase in the fine that just deter a cartel with a marginally larger overcharge than k^{PC} . *Q.E.D.*

In the case shown in Proposition 2, cartels with the highest negative impact on welfare are deterred while cartels with the lowest negative impact on welfare are formed. We see that this is true if the fine is able to capture the additional expected profits associated with a more successful cartel (and thereby a more welfare deteriorating cartel), *i.e.*, when $\partial F/\partial k$ is sufficiently large.

3.1.1 A discriminatory fine

Let us for the moment assume that there is no private litigation ($S = 0$). Rearranging the expression in Proposition 2 we have that the worst cartels are deterred if

$$p > \frac{\frac{\partial \alpha}{\partial k} \pi}{\frac{\partial \alpha}{\partial k} \pi + \frac{\partial F}{\partial k}}. \quad (6)$$

If the fine is not discriminatory at all ($\partial F/\partial k = 0$) it is evident from (6) that the cartels that are more harmful than the marginal one are not deterred even if the probability of detection approaches one. The reason is that the cartels most harmful to welfare are the most profitable ones, and as long as one cannot discriminate the fine it is not possible to deter those worst cartels from being formed.

Let us assume that the fine is discriminatory, so that it can capture at least some of the gain associated with a more profitable cartel. If the additional fine for a cartel with a larger negative impact is larger than the additional per period profits ($\frac{\partial F}{\partial k} > \frac{\partial \pi_C}{\partial k} = \frac{\partial \alpha}{\partial k} \pi$), we define this as an overproportional discriminatory fine.⁶

It follows straightforwardly from (3.1):

Corollary 1 *If $p < \frac{1}{2}$ and S is independent of k , and the cartel with overcharge k^{PC} is marginally deterred, the fine must be overproportional discriminatory ($\frac{\partial F}{\partial k} > \frac{\partial \pi_C}{\partial k}$) to deter cartels with overcharge above k^{PC} as well.*

Corollary 1 shows that if a discriminatory fine captures exactly the additional per period profit due to a larger cartel overcharge so that $\frac{\partial F(k)}{\partial k} = \frac{\partial \pi_C(k)}{\partial k}$ and a particular cartel is marginally deterred, the fine schedule will not be able to deter cartels with a larger harm if the probability of being detected is less than a half. In such a case an overproportional discriminatory fine is needed to deter the worst cartels.

We assume that the firms anticipate the probability of being detected if they form a cartel. This implies that the probability for being detected is of importance for the design of the fine schedule. If the probability of detection is low, then only a small fraction of the increase in the fine will be taken into account by the firms. In this case the increase in fine for a cartel with a larger negative impact on welfare must be larger than the increase in per period profits.

⁶This is identical to the definition of proportionality in Smith et al. (1987).

To understand this, let us assume that the fine is set such that the cartel with the lowest negative impact on welfare is indifferent between forming a cartel and not. To ensure that a cartel that has a larger negative impact on welfare is indifferent as well, the fine must of course be higher than for the cartel with the lowest negative impact on welfare. What we have shown is that if the probability of being detected is sufficiently low, it is not sufficient to increase the fine by the difference in per period profits for the two potential cartels, but that the increase in the fine must overcompensate for the difference in per period profits. In the design of the fine schedule it is necessary to take into account the fact that cartels anticipate the low probability of being detected. A higher fine for cartels with a larger negative impact on welfare is needed to deter it, and in this case the additional fine is larger than the difference in per period profits for those two cartels.

3.1.2 Private litigation

Finally, let us consider the effect of private litigation on the participation constraint. It can easily be seen that F can be reduced due to the threat of private litigation, since $\partial F_{PC} / \partial S < 0$.

If we, instead of assuming that S is fixed assume that $S(k) = \sigma(\alpha(k) - 1)\pi$, i.e., that cartel members costs with private litigations is given by a fraction $0 \leq \sigma \leq 1$ of the cartel's profit increase from the collusive agreement.

The critical fine making cartel formation just unprofitable changes to

$$F_{PC}^S = \frac{1 - p(1 + \sigma)}{p} (\alpha(k) - 1) \pi$$

and we can confirm that $\partial F_{PC} / \partial \sigma < 0$.

Given that the question is whether it is profitable to form a cartel or not, private litigation that leads to payments to customers will make it less profitable to form a cartel. This is straight forward, since it simply adds to the fine imposed by CA. Then we have the following result:

Corollary 2 (i) *The fine that marginally deters a cartel with overcharge k decreases when private litigation cost increases, and (ii) the optimal fine is overproportional discriminatory if $p < \frac{1}{2+\sigma}$ when $S(k) = \sigma(\alpha - 1)\pi$.*

When we compare Corollary 2 part (ii) with Corollary 1, we see that it is less likely that the fine must be overproportional discriminatory when there is private litigation. As long as private litigation captures a fraction σ of the additional profits for a more harmful cartel, the fine can be correspondingly less discriminatory. However, as we will see, if the incentive constraint is binding both results in Corollary 2 are reversed.

3.2 Incentive constraint: Cartel desistence

Let us now consider the incentive constraint. If there is a leniency program, this implies that a firm may find it individually rational to defect and inform CA about the cartel. If a firm deviates, it increases the profit relative to the collusive profit $\pi_C = \alpha\pi$ by a factor $\beta > 1$, capturing $\beta\alpha\pi$ in the period it deviates. β can also be interpreted as a parameter capturing the number of firms, since a larger number of firms will imply that the gain from deviating is increased.

Every firm that reports the cartel to CA is eligible for leniency under which they pay a fine L , $0 \leq L < F(k)$.

