FINE SCHEDULE WITH HETEROGENEOUS CARTELS: ARE THE WRONG CARTELS DETERRED?[*]

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ABSTRACT:
The purpose of this paper is to analyze the minimum fines necessary to prevent price fixing when the size of the potential cartel overcharge differs 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 quite low. We show that the introduction of private litigation and criminal sanctions (such as imprisonment) can make cartels with high overcharges more stable and only deter some of the potential cartels with low overcharges. We contrast our minimum fine schedule with the fine schedules that can be derived from current judicial practice, and discuss the policy implications of our results.

JEL: K21; K42; L41

I INTRODUCTION

The empirical literature shows that while price fixing raises prices by 40% or more in some industries, it has a negligible effect on prices in other industries.[1]. In this paper, we discuss the implications of this heterogeneity for fine policy implemented against cartels. In particular, we derive the minimum fine schedule needed to deter cartels. Our results show that it is crucial to distinguish between cartels that are not formed because they are expected to be unprofitable, and those not formed because they would have been unstable. We compare the theoretically optimal fine policy we derive with the actual fine schedules derived from judicial practice and policy in the European Union (EU) and the United States (US).

Numerous studies discuss the optimal fine policy toward antitrust violations.[2] Our study focuses on the interplay between the participation and incentive constraints for cartel members. This interplay has also been present in theoretical studies, and is strongly supported by experimental evidence.[3] In contrast to the existing theoretical literature on cartels, we show that the two constraints can be binding across different industries in a systematic way, and that this regularity has important implications for the formulation of optimal fine policy toward cartels. In that respect, our study also relates to the debate concerning the determination of fines. For instance, there are divergent views on whether the existing fines in, for example, the EU and the US, are sufficiently high to deter cartels.[4] However, none of these studies discuss whether cartels are deterred because they are unprofitable or because they are unstable. We find that the distinction between unprofitable and unstable potential cartels is of critical importance for understanding how discrimi-

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[1]See, for instance, J. M. Connor. & R. H. Lande (2006): 'The size of cartels overcharge: Implications for US and EU fining policies', *The Antitrust Bulletin*, 51(4), 983-1022 and J. M. Connor & R. H. Lande (2012): 'Cartels as rational business strategy: Crime pays', *Cardozo Law Review*, 34(2), 428-491.

[2]This is in the spirit of G. S. Becker (1968): 'Crime and punishment: An economic approach', *Journal of Political Economy*, 76(2), 169-217. For a recent review of the literature on cartel policy, see for example P. Buccirossi & G. Spagnolo: 'Optimal fines in the era of whistleblowers: Should price fixers go to jail?', in V. Goshal & J. Stennek (eds.): The Political Economy of Antitrust, 81-122, North-Holland; Elsevier.

[3]See G. Spagnolo (2004): 'Divide et impera: Optimal lenience programs', CEPR DP/4040 for a theoretical study, and J. Hinloopen & A. R. Soetevent (2008): 'Laboratory evidence on the effectiveness of corporate leniency programs', *RAND Journal of Ecomics,* 39, 607-616 and M. Bigony, S.-O. Fridolfsson, C. le Coq & G. Spagnolo (2012): 'Fines, leniency and rewards in antitrust', *RAND Journal of Economics*, 43, 368-390 for experimental evidence.

[4]See Connor & Lande (2006), *supra* note 1, that draws on a range of empirical evidence to support the argument that fines in the EU and the US are not sufficiently high to deter cartels. M.-L. Allain, M. Boyer, R. Kotchomi & J.-P. Ponssard (2012): 'The determination of optimal fines in cartel cases: The myth of underdeterrence', Discussion Paper 2011-34 and Y. Katsoulacos & D. Ulph (2013): 'Antitrust penalties and the implications of empirical evidence on cartel overcharges', *The Economic Journal*, 123, 558-581. Both question some key assumptions in these calculations, and conclude that the fine policy in the EU is sufficiently tough to deter cartels. See also M. Motta (2007): 'On cartel deterrence and fines in the EU', mimeo, European University Institute, Florence, presenting some calculations concerning the fine policy in the EU after new guidelines were introduced in 2003.

natory fines should be set to deter potential cartels. Some policy instruments (such as more private litigation and criminal sanctions) could deter some cartels, but at the same time, make other cartels more stable.