If a firm deviates and does not report, the drop in prices can lead to an investigation by the antitrust authorities. If so, a deviation followed by no report will result in a higher probability of detection than before the deviation. Let us define γ as the increase in the probability of cartel detection that follows if one or more firms deviates from the collusive price setting, *i.e.*, $0 \leq \gamma < 1$, and $p + \gamma < 1$. Given that a firm deviates, the strategy of deviating and reporting will dominate the strategy of deviating and not reporting if

$$\begin{aligned} \beta\alpha(k)\pi - L - S + \frac{\delta}{1-\delta}\pi &> \beta\alpha(k)\pi - (p + \gamma)(F(k) + S) + \frac{\delta}{1-\delta}\pi \\ L &< (p + \gamma)F(k) - (1 - p - \gamma)S \end{aligned} \quad (7)$$

From condition (7) above it is immediate that self-reporting to the CA is more likely the more generous the leniency program is, and the larger the probability of CA detecting the cartel without any member providing information about its existence. Further, if the fine is discriminatory, *i.e.*, when $\partial F/\partial k > 0$, the worst cartels are the ones that are most likely to self-report, and every firm that deviates will also report under full leniency ($L = 0$) if it does not risk private litigation costs. Private litigation, on the other hand, may destroy the members' incentives to self-report. To see this, notice that if a member of a cartel with overcharge \tilde{k} is indifferent between reporting and not under full leniency (7) is just met for the cartel \tilde{k} :

$$(p + \gamma)F(\tilde{k}) - (1 - p - \gamma)S(\tilde{k}) = 0 \quad (8)$$

The cartel $\tilde{k} + \varepsilon$ will report only if $\partial S/\partial k \leq \frac{p+\gamma}{1-p-\gamma} \partial F/\partial k$. If $p + \gamma < \frac{1}{2}$ then $F(k)$ must be steeper than $S(k)$ for this condition to be met. Hence, discriminatory private enforcement may destroy the incentive to report for the worst cartels.

Deviate and report is the most profitable strategy if the firm deviates given that L is sufficiently low and/or γ is sufficiently high. We will assume that this is the case throughout the analysis. The strategy “deviate and report” will of course always dominate the strategy “collude and report”. Hence, given that the restriction in (7) is met, the two strategies we are comparing are “always collude” and “deviate and report”. The incentive constraint gives the following restriction on the fine

$$\frac{(1-p)\alpha(k)\pi + p\left(\frac{\pi}{1-\delta} - F - S\right)}{1-\delta(1-p)} < \beta\alpha(k)\pi - L - S + \frac{\delta}{1-\delta}\pi \quad (9)$$

Let us assume that there exists a marginal cartel, *i.e.*, a cartel that is indifferent between collusion and deviation. We define this marginal cartel by $k^{IC} \in (0, \bar{k})$. Knowing that the incentive constraint is binding for k^{IC} the fine that just desists this cartel is

$$F_{IC} = \frac{((1-p)(1+\delta\beta) - \beta)\alpha + (p - \delta(1-p))}{p}\pi + \frac{1 - \delta(1-p)}{p}L + \frac{(1-\delta)(1-p)}{p}S \quad (10)$$

Let us now return to the case where the cartel overcharge can influence the probability of detection, *i.e.*, $p(k)$. We assume for the moment that $L = S = 0$. A marginal change in the overcharge has then the following effect:

$$\frac{\partial F_{IC}}{\partial k} = \frac{(1-p)(1+\delta\beta) - \beta}{p} \frac{\partial \alpha}{\partial k} \pi - \frac{(1 - \beta(\delta - 1))\alpha - \delta}{p^2} \frac{\partial p}{\partial k} \pi$$

As is the case with the participation constraint, an increase in k will trigger two opposing forces. We have the following result:

Proposition 3 *Let us assume that the participation constraint for each cartel member is met and non-binding. If*

$$\frac{[(1-p)(1-\delta\beta) - \beta]p}{[1 - \beta(\delta - 1)]\alpha - \delta} > \frac{\frac{\partial p}{\partial k}}{\frac{\partial \alpha}{\partial k}}$$

then

$$\frac{\partial F^{IC}}{\partial k} > 0.$$

We see that the probability of detection and the profit increase per period from cartelizing have the same qualitative effects as when the participation constraint is binding (see Proposition 1). In addition, we see that the parameters β and δ also influence the relationship between the cartel overcharge and the minimum fine.

As argued earlier, it can be difficult for the competition authorities to detect which cartels have the highest price-cost margin. Let us therefore from now on unless otherwise stated assume that the overcharge has no effect on the probability of detection. We then have the following result:

Proposition 4 *Let us assume that the participation constraint is strictly non-binding for all $k \in [k^{IC}, \bar{k})$, that L and S are independent of k , and that the cartel with overcharge k^{IC} is indifferent between deviating and not. If*

$$\frac{\partial F}{\partial k} > \frac{(1-p)(1+\delta\beta) - \beta}{p} \left(\frac{\partial \alpha}{\partial k} \right) \pi \quad \forall k \in (0, \bar{k}) \quad (11)$$

then all cartels $k \in [k^{IC}, \bar{k})$ are desisted while all cartels $k \in (0, k^{IC})$ are sustained.

Not surprisingly, we see from Proposition 4 that the worst cartel can be deterred if the increase in fine is everywhere sufficient large for cartels with infinitesimal larger overcharge ($\partial F/\partial k$ is sufficiently large). This is similar to what we found when we checked the participation constraint (see Proposition 2). However, as we will show later the fine schedule differs from the fine schedule we derived when the participation constraint was binding.

3.2.1 Full leniency

Let us for the moment assume that $L = S = 0$. From Proposition 4 it can easily be verified that:

Corollary 3 *Let us assume full leniency ($L = 0$) and no private litigation ($S = 0$).*

(i) *An overproportional discriminatory fine is needed if*

$$p < 1 - \frac{1 + \beta}{2 + \delta\beta} \equiv p^{FL} \quad (12)$$

(ii) *The scope for an overproportional discriminatory fine is*

- *increasing in the discount factor* $\left(\frac{\partial p^{FL}}{\partial \delta} > 0 \right)$
- *decreasing in the gain from deviating* $\left(\frac{\partial p^{FL}}{\partial \beta} < 0 \right)$.