In theory, a fixed cartel fine could be set that is so high that all potential cartels are deterred. However, this would be in stark contrast to present judicial practice in most countries. According to case law, for example, in the EU and the US, the punishment of firms that violate the law should be proportional to the damage caused.[5] One interpretation of this principle is that a cartel that has caused only limited harm should at least not pay a fine that is any higher than that for a cartel that has caused serious harm. Indeed, fines for various cartels differ greatly in practice. Given that levying excessively high fines is not feasible, we examine the minimum fine schedule that ensures that all cartels are marginally deterred.[6]

In some industries, cartels are not formed because the participation constraint is violated (*i.e.*, it is not profitable to form a cartel), whereas in other industries, cartels are not formed because the incentive constraint is violated (*i.e.*, it is profitable to deviate from a cartel). We show that if the participation constraint is binding, then the fine schedule must typically be more discriminatory than if the incentive constraint is binding. The reason is that a higher overcharge will make it more tempting to deviate. Thus, when the incentive constraint is binding, the increase in the fine for more harmful cartels should be more limited than where the participation constraint is binding.

This mechanism implies that potential cartels that are able to have a large overcharge are typically profitable to form, but their main problem is to avoid cartel breakdown (the incentive constraint). Conversely, the main problem for cartels with low overcharges is that they are not sufficiently profitable to form given the risk of being detected and fined. In line with this, we find that if our recommended fine schedule is enforced, potential cartels with limited harm are typically deterred by the participation constraint while potential cartels with large harm are typically deterred by the incentive constraint.

The distinction we point to above has important implications for the enforcement effects of cartel policy. For example, private litigation can make the potential cartels with limited harm less profitable, but at the same time make the potential cartels with large harm more stable. The same problem arises with the introduction of criminal sanctions, such as imprisonment. This illustrates that any fine policy revision that is to be applied across all industries must take into account the possibility that it could destabilize cartels in some industries while at the same time making cartels in other industries more profitable. A natural response would be to grant leniency, not only for fines, but also for private litigation costs and criminal sanctions. Given such a leniency policy, private litigation and criminal sanctions would also contribute to strengthening the enforcement effect of the cartel policy vis à vis the most profitable cartels.

We compare our theoretical predictions with actual fine policies in the US and the EU. Unfortunately, actual fine policies are often seemingly not even close to being discriminatory along the lines we propose. In the US, for example, the guidelines for setting fines do not require that the actual gains or losses from the cartel are determined, but instead recommend that fines are set as a percentage of the volume of commerce. In the EU, the upper limit on the fines would, if they bind, make it difficult to deter the worst cartels. Moreover, we argue that the EU Commission's initiative to promote more private litigation might serve to stabilize rather than deter those cartels with the largest overcharges.

The remainder of the paper is organized as follows. In Section 2, 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 constraint or the incentive constraint is binding. In Section 4, we challenge the predictions of our model with actual fine policy for cartels in the US and the EU. Finally, we offer some concluding remarks in Section 5.

II   THE MODEL

Let us assume 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

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[5]See the principle of proportionality in d. G. Burka (1993): 'The principle of proportionality and its application in EC law', *Yearbook of European Law*, 13, 105-150 for the EU and in in E. Sullivan & R. S. Frase (2008): 'Proportionality principles in American law: Controlling excessive government actions', Oxford Univerity Press for the US. For a recent discussion, see W. Sauter (2013): 'Proportionality in EU law: A balancing act?', TILEC Discussion Paper 2013-003.

[6]This is in line with the proposal in Becker (1968), *supra* note 2, where the crime is punished in such a way that the expected costs of the crime marginally exceed any gains. However, note that it has been shown (see, for example, S. Shavell (1991): 'Specific versus general enforcement of law', *Journal of Political Economy*, 99, 1088-1108 and D. Mookherjee & I. P. L. Png (1994): 'Marginal deterrence in enforcement of law', *Journal of Political Economy*, 102, 1039-1066) that if a firm chooses between various harmful activities (instead of between committing a crime or not) this could lead to a deviation from the stated principle.

that cartels are formed in all these markets. For various reasons, we could argue that different cartels may 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.