We see from Corollary 3, in line with the results from Proposition 4, that an overproportional discriminatory fine is necessary for deterring the worst cartels if the probability of being detected is sufficiently low. Furthermore, it can be shown that overproportionality is more likely for larger values of the discount factor (δ) and the smaller the gain is from deviating (β). None of these two parameters had any influence on the fine when the participation constraint determined the fine schedule.

As we explained above, a low probability for detection will imply that the expected value of a fine associated with detection is low as well. In this case overcompensation is needed to deter the most harmful cartels. The higher the discount factor (measured by δ), the more likely is the firm to continue with cartel behavior rather than reporting, and the need for an overproportional discriminatory fine is larger the higher the discount factor.

We also see that the lower the gain from deviating (measured by β), the larger is the need for overcompensation. The reason is that a smaller β will scale down the gain from deviating and everything else equal make it less tempting to deviate. To ensure that firms decides to deviate from the cartel the increase in the fine must be correspondingly larger. Note that one interpretation of a high β is that the number of firms is large. All else equal, a larger number of firms will make it less likely that an overproportional discriminatory fine is needed.

3.2.2 Partial leniency

Let us keep holding onto the assumption that $S = 0$, but assume that firms are eligible only to some leniency. In particular, assume that firms reporting the cartel to the competition authorities instead of paying F pay a reduced fine $L = \lambda F$. Obviously, this tends to make it less likely that the members of the worst cartels deviates and reports to CA. This time, given that a firm deviates, the strategy of deviating and reporting will dominate the strategy

of deviating and not reporting if

$$\lambda < p + \gamma$$

Assume that the incentive constraint is binding for some interior value $k_{IC}^L \in (0, \bar{k})$. By substituting for $L = \lambda F$ into (10) we find the fine that just desist this cartel is

$$F_{IC}^L = \frac{((1-p)(1+\delta\beta) - \beta)\alpha(k) + (p - \delta(1-p))\pi}{p - \lambda(1 - \delta(1-p))} \quad (13)$$

In order to (weakly) desist all cartels above k_{IC}^L as well, the fine must change with the cartel overcharge, *i.e.*,

$$\frac{\partial F}{\partial k} \geq \frac{(1-p)(1+\delta\beta) - \beta}{p - \lambda(1 - \delta(1-p))} \left(\frac{\partial \alpha(k)}{\partial k} \right) \pi \quad (14)$$

It is now easy to derive the following result:

Corollary 4 *If (i) $L < F$, an increase in the leniency fine must be more than compensated by an increase in the fine F . If (ii) $L = \lambda F$ and $0 < \lambda < 1$,*

- an overproportional discriminatory fine is needed if

$$p < 1 - \frac{1 + \beta - \lambda}{2 + \delta(\beta - \lambda)} \equiv p^{PL}, \text{ and} \quad (15)$$

- a higher leniency fine relative to the fine F (an increase in λ) will lead to a larger scope for an overproportional discriminatory fine ($\frac{\partial p^{PL}}{\partial \lambda} > 0$).

Part (i) can easily be verified by observing that $\partial F_{IC}/\partial L > 1$ in (10) since $[1 - \delta(1-p)]/p > 1$. It implies that if the leniency fine is increased with an amount X , then the ordinary fine must increase with more than X to ensure that a member of cartel that is at the outset indifferent between deviating

and not is indifferent also after the increase in L and F . The reason is that the leniency fine must be paid with certainty if they deviate and report, while there is a probability less than one that the cartel will be detected and fined if it continues to operate. A low discount factor means that a cartel member places less weight on future profit and is more tempted to deviate in any case. Hence, the lower is δ the lower is the likelihood that the fine has to be overproportional. Similarly, a higher β scales up the one-period gain from deviating and a cartel member is more tempted to deviate in any case. Moreover, we see from (ii) that the larger the leniency fine relative to the ordinary fine the larger is the scope for an overproportional discriminatory fine F .

The result in Corollary 4 is a strong argument against using a discriminatory leniency fine, but instead set a fixed leniency fine for all firms that report. In theory one should use a negative discriminatory leniency fine, where member of cartels with a large negative impact on welfare should pay a lower leniency fine than firms with a more modest negative impact on welfare.

3.2.3 Private litigation

Finally, let us consider the case where a cartel that is detected or a firm that apply for leniency risks private litigation, amounting to $S(k)$. Given this risk, private litigation would be an expected cost for the firm both if it sticks to the cartel agreement and if it reports. To simplify, let us assume that $L = 0$ but that a detected cartel, either detected by the competition authority or by one or more members that self-report, risks private litigation.

Assume that the incentive constraint is binding for some interior value $k_{IC}^S \in (\underline{k}, \bar{k})$. By substituting for $S = \sigma(\alpha - 1)\pi$ into (10) we find the fine that just desist this cartel as

$$F_{IC}^S = \frac{((1-p)(1+\delta\beta + \sigma(1-\delta)) - \beta)\alpha(k) + (p - (\delta + \sigma(1-\delta))(1-p))}{p}\pi$$

In order to weakly desist all cartels above k_{IC}^S as well, the fine must increase with the cartel overcharge

$$\frac{\partial F}{\partial k} \geq \frac{((1-p)(1+\delta\beta + \sigma(1-\delta)) - \beta)}{p} \left(\frac{\partial \alpha}{\partial k} \right) \pi$$

The following can easily be verified:

Corollary 5 (i) $\frac{\partial F_{IC}^S}{\partial \sigma} > 0$. And if (ii) $p < \frac{1-\delta}{2-\delta}$, then an increase in the private litigation as a fraction of the damage (increase in σ) must be compensated by an increase in the fine F that exceeds the per period increase in profit from colluding $((\alpha - 1)\pi)$.

Proof: Concerning (i), it can easily be verified that $\partial F_{IC}/\partial \sigma > 0$ in (10) when $\partial S/\partial \sigma = (\alpha - 1)\pi$ since $(1 - \delta)(1 - p)/p > 0$. Concerning (ii), it is easy to verify that $\partial F_{IC}^S/\partial \sigma > (\alpha - 1)\pi$ if $p < \frac{1-\delta}{2-\delta}$.