A cartel that raises prices substantially is typically more profitable than a cartel that chooses only a modest price increase. 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. Each market is thus characterized by the cartel overcharge $k = (p^C - p^N)/p^N$, where p^C is the cartel price and p^N is the noncollusive price under competition. We assume that the overcharge is unaffected by the fine.[7] Later, we provide an example where the overcharge is endogenously determined, and show that the result we report in the basic model continues to hold in that case (see Section 3.4).

We assume that there is an active antitrust policy, where competition authorities (CA) detect cartels and apply fines (or grant leniency) to detected or reported cartels. Let p denote the probability of detection.[8] At the outset, we assume that $p = p(k)$, *i.e.*, it is possible that the cartel overcharge has an impact on the probability of detection. One reason could be that a high overcharge makes it more likely that customers become suspicious and report the cartel to the competition authorities, or because it is more likely that someone inside the firm whistleblows about the illegal practice. On the other hand, firms that are involved may be even more cautious not to trigger an investigation and in hiding any evidence of illegal practice if the cartel overcharge is high. Furthermore, it is well known that marginal costs are difficult to observe. It is therefore difficult for an outsider to target cartels with the highest price–cost margins.[9] Consequently, the main part of our analysis is devoted to deriving the minimum fine schedule when the cartel overcharge does not affect the probability of detection.[10] Note, however, that our main results remain valid when assuming that the cartel overcharge affects 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 granted. We assume that $F > L = 0$. The latter implies that a firm that is granted leniency will have a zero fine. We further allow for other costs incurred by the cartel if detected and denote these as S. One interpretation would be that it is private litigation, where a party that has suffered damage from the cartelization can request compensation S. Alternatively, we could interpret S as criminal sanctions: say, imprisonment. Later, we distinguish between private litigation and criminal sanctions and discuss each separately. Finally, we also consider that there may be nonpecuniary costs C associated with being caught for involvement in cartel-related activities. For example, there may be some social norms that declare that

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[7]This is an assumption made in several other studies of cartel fine policy, including P. Cyrenne (1999): 'On antitrust enforcement and the deterrence of collusive behaviour', *Review of Industrial Organization*, 14, 257-272 and M. Motta & M. Polo (2003): 'Leniency programs and cartel prosecution', *International Journal of Industrial Organization*, 21, 347-379. As shown in M. K. Block, F. C. Nold & J. G. Sidak (1981): 'The deterrent effect of antitrust enforcement', *Journal of Political Economy*, 89, 429-445, 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, J. E. Harrington (2004): 'Cartel pricing dynamics in the presence of an antitrust authority', *RAND Journal of Economics*, 46, 651-673). As noted in J. E. Harrington (2005): 'Optimal cartel pricing in the presence of an antitrust authority', *International Economic Review*, 46, 215-246, 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, the assumption of joint profit maximization may not 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. Because of this, we assume that there are factors other than the fine that determine the cartel overcharge.

[8]Obviously, the probability of detection increases with a more active policy (higher activity level) by antitrust authorities. In this paper, we focus on the optimal use of fines, and defer the issue concerning the optimal activity level to future research.

[9]Block, Nold & Sidak, supra note 7, have shown that if cartels with a higher overcharge have a greater probability of detection, then it would be optimal for cartels to let the cartel price depend on the fine. This has been further investigated in E. Motchenkova (2008): 'Determination of optimal penalties for antitrust violations in a dynamic setting', *European Journal of Operational Research*, 189, 296-291 and H. E. Houba, E. Motchenkova & Q. Wen (2010): 'Antitrust enforcement with price-dependent fines and detection probabilities', *Economics Bulletin*, 30, 2017-2027. Furthermore, Harrington (2004), *supra* note 7, has shown that this would imply that the cartel price would decrease over time given the accumulated fine for a cartel is increasing over time. As mentioned, Harrington (2005), *supra* note 7, note that there is no empirical evidence supporting such a cartel price profile, inferring that 'detection is not largely driven by the price level' (p. 152). This makes it natural to assume that there is no relationship between the cartel overcharge and the probability of detection, as we do in the main part of our analysis. The same assumption is made in several studies of fine policy toward cartels: for example, Cyrenne, supra note 5, Motta & Polo, *supra* note 5, and Spagnolo, *supra* note 2.

[10]In S. Jensen & L. Sørgard (2012): 'Enforcement with heterogenous cartels', SNF working paper 14/12, it is shown 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. They also 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 nonmonotonic relationship between the probability of detection and the minimum fine schedule.

price fixing is an unlawful action and thereby an action that is detrimental to the welfare of the persons violating the law.[11] To simplify the exposition, we do not include the cost C until we compare the incentive and participation constraints in Section 3.3.

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

Stage 1 CA sets fines F.

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 and incur a cost S.

At stage 3, cartels are detected and fined, and those that report to the CA (leniency) are given a lower or zero fine. We assume that detected cartels are drawn randomly from the population of cartels. At stage 3 then, a cartel is detected with probability p, where the probability may depend on the cartel overcharge. If a cartel is detected, it must pay a fine. We allow the fine to depend on the cartel overcharge, *i.e.*, $F(k)$. Furthermore, we assume that the amount paid in private litigation may also depend on k. If all firms stick to collusion with overcharge k, each firm's profit is given by $\pi^C = \alpha(k)\pi_N$ where $\alpha(k) > 1$ ($\alpha(k) \to \infty$ when $\pi_N \to 0$). π^N is the profit per firm when all firms chose the noncooperative 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 (the monopoly price), then $k \in [\underline{k}, \overline{k}]$, where $\underline{k}$ is the cartel overcharge when the competitive price is high, for instance, when products are differentiated, and $\overline{k}$ is the cartel overcharge when the competitive price approaches marginal cost.

At stage 2, the firms decide whether to form a cartel or to deviate from an existing cartel. We assume that if a firm decides to deviate it will also report to CA and thereby apply for leniency.[12] This implies that we rule out the possibility that a deviation is followed by not reporting to the CA. Deviation with reporting is a more profitable strategy than deviating and not reporting if S is sufficiently low.

Finally, the CA are assumed to determine fines at stage 1 to ensure that all potential cartels are either deterred or desisted.

III   CARTEL STABILITY

A cartel is sustainable only if (i) the participation constraint and (ii) the incentive constraint are met.[13]

A   Participation constraint: Cartel deterrence

The participation constraint for a cartel is met, *i.e.*, for all individual cartel members, 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 forming a cartel with overcharge k is:

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

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

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

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[11]For a discussion of the forming of social norms, seeE. Fehr & U. Fischbacher (2004): 'Social norms and human cooperation', *Trends in Cognitive Science*, 8, 185-190. As discussed in S. Stephan (2010): 'Cartel laws undermined: Corruption, social nroms, and collectivists business cultures', *Journal of Law and Society*, in some societies, social norms may not be hostile toward cartel activities. If so, $C = 0$.

[12]Leniency as such, where we assume the fine falls to zero, can be sufficient to ensure that deviation and report is better than deviation alone. If deviation leads to an increase in the probability of detection, this will make deviation and report even more profitable when compared with only deviation. This is explained in detail in Jensen & Sørgard, *supra* note 10. Note that our assumption is identical to that made in Cyrenne, *supra* note 7, and Spagnolo, *supra* note 3.

[13]This is explained in Buccirossi & Spagnolo, *supra* note 2, and G. Spagnolo (2006): 'Leniency and whistleblowers in antitrust', CEPR DP/5794.

By comparing the above net present value with the net present value if a cartel is not formed, we find that a cartel is profitable if

$$V^C(k) > \frac{\pi}{1-\delta}. \tag{2}$$

Solving for $F(k)$ in the participation constraint in (2) yields the fine that is necessary to deter a cartel with overcharge k:

$$F \geq \frac{1-p(k)}{p(k)}(\alpha(k)-1)\pi - S. \tag{3}$$

We assume that there exists a marginal cartel (*i.e.*, a cartel that is indifferent between forming or not) and 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 deters the cartel is:

$$F_{PC} = \frac{1-p(k^{PC})}{p(k^{PC})}(\alpha(k^{PC})-1)\pi - S. \tag{4}$$

We can see that the cartel overcharge k will influence both the probability of detection and the profits from colluding.

B   Incentive constraint: Cartel desistence

Let us now consider the incentive constraint. The presence of a leniency program implies that a firm may find it individually rational to defect and inform the CA about the cartel. A firm that deviates increases its profits relative to the collusive profit $\pi_C = \alpha\pi$ by a factor $\beta > 1$, by capturing $\beta\alpha\pi$ in the period it deviates. β can also be interpreted as a parameter capturing the number of firms, as a larger number of firms implies that the gain from deviation increases.