While deviation will with certainty lead to a private litigation, there is a probability less than one for detection and subsequent private litigation if the cartels continue to operate. This implies that the larger the expected payment due to private litigation, the higher is the fine that is needed in order to destabilize the cartel. If the probability of detection is sufficiently low, the increase in the fine for a more harmful cartel must exceed the increase in the private litigation costs.

3.3 Participation versus incentive constraint

Let us now assume that the fine schedule enforced has the characteristics as described above. All cartels are marginally deterred, and in each industry either the incentive constraint or the participation constraint binds. Let us check carefully the interaction between those two constraints. We define the following:

V^C = Present value of a cartel

V^N = Present value of competition

V^D = Present value of deviation from cartel and competition in all future periods

We know from the analysis that:

- $V^C > V^N$: Participation constraint binds
- $V^C > V^D$: Incentive constraint binds

In the previous sections we have solved for the lowest fine that will ensure that the participation constraint and the incentive constraint is binding, respectively. Since $\partial V^C / \partial F < 0$ and $\partial V^N / \partial F = \partial V^D / \partial F = 0$, the fine F should be increased until either $V^C < V^N$ or $V^C < V^D$. This implies that the participation constraint (incentive constraint) is the binding constraint if $V^N > V^D$ (if $V^N < V^D$). We can use the expressions for V^N and V^D as defined in the previous sections. However, let us assume that there are some non-pecuniary costs C associated with being caught for involvement in cartel activities. For example, there might be some norms saying that price fixing is an unlawful action and thereby an action that is detrimental to the welfare for the persons making those decisions. Then we have that $V^N > V^D$ if

$$\frac{\pi_N}{1-\delta} > \beta\pi_C - L - S - C + \left(\frac{\pi_N}{1-\delta}\right)\delta$$

We see that if L , S or C are sufficiently high, the participation constraint is the binding constraint. In such a case an existing cartel will be punished quite fiercely by reporting and thus the fine must be rather high to give the existing cartel members incentives to deviate and report.

Furthermore, let us check the slopes of the fine schedule when the incentive and the participation constraints, respectively, are binding. In Propositions 1 and 3 we have defined the slopes of those minimum fine schedules, and we can from that information define the following parameters

$$\begin{aligned}
A &= \frac{1-p}{p} \\
B &= \frac{(\alpha-1)}{p^2} \\
C &= \frac{(1-p)(1+\delta\beta) - \beta}{p} \\
D &= \frac{(1-\beta(\delta-1))\alpha - \delta}{p^2}
\end{aligned}$$

The following condition tell us whether the minimum fine schedule as determined by the incentive constraint has a lower slope than the fine schedule as determined by the participation constraint:

$$\frac{dF_{IC}}{dk} \equiv A \frac{\partial \alpha}{\partial k} - B \frac{\partial p}{\partial k} < C \frac{\partial \alpha}{\partial k} - D \frac{\partial p}{\partial k} \equiv \frac{dF_{PC}}{dk}$$

Rearranging, we have that the F_{IC} fine schedule is flatter than the F_{PC} fine schedule if:

$$\frac{p\beta[\delta(p-1)+1]}{(\delta-1)(\alpha\beta+1)} < \frac{p'_k}{\alpha'_k}$$

We see that the lefthand side is negative, while $p'_k \geq 0$ and $\alpha'_k \geq 0$. It implies that the F_{IC} fine schedule is always flatter than the F_{PC} , irrespective of whether the overcharge influences the probability of detection or not.

Let us consider the case where $p'_k = 0$ (k has no effect on p). Then the fine must be discriminatory no matter which constraint is binding. By comparing the two constraints we see, in line with what we have already shown, that the participation constraint leads to a more discriminatory fine than the incentive constraint does. This can easily be seen from the following:

$$\frac{dF_{IC}}{dk} \equiv \frac{(1-p)(1+\beta\delta) - \beta}{p} < \frac{1-p}{p} \equiv \frac{dF_{PC}}{dk}, \quad (16)$$

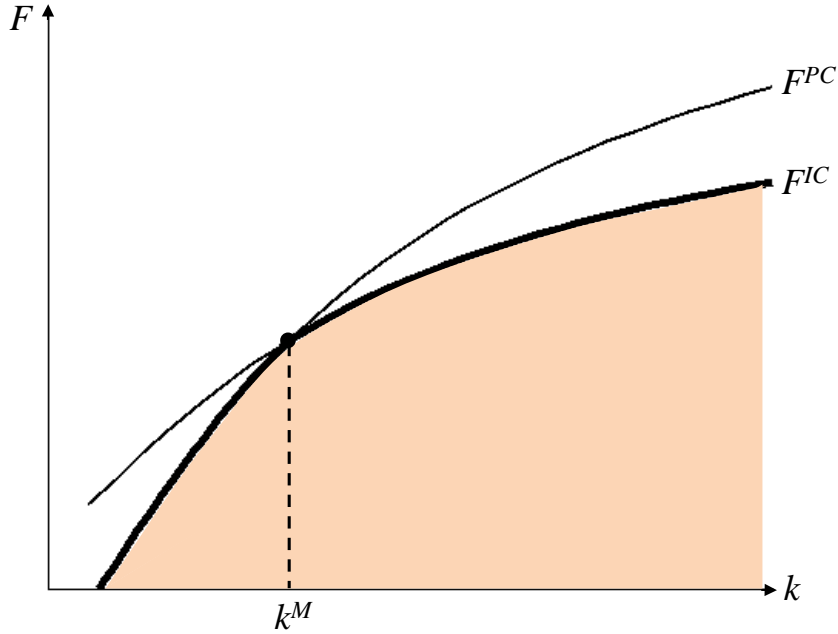


Figure 1: The optimal fines given incentive and participation constraints.

The optimal fine schedule is illustrated in Figure 1, which is everywhere the lowest as determined by the participation constraint and the incentive constraint, respectively. When we assume that the non-pecuniary cost C has an identical effect on all cartels the incentive constraint line F_{IC} is shifted upwards by C .