As described, we assume that deviate and report is the most profitable strategy if the firm deviates. The strategy "deviate and report" will, of course, always dominate the strategy "collude and report". Hence, the two strategies we compare are "always collude" and "deviate and report". The incentive constraint gives the following restriction on the fine:

$$\frac{(1-p)\alpha(k)\pi + p\left(\frac{\pi}{1-\delta} - F - S\right)}{1-\delta(1-p)} < \beta\alpha(k)\pi - S + \frac{\delta}{1-\delta}\pi. \tag{5}$$

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

$$F_{IC} = \frac{1-p(k^{IC})}{p(k^{IC})}(\alpha(k^{IC})-1)\pi - \frac{\beta\alpha(k^{IC})-1}{p(k^{IC})}(1-\delta(1-p(k^{IC})))\pi$$
$$+ \frac{(1-\delta)(1-p(k^{IC}))}{p(k^{IC})}S. \tag{6}$$

C   Participation versus incentive constraint

Let us now assume that the fine schedule that is enforced has the characteristics described above, implying either that F_{PC} or F_{IC} is binding. Consequently, all cartels are marginally deterred.

We now include the nonmonetary costs C, resulting, for instance, by breaking the social norms associated with being involved in unlawful cartel activities. Moreover, we also include S. These are other costs associated with detection, *i.e.*, private litigation and criminal sanctions. It is natural to assume that criminal sanctions are not affected by the overcharge. In that case, we let $S = S_C$. Private litigation costs, on the other hand, are typically related to the overcharge. To capture this, we assume that the private litigation cost is $S_P = \sigma(\alpha-1)\pi$, where $0 \leq \sigma \leq 1$.

For sufficiently large differences in idiosyncratic characteristics between the various industries, the typical situation will be that the incentive constraint is binding in some industries, whereas the participation constraint is binding in others. Given that we have criminal sanctions and private litigation, as well as other nonmonetary costs, we obtain the following result.

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Proposition 1 *The participation constraint is the binding constraint if*

$$S_C + C > [\beta\alpha - 1 - \sigma(\alpha - 1)]\pi.$$

Proof: Let $V^C = $ be the present value of a cartel, $V^N = $ the present value of competition, and $V^D = $ the present value if a firm deviates from the cartel followed by competition in all future periods. We know from the analysis that if $V^C > V^N$, then the participation constraint binds, and if $V^C > V^D$, then the incentive constraint binds. In earlier sections, we have solved for the lowest fine that ensures that the participation constraint and the incentive constraint is binding. Whereas both V^N and V^D are unaffected by the fine ($\partial V^N / \partial F = \partial V^D / \partial F = 0$), an increase in F reduces V^C ($\partial V^C / \partial F < 0$). Therefore, the fine F should be increased until either $V^C < V^N$ or $V^C < V^D$. This implies that the participation constraint (or incentive constraint) is the binding constraint if $V^N > V^D$ (or $V^N < V^D$). Using the expressions we defined for V^N and V^D in the previous sections, we have that $V^N > V^D$ if

$$\frac{\pi}{1-\delta} > \beta\alpha\pi - S_C - S_P - C + \left(\frac{\pi}{1-\delta}\right)\delta.$$

By rearranging and replacing the expression for S_P, we have the expression in the Proposition 1. QED.

First, note that the participation constraint is binding if S_C and/or C are sufficiently high. Under these conditions, the existing cartel will be punished quite fiercely by reporting, as it then will also incur nonpecuniary cost along with criminal sanctions. Then it is likely that the cartel can be stable, but not profitable. The fine must be quite high to provide the existing cartel members with an incentive to deviate and report. If so, the cartel is not formed because it is unprofitable (the participation constraint is not met) even though it is stable (the incentive constraint is met). As the only way to avoid these costs is not to form a cartel, their existence tends to make the participation constraint binding (*i.e.*, it is not profitable to form a cartel).

Second, we can see that a high overcharge (α) and a large gain from deviation (β) will make it likely that the incentive constraint rather than the participation constraint is binding. Under these circumstances, it is tempting to deviate, to capture the large short-term deviation, and the reason why the cartel is not formed is because of the sizeable prospects for a cartel breakdown.

Third, we can see that private litigation will make it more likely that the participation constraint is binding. We can technically see this from the fact that when $\sigma > 0$, the right-hand side of the condition in Proposition 1 decreases. The intuition is straightforward: It becomes less tempting to deviate and report, and the participation constraint will be the binding restriction for the cartel.

Furthermore, let us check the slope of the fine schedule when the incentive and participation constraints are respectively binding.

Proposition 2 *Without private litigation ($S = 0$), the slope of the fine schedule $F(k) \equiv \min\{F_{PC}(k), F_{IC}(k)\}$ is steeper when the participation constraint is binding rather than the incentive constraint, i.e., $\frac{dF_{PC}}{dk} > \frac{dF_{IC}}{dk}$, if:*

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

Proof: From the previous conditions, we have the following two conditions:

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

$$\frac{\partial F_{IC}}{\partial k} = \left[\frac{1-p}{p} - \frac{\beta(1 - \delta(1-p))}{p}\right]\frac{\partial\alpha}{\partial k}\pi - \left[\frac{(\alpha - 1)}{p^2} - \frac{(\beta\alpha - 1)(1-\delta)}{p^2}\right]\frac{\partial p}{\partial k}\pi.$$

We then have the following condition for the minimum fine schedule being less steep according to the incentive constraint than according to the participation constraint:

$$\frac{p\beta[1 - \delta(1-p)]}{(1-\delta)(\alpha\beta - 1)} > \frac{p'}{\alpha'}. \tag{7}$$
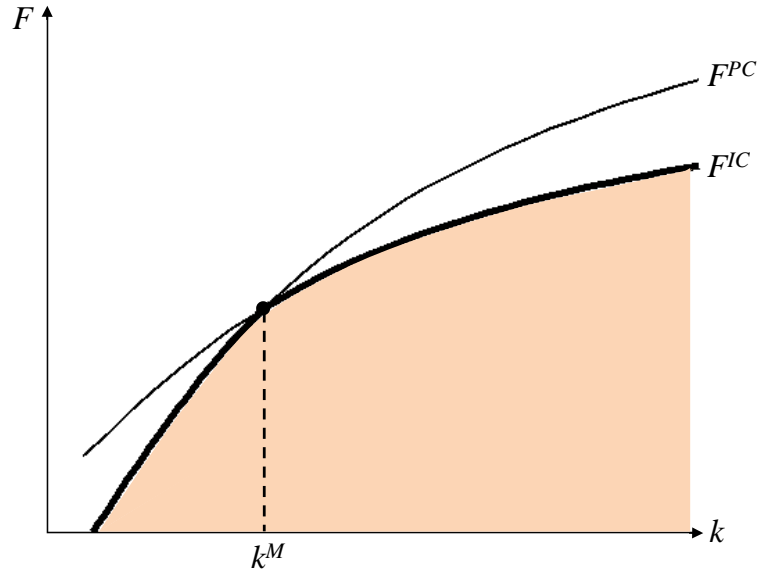
This is the condition in the Proposition. QED.

Figure 1: The fine given that either the participation or the incentive constraint binds

Consider the case where p' is approaching zero, *i.e.*, the overcharge has a very limited or no effect on the probability of detection. We can then see that the right-hand side condition in Proposition 2 is approaching zero, while the left-hand side is positive. It then follows from Proposition 2 that the fine schedule will be steeper if the participation constraint, rather than the incentive constraint, binds. This implies that any additional fine for a more harmful cartel should be larger if the participation constraint binds than if the incentive constraint binds. We characterize this as a discriminatory fine. To understand this, note that with a binding incentive constraint each cartel member is tempted to deviate. A higher overcharge will make the short-term gain from deviating larger, which dampens the need for an increased fine for a more harmful cartel.

If $p' > 0$ and is sufficiently large, we can see from Proposition 2 that the above result reverses. This implies that cartels with high overcharges are much more likely to be detected. However, given that $p' > 0$, the fine schedule may no longer have a positive slope: the optimal fine can be lower for an industry with a high overcharge than in an industry with a low overcharge. We do not consider this case in detail.[14]

Let us consider the case where $p' = 0$ (k has no effect on p), and again allowing $S \geq 0$. It is then easy to show that the fine must be increasing in the overcharge, no matter which of the two constraints is binding. By comparing the two binding constraints, we can see that in line with what we have already shown, that the participation constraint leads to a more discriminatory fine than does the incentive constraint. We can easily see this by comparing $\partial F_{IC}/\partial k$ and $\partial F_{PC}/\partial k$, and this follows from $1 - \delta(1 - p) > 0$.