The solid piece-wise line shows the binding constraint. If any part of the schedule $F(k)$ lies within the shaded area these cartels are neither deterred nor desisted, thus they are formed and stable. We then have the following result:

Proposition 5 *Assume that there exist some level of k such that $F_{IC} = F_{PC}$ for the cartel with overcharge $k^M \in (\underline{k}, \bar{k})$, where k^M is defined by*

$$\alpha(k^M) = \frac{\pi + C + L + S}{\beta\pi}$$

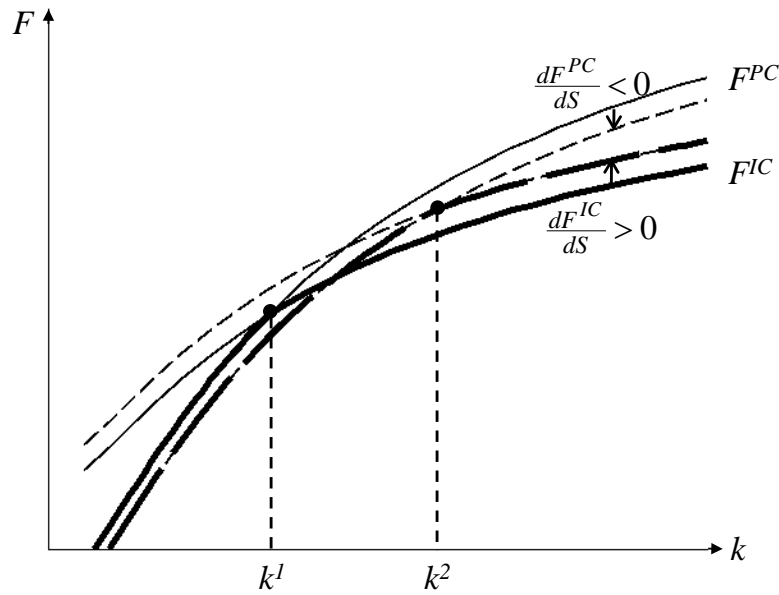
If $F = \min[F_{PC}, F_{IC}] \equiv F^(k)$, then all cartels $k \in [0, k^M)$ are deterred while*

all cartels $k \in [k^M, \bar{k}]$ are desisted.

As shown in Proposition 2 and illustrated in Figure 1, the participation constraint stops cartels with a low potential harm to consumers from forming and the incentive constraint stops cartels with a large potential harm to consumers from sustaining collusion. In both cases the firms' best choice is not to form cartels. Since both constraints bind, although for various industries, a change in the cartel policy can have very different effects in different industries. As shown in the previous sections, private litigation as such will make cartels more sustainable (incentive constraint) but at the same time make cartels less profitable (participation constraint). Table 1 summarizes the comparative statics with respect to changes in the leniency policy and in the private litigation costs under all possible enforcement regimes, i.e., combinations of private litigation and leniency.

Before we proceed it is necessary to set up some criteria for how we can assess the efficiency with respect to policy enforcement in our setting. Since we are not considering policy changes that has any direct costs for the competition authorities, e.g., an increase in p across all industries, or in targeted industries, it is in principle desirable and feasible to fight all potential cartels by designing the rules on how cartels should be fined together with appropriate leniency and private litigation. That is, to apply the policy $F^*(k)$ as defined in Proposition 5. However, due to fear of overdeterrence and the adverse effects of firm failure, policy rules with high fines may be difficult to implement in practice. Hence, searching for efficient enforcement policy amounts to design the mix of the available policy instruments in order to minimize the level of fines and the steepness of $F(k)$. The remaining part of this section discusses the trade-offs in such a policy design.

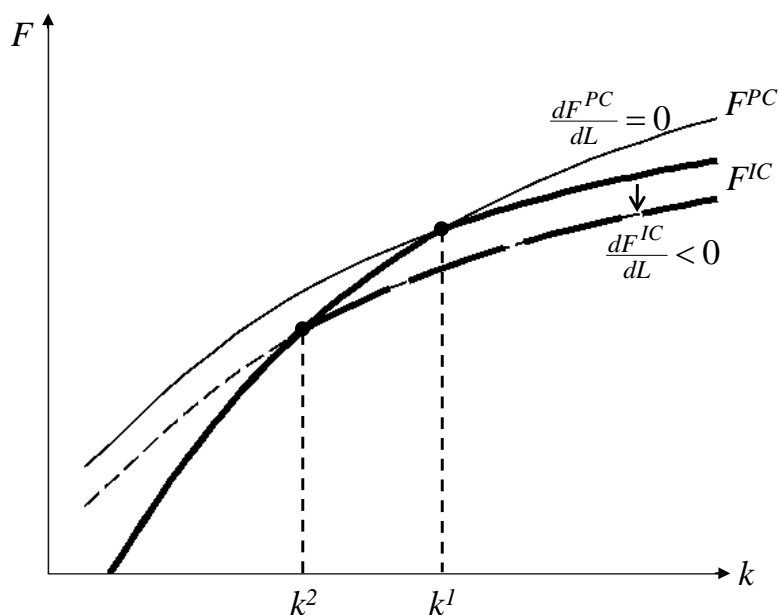
First, let us consider how a change in S affects the optimal schedule $F^*(k)$. If there is no leniency program at all in the CA's enforcement policy, an increase in S will lead to a reduction in F^* by the same amount, i.e., $dF^*/dS = -1$. If private litigation costs depends on cartel overcharge, i.e., $S = \sigma(\alpha - 1)\pi$, the slope of $F^*(k)$ is decreased as well. k^M remains unchanged in both cases. If

Figure 2: The effects of an increase in S .

there is a leniency program in place, the effects of increased private litigation costs are different. Then F_{PC} is shifted downwards, while F_{IC} is shifted upwards, and both $dk^M/dS > 0$ and $dk^M/d\sigma > 0$. Hence, more widespread use of private litigation makes it easier to deter cartels with relatively small overcharge, but more difficult to desist cartels with larger overcharges. The effects of increased private litigation under leniency is illustrated in Figure 2.