In line with what we have explained above, the fine schedule is less discriminatory if the incentive constraint rather than the participation constraint is binding. We can also see that the gain from deviating (β) and the discount factor (δ) is of importance for how discriminatory the fine schedule will be. In Figure 1, we illustrate the optimal fines given that the participation constraint or the incentive constraint is respectively binding. We assume that the nonpecuniary cost C has an identical effect on all cartels. This implies that the incentive constraint line F_{IC} shifts upwards.

The piecewise solid line depicts 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 are stable. We then have the following result.

Proposition 3 *Assume that there exists some level of k so that $F_{IC} = F_{PC}$ for the cartel with overcharge $k^M \in (\underline{k}, \overline{k})$, where k^M is defined by*

$$\alpha(k^M) = \frac{\pi(1 - \sigma) + C + S_C}{(\beta - \sigma)\pi}.$$

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[14]For details on how $p' > 0$ may affect the outcome, see Jensen & Sørgard, *supra* note 10.

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

As shown in Proposition 3 and illustrated in Figure 1, the participation constraint stops cartels with a low potential overcharge from forming and the incentive constraint stops cartels with a large potential overcharge from sustaining collusion. Cartels in which the potential overcharge is low can easily be deterred from being formed, while cartels in which the potential overcharges are high may find it profitable to form, but will be difficult to sustain because it will be difficult to prevent firms from deviating from the cartel.

Given both constraints bind, although for dissimilar industries, a change in cartel policy can have very different effects in different industries. To illustrate, let us now consider how a change in S affects the optimal fine schedule. First, let us interpret S as criminal sanctions such as imprisonment. As above, we define this as S_C. It is natural to assume that the criminal sanction is not affected by the overcharge. Then it follows from equations 4 and 6 that:

Proposition 4 *If criminal sanctions are introduced and they are not affected by the overcharge, then $\partial F_{PC}/\partial S_C < 0$ and $\partial F_{IC}/\partial S_C > 0$.*

The effect of criminal sanctions is quite intuitive. In industries where a cartel is not formed because it will be unprofitable, it will be even less attractive to form a cartel when they anticipate possible imprisonment if the cartel is detected. On the other hand, in industries where a cartel is not formed because it will be unstable, the introduction of criminal sanctions will, all else equal, make the cartel more stable. The reason is that the cartel members will find it less tempting to deviate, as they would then face criminal sanction. Obviously, leniency for criminal sanctions as well as for fines would eliminate the above effect and criminal sanctions would not make the cartels more stable.

Second, let us interpret S as the compensation to customers. It is then natural to assume that $S = \sigma(\alpha - 1)\pi$, *i.e.*, such that private litigation costs depends on the cartel overcharge. We can then easily show that the critical fines for the participation and incentive constraints, respectively, are as follows.

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

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

We obtain the following result.

Proposition 5 *An increase in private litigation costs (higher σ), all else equal, would lead to $\partial F_{PC}/\partial\sigma < 0$ and $\partial F_{IC}/\partial\sigma > 0$.*

Proof: It is easily verified that $\partial F_{PC}/\partial\sigma < 0$ and $\partial F_{IC}/\partial\sigma > 0$ as $\alpha > 1$. QED

We can see that private litigation would, all else equal, lead to less stable cartels if the participation constraint is binding, and more stable cartels if the incentive constraint is binding. Firms that consider forming a cartel (where the participation constraint is binding), will then be less tempted to do so when they consider the risk of private litigation. Conversely, private litigation will make the decision to deviate and report less profitable.[15] This is in line with the effect of introducing criminal sanctions (see above). If we combine these insights with the lessons from Proposition 3, we can see that more widespread use of private litigation makes it easier to deter cartels with relatively small overcharge, and at the same time, make it more difficult to desist cartels with larger overcharges.

IV   ARE ACTUAL CARTEL FINES DISCRIMINATORY?

According to the US guidelines for fines, a base fine level should be set at 20% of affected commerce.[16] This is clearly based on an average cartel overcharge consideration.[17] Adjustments should also take place

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[15]This is well known in the existing literature, for example, Spagnolo, *supra* note 3.

[16]See US Sentencing Guidelines Manual § 2R1.1 (2012).

[17]It 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 & Lande (2006), *supra* note 1, and Connor & Lande (2012), *supra* note 1, for a discussion of the guidelines.

in the base fine level by taking a number of factors into consideration; for instance, fines should be adjusted upwards if bid rigging or other aggravating factors are involved, or downwards if the firm cooperates with the antitrust authority. However, it is difficult 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 is set at a level of up to 30% of the relevant sales in the previous business year.[18] This amount should be multiplied by the number of years of infringement and a fixed component equal to 15–25% of annual sales should also be added. The EU guidelines state that factors such as the nature of the infringement, the combined market shares of the involved firms, and the geographic scope of the infringement should influence the decision as to whether the basic amount should be at the lower or upper end of the scale. Except for the combined market shares, which can be decisive for how much firms are able to raise the price, none of the other factors are discriminatory in the way interpreted in our model. The basic amount of the fine should be increased or reduced in each particular case taking into account all relevant circumstances. This gives the Commission large discretionary powers in imposing discriminatory fines. However, none of the instances mentioned that could lead to an increase or a reduction in the basic amount are directly related to the differences in profits between various cartels. Finally, the fine cannot exceed 10% of the previous business year's total turnover for the firm. Clearly, this may make it impossible to deter or desist the most harmful cartels.

The EU Commission has also taken the initiative to encourage more private litigation.[19] As argued, if there is more private litigation without a corresponding change in fine policy, the worst cartels may become more sustainable. Unfortunately, the measures proposed by the EU Commission will not prevent this detrimental effect. It is, however, 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 as it does not distinguish between cartels that cause significant harm to society and those that do not. In the US, private litigation has been quite common for many years. The private penalties in the US are highly discriminatory.[20] According to our approach, this is bad news for the fight against the worst cartels.

The leniency program is designed to make cartels more unstable; but as pointed out, private litigation and criminal sanctions could undermine the effectiveness of the leniency program. In the US, they have at least partly corrected for this. While the common rule for damages in the US is that the purchasers should be paid treble damages, firms that have been given leniency should pay only simple damage. At the same time, those that report will also be granted leniency with respect to imprisonment. In the EU, on the other hand, there is no leniency for damages and no criminal sanctions for price fixing.

V   SOME POLICY IMPLICATIONS

When firms agree to fix prices, it leads, with very few exceptions, to higher prices. In that respect, it is natural to have a per se ban on price fixing. Given price fixing in almost all instances will result in higher prices, there is no need to show that it has in fact 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, we run the risk that the most harmful cartels are formed while the not so harmful cartels are deterred.

The obvious response to the problem is to make fines discriminatory, in line with what we have seen in other areas concerning crime and punishment. We show that it is nontrivial to design optimal fines for cartel activities. First, how discriminatory the fine should be depends on whether the participation constraint or the incentive constraint is binding. Second, the response to changes (for instance, more private litigation) depends critically on whether cartels are deterred due to the lack of profitability or from the private incentives to deviate. Unfortunately, we find that present policy in the US and EU is not addressing these problems in a satisfactory way. This implies that there is a risk that the most harmful cartels are at present not deterred. In particular, the large number of leniency cases in both the US and EU during the

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[18]See the 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 guidelines, see P. van Cayseele, P. D. Camesasca & K. Hugmark (2008): 'The EC Commission's 2006 fine guidelines reviewed from an economic perspective: Risking overdeterrence', *The Antitrust Bulletin*, 53, 1083-1126..

[19]See the white paper on damage actions for breach of the European Community (EC) antitrust rules issued by DG Competition 2.4.2008.

[20]This is shown in Connor & Lande (2012), *supra* note 1.

last decade indicates that the violation of the incentive constraint, at least for those firms, is decisive for the fight against cartels.

Our study points to the ambiguous effect of private litigation on cartels. While the prospects for private litigation will deter some cartels from being formed, it can make it less attractive for existing cartel members to ask for leniency. If the incentive constraint is binding for the cartels with the highest overcharges, there is therefore a risk that more discriminatory private litigation, as proposed by the EU Commission, would deter the wrong cartels. Our results then illustrate the importance of leniency, not only with respect to the fine, but also for private damage claims and imprisonment.