We see that if the fines F are not changed, the cartels with a limited damage will still be deterred but the fine will now be excessively high for each of them. For cartels with a large damage, no change in the fines following an increase in the private litigation will imply that more cartels are formed and sustainable.

Corollary 6 *An increase in private litigation, all else equal, would make it less likely that cartels with limited harm to consumers are formed and more likely that cartels with large harm to consumers are formed.*

Figure 3: The effects of a reduction in L .

Next, let us consider how the introduction of or a change in the leniency program affects F^* and k^M . First, notice that leniency has no effect on the participation constraint. Hence, a change in the leniency fine will affect cartels with cartel overcharge $k \in [k^M, \bar{k}]$. The effects are simply that when leniency fines are decreased, F_{IC} is shifted downwards, and the slope of F_{IC} is reduced as well if λ is decreased under partial leniency. The effects of a reduction in L is illustrated in Figure 3.

Corollary 7 *An decrease in the leniency fine, all else equal, will make it less likely that cartels with large harm to consumers are formed while the likelihood that cartels with limited harm to consumers are formed is unaffected.*

Finally, taking as a starting point an initial enforcement policy that deter cartels $k \in [\underline{k}, k^M)$ and desist cartels $k \in (k^M, \bar{k}]$, we ask whether this deterrence/desistence ratio can be sustained at lower levels of $F^*(k)$ by shifting the policy towards a regime with more generous leniency and

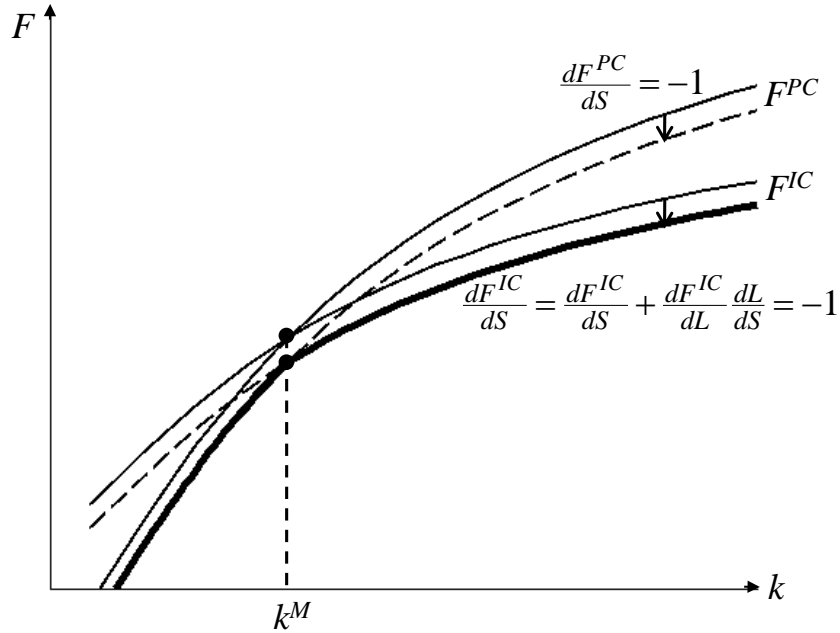


Figure 4: The effects of a k -neutral change $dL = -dS$.

more widespread use of private litigation? If S and L are changed simultaneously, the policy change has a neutral effect on k^M if the change has the form $dL = -dS$. That is, if $dL = -dS$, then dk^M as defined in Proposition 5 is preserved. Differentiating (5) and (10) with respect to L and S , using the above defined k -neutral policy change we find that $dF_{PC}/dS = -1$ and $dF_{IC}/dS = \partial F_{IC}/\partial S + (\partial F_{IC}/\partial L)(dL/dS) = -1$. The effects of the policy change is illustrated in Figure 4.

Corollary 8 *A policy change towards more generous leniency and more widespread use of private enforcement, all else equal, will make it less likely that cartels are formed. When the policy change has reached a point with full leniency to reporting firms, further increase in private litigation costs would make it less likely that cartels with limited harm to consumers are formed and more likely that cartels with large harm to consumers are formed.*

4 Are actual cartel fines discriminatory?

Commentators have criticized the cartel fine policy in both EU and the US, arguing that fines have been too low.⁷ These studies consider the gains from a typical cartel, and compare that with the expected fine they have to pay. They point out, as is clearly present in our model too, that since the probability of detection is rather low the fines should be substantially more than the damages they cause. However, they also point out that the new guidelines in the EU for setting fines will imply that fines will be higher in the future and thereby closer to the fines that deter cartels.⁸

However, our main concern is whether fines are sufficiently discriminatory to deter the worst cartels. We find that for sufficiently low probability of detection the discriminatory fines should even be overproportional to the additional damage of a more harmful cartel. There are not many detailed empirical studies of the probability of detection. Bryant and Eckard (1991) found that the probability for a cartel being detected in one year cannot be higher than 13 - 17%.⁹ If this is true, it suggests that the differences in fines between cartels should be overproportional to the difference in damage they cause. Unfortunately, the present policy in both the US and EU is such that it is an open question whether fines are discriminatory at all.

According to the US guidelines for fines it should be set a base fine level at 20% of affected commerce.¹⁰ This is clearly based on an average cartel overcharge consideration.¹¹ It seems to be a deliberate choice not to try to

⁷See for example Connor and Lande (2006) concerning both EU and the US, and Schinkel (2006), Veljanovski (2007) and OFT (2009) concerning EU.

⁸See, for example, Motta (2007). He makes some simple calculations of whether fines that are set according to the new rules are high enough. Although his calculations suggests that they will still be too low, he points out that his simple calculation cannot capture all relevant factors and therefore he cannot reject the hypothesis that fines will be high enough.

⁹See also Combe, Monnier and Legal (2008). They use data for the EU, and find that the probability for being caught cannot be higher than 13.3% each year.

¹⁰See U.S. Sentencing Guidelines Manual § 2R1.1 (2005).

¹¹It has been a presumption that the average gain from price-fixing is 10% of the selling price. The guidelines doubled that amount to account for harm to consumers that could not buy the product at the higher price. See Connor and Lande (2006) for a discussion of

calculate the actual damage from each cartel:

The purpose of specifying a percent of the volume of commerce is to avoid the time and expense that would be required for the court to determine actual gain or loss.

The base fine level should be adjusted by a number of factors, such as adjusted upwards if bid rigging or other aggravating factors are involved or downward if the firm cooperates with antitrust authority. However, it is hard to see that such adjustments introduce anything that would imply that the fine should depend on the actual damage. This suggests that the fine is not discriminatory at all.

In the EU guidelines for fines, the starting point is that the basic amount will be set at a level up to 30% of the relevant sales the last business year.¹² This amount should be multiplied with the number of years of infringement, and added a fixed component which equals 15-25% of annual sales. Note that it is argued that fines should have a deterrence effect:

Fines should have a sufficiently deterrent effect, not only in order to sanction the undertaking concerned (specific deterrence) but also in order to deter other undertakings from engaging in, or continuing, behavior that is contrary to Articles 81 and 82 of the EC treaty (general deterrence) (see paragraph 4).

One interpretation of this is that the fine should be set such that the probability of detection is taken into account.

In the EU guidelines it is stated that factors such as the nature of the infringement, the combined market shares of the involved firms and the geographic

the guidelines.

¹²See Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003. For a critical review of the guideline, see Van Cayseele, Camesasca and Hugmark (2008).

scope for the infringement should influence the decision whether the basic amount should be in the lower or upper end of the scale. Except for the combined market shares, which can be decisive for how much they are able to raise the price, none of these factors are discriminatory the way we have interpreted it. This basic amount of the fine should be increased or reduced in each particular case taking into account all relevant circumstances. It leaves a large discretion for the Commission to impose discriminatory fines. However, none of the moments mentioned that could lead to an increase or a reduction in the basic amount is directly related to the differences in profits between various cartels. Nevertheless, there is scope for a discriminatory fine:

The Commission will also take into account the need to increase the fine in order to exceed the amount of gain improperly made as a result of the infringement where it is possible to estimate that amount (paragraph 31).

Finally, the fine cannot exceed 10% of the previous business year's total turnover for the firm.

It is then an open question how discriminatory the fine is in the EU. In any case, there is no indication that it can be overproportional discriminatory. In Figure 5 we have illustrated two possible outcomes, assuming that the fines in EU are discriminatory within a lower and an upper bound.

The solid line F illustrates the optimal fine. It is an upward sloping piece-wise line, in accordance with Figure 1. The dashed piece-wise line illustrates the actual fine. Since there is a lower limit on the actual fine, even the cartel with the lowest negative (or even positive) effect on welfare will incur a fine. This explains why the actual fine does start at a positive level. There is also an upper limit on the fine, shown with the flat part of the dashed piece-wise line.

Obviously, there are many possible outcomes. In the left part of the figure we have shown a case where only the cartels with a medium negative impact

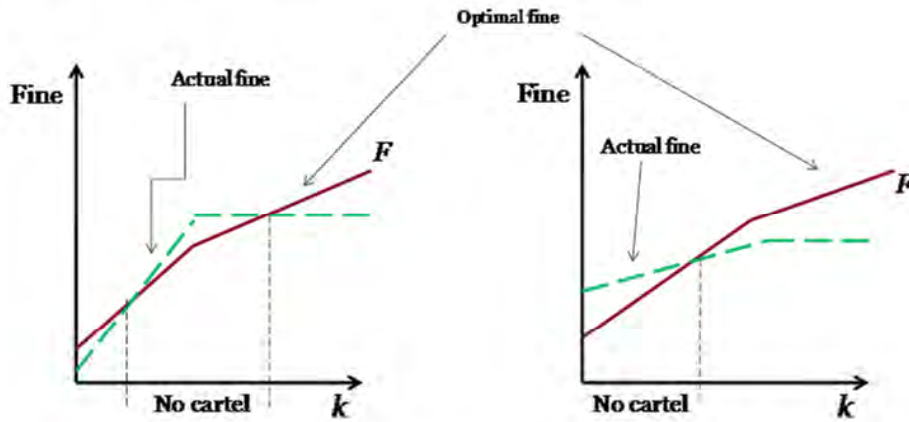


Figure 5: An example: Actual versus optimal fines.

on welfare are deterred, while in the right part of the figure we have shown a case where only the cartels with the lowest negative impact on welfare are deterred. The worst cartels are not deterred in any of these cases, and the obvious reason is that there is an upper limit on the fine. If we take the guidelines from the US for face value, a similar pattern as the right part of the figure would emerge. The dashed line should then be flat, since fines are not discriminatory at all.

Apparently, private litigation can help to mitigate this problem. Motta (2007) claims the following:

..if civil actions were likely and led to significant damages being recognized to clients and/or consumers hurt by cartels, the effect would be to substantially add to the fines that firms have to pay, thereby increasing deterrence.

As we have shown, private litigation can stop the formation of cartels if the participation constraint is binding. However, if the incentive constraint is binding this is no longer true. On the contrary, we have shown that private action where payments to consumers are related to the damage they cause

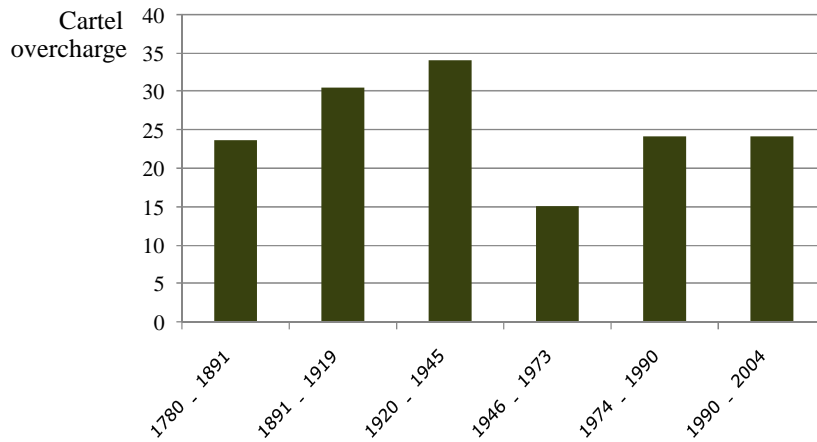


Figure 6: Cartel overcharge - the percentage price increase.

can undermine attempts to use discriminatory fines if the incentive constraint is the binding constraint.

Recently, EU commission has taken an initiative to spur more private litigation.¹³ As argued above, if more private litigation and at the same time no change in the fine policy the worst cartels can become more sustainable. Unfortunately, the measures proposed by EU Commission will not prevent such a detrimental effect. It is proposed that the scope for damage to be paid by immunity recipients should be more limited when a leniency program is in place. The problem is that such a measure is not discriminatory, since it does not distinguish between cartels with a large harm and cartels with a more limited harm.

The large number of leniency cases in both the US and EU the last decade indicates that the violation of the incentive constraint, at least for those firm, is decisive for the fight against cartels. If the incentive constraint is binding, though, there is a risk that a discriminatory private litigation would deter the wrong cartels from deviating and reporting.

¹³See white paper on damages actions for breach of the EC antitrust rules that was issued by DG Competition 2.4.2008.

In Figure 6 we have shown some figures for cartel overcharges for cartels in different time periods. Active cartel policy has been present only during the last century, and especially during the last couple of decades. If the worst cartels are deterred due to an active cartel policy, we would expect that detected cartels in the later periods have a lower average overcharge. From the figure we see that there is no such tendency according to these data.

5 Some concluding remarks

When firms agree to fix prices, it leads with very few exceptions to higher prices. In that respect it is natural with a per se ban on price fixing. Since price fixing in almost all instances will result in higher prices, there is no need to show that it has led to higher prices to conclude that the ban is violated. This is the present policy in most jurisdictions. We have argued that unless fines are very high, and thereby excessively high in most cases, it is a risk that the most harmful cartels are formed while the not so harmful cartels are deterred.

The obvious response to such a problem is to make fines discriminatory, in line what we have seen in other areas concerning crime and punishment. We show that it is non-trivial to design the optimal fines for cartel activities. First, for plausible parameter values we find that an overproportional discriminatory fine is needed. Second, the response to changes as, for example, more private litigation depends critically on whether cartels are deterred due to the lack of profitability or deterred due to the private incentives to deviate. Unfortunately, we find the the present policy in the US and EU are not addressing these problems in a satisfactory way. This might imply that it is a risk that the most harmful cartels are not deterred at present.

Table 1: Comparative statics, non-zero effects only.

	$L = F$	$L \in [0, F]$	$L = \lambda F$
$S = 0$	$\frac{\partial F^{PC}}{\partial k} > 0, \frac{\partial F^{IC}}{\partial k} > 0$	$\frac{\partial F^{IC}}{\partial L} > 0$	$\frac{\partial F^{IC}}{\partial \lambda} > 0$
	$\frac{\partial F^{PC}}{\partial k} > \frac{\partial F^{IC}}{\partial k}$		$\frac{\partial^2 F^{IC}}{\partial k \partial \lambda} > 0$
	$\frac{\partial F^{PC}}{\partial S} < 0, \frac{\partial F^{IC}}{\partial S} < 0$	$\frac{\partial F^{PC}}{\partial S} < 0, \frac{\partial F^{IC}}{\partial S} > 0$	$\frac{\partial F^{PC}}{\partial S} < 0, \frac{\partial F^{IC}}{\partial S} > 0$
$S \in [0, (\alpha - 1)\pi^N]$		$\frac{\partial F^{IC}}{\partial L} > 0$	$\frac{\partial F^{IC}}{\partial \lambda} > 0$
			$\frac{\partial^2 F^{IC}}{\partial k \partial \lambda} > 0$
	$\frac{\partial F^{PC}}{\partial \sigma} < 0, \frac{\partial F^{IC}}{\partial \sigma} < 0$	$\frac{\partial F^{PC}}{\partial \sigma} < 0, \frac{\partial F^{IC}}{\partial \sigma} > 0$	$\frac{\partial F^{PC}}{\partial \sigma} < 0, \frac{\partial F^{IC}}{\partial \sigma} > 0$
$S = \sigma(\alpha - 1)\pi^N$	$\frac{\partial^2 F^{PC}}{\partial k \partial \sigma} < 0, \frac{\partial^2 F^{IC}}{\partial k \partial \sigma} < 0$	$\frac{\partial F^{IC}}{\partial L} > 0$	$\frac{\partial F^{IC}}{\partial \lambda} > 0$
		$\frac{\partial^2 F^{PC}}{\partial k \partial \sigma} < 0, \frac{\partial^2 F^{IC}}{\partial k \partial \sigma} > 0$	$\frac{\partial^2 F^{PC}}{\partial k \partial \sigma} < 0, \frac{\partial^2 F^{IC}}{\partial k \partial \sigma} > 0$
			$\frac{\partial^2 F^{IC}}{\partial k \partial \lambda} > 0$

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The purpose of this article is to analyze the minimum fines needed in order to prevent price fixing when there is heterogeneity in the potential for a cartel overcharge across industries. We show that the incentive constraint is typically binding in industries where cartels would lead to a high overcharge, while the participation constraint is typically binding in industries where the potential for overcharge is rather low. We show that a discriminatory fine should depend on the probability of detection, the discount factor and the gains from cartel deviation. We contrast our minimum fine schedule with the one we can derive from judicial practice, a fine schedule that is proportional to the gain in per period profits. Furthermore, it is shown that more private litigation can make the most harmful cartels more stable, while cartels with lower negative impact can become less profitable.



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