forthcoming in *American Law and Economics Review*

Rebating Antitrust Fines to Encourage Private Damages Negotiations*

Winand Emons[†] Severin Lenhard[‡]

Version: October 2022

Abstract

To encourage private negotiations for damages in antitrust cases some jurisdictions subtract a fraction of the redress from the fine. We analyze the effectiveness of this policy. Such a rebate does not encourage settlement negotiations that would otherwise not occur. If, however, the parties settle without the rebate, the introduction of the reduction may increase the settlement amount. Yet deterrence for those wrongdoers who are actually fined always goes down. Under a leniency program the rebate does not affect the leniency applicant: she doesn't pay a fine that can be reduced. The overall effect of a fine reduction on deterrence is, therefore, negative.

Keywords: antitrust, damages, deterrence, leniency.

JEL: D43, K21, K42, L40

*Winner, 2021 Antitrust Writing Awards: Articles, Academic, Private Enforcement. We thank Stefan Bühler, Albert Choi, David Gilo, Igor Letina, Giancarlo Spagnolo, Niklaus Wallimann, Larry White, two referees, and the participants of 24th Debating Competition Dinner for helpful comments. The usual disclaimer applies. The views expressed in this paper are those of the authors and do not necessarily represent those of the Swiss Competition Commission. Emons acknowledges the hospitality of the Department of Economics at the University of Melbourne. Authors' address: Departement Volkswirtschaftslehre, Universität Bern, Schanzeneckstrasse 1, Postfach 8573, CH-3001 Bern, Switzerland.

[†]Universität Bern, CEPR, Swiss Competition Commission, winand.emons@unibe.ch.

[‡]Universität Bern, severin.lenhard@unibe.ch.

1 Introduction

Antitrust rules are enforced publicly by competition agencies, typically by way of fines. Moreover, they can be enforced privately by the victims of an infringement through damage actions. In quite a few jurisdictions there is concern about the underdevelopment of private antitrust enforcement. For example, while in the US private cases already amount to at least 90% of antitrust enforcement, in the EU no more than 10% of antitrust enforcement was private.[1] During the period 2006-2012 less than 25% of the Commission's infringement decisions were followed by private damages actions. Cases were mostly brought in Germany, the Netherlands, and the United Kingdom, while no follow-on actions were reported in 20 out of 28 member states.[2]

Several factors contribute to this underdevelopment: Typically, jurisdictions in Europe do not allow for collective actions and do not award punitive damages. Furthermore, the plaintiff in a civil suit does not have the means of an antitrust authority like dawn raids etc. to prove the infringement.[3] Finally, the plaintiff assumes substantial expense risk, in particular if the English cost allocation rule applies and contingency fees are not allowed.

To encourage private antitrust enforcement the EU adopted Directive 2014/104/EU in 2014. The Directive establishes the right of victims to obtain full compensation for the harm caused by an anti competitive conduct. Full compensation includes actual losses and loss of profit, plus interest from the time the harm occurred until compensation is paid. In order to ensure that the right to full compensation is effectively guaranteed, the Directive introduces a number of measures which should facilitate antitrust damages claims in EU Member States.[4]

One measure that has been put forward lately is to subtract part of a

[1] EU (2007), p. 28.
[2] OECD (2015), p. 5.
[3] The burden of proof is, however, lower in a civil than in an administrative suit.
[4] For details about the measures, see, e.g., OECD (2015).

voluntary redress paid to the victims from the fine. For example, in its decisions *Strassenbau* and *Engadin II* (3.9.2019), the Swiss Competition Commission subtracted half of the settlement payment paid by the bid rigging construction companies to the victim (the Canton of Graubünden) from the wrongdoers' fines.[5] Likewise, in June 2014 the Israeli Antitrust Tribunal approved a consent decree reached between Israeli banks who allegedly exchanged information and the Israeli Antitrust Authority providing that the entire settlement payment would be subtracted from the wrongdoers' fine.[6]

The EU also allows for and encourages this possibility.[7] For instance, the Directive (EU) 2019/1 of the European Parliament and of the Council states: (47)...“ NCAs [national competition authorities] should be able to take into account any compensation paid as a result of a *consensual settlement*” [our emphasis] and in Article 14(2) “Member States shall ensure that national competition authorities may consider compensation paid as a result of a *consensual settlement* [our emphasis] when determining the amount of the fine to be imposed for an infringement of Article 101 or 102 TFEU, in accordance with Article 18(3) of Directive 2014/104/EU.”[8]

[5] www.newsd.admin.ch/newsd/message/attachments/58229.pdf

[6] See H″43129-03-10 Bank Hapoalim Ltd. v. Director General of the Israeli Antitrust Authority (15.6.2014).

[7] Cartel Working Group (2019), p. 10.

[8] eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L&_.2019.011.01.0003.01.ENG&toc=OJ:L:2019:011:TOC. In two cases, *Pre-Insulated Pipes Cartel* [1999] OJ L24/1 and *Nintendo* [2003] OJ L255/33, the European Commission granted reductions of fines in recognition of the fact that the wrongdoers had paid substantial compensation. The European Commission refused to grant reductions in other cases. The EC Court of First Instance confirmed in *Archer Daniels Midland v Commission* [2006] ECR II-3627 that there is no obligation to grant such reductions. The UK offers to reduce the fine by 5-10% should an undertaking make a voluntary redress in the processing on imposing penalty. In Korea the competition agencies can apply a 20-30% reduction. In Turkey the fine can be reduced at a rate of 25-60%. In Canada restitution is a factor that can be taken into account by a court in imposing a sentence for a criminal offence. The Dutch and Spanish competition authorities take into account voluntary compensation as a mitigating circumstance in setting the fine. In the US the Department of Justice does not grant rebates; there voluntary compensation is one of the conditions for obtaining leniency. See Wils (2009), OECD (2015), and Cartel Working Group (2019).

In this paper we analyze whether rebating fines indeed stimulates private damage negotiations. Furthermore, we study the effects on deterrence, in particular if a leniency program applies.

A firm has been fined by the antitrust authority for anti competitive behavior. The victim seeks damages. The victim and the firm may settle the case out-of-court. The competition authority subtracts a fraction of the settlement payment from the wrongdoer's fine. If they do not reach a settlement, the victim can take the case to court.

The players' payoffs from going to court determine their threat points in the bargaining stage. Bargaining is of the random offeror type.[9] If the plaintiff does not go to court in the last stage, his outside option whilst bargaining is zero. The defendant will, therefore, not settle. This holds independently of the amount that is subtracted from the defendant's fine. Rebating the fine thus does not stimulate settlements that would otherwise not occur.

If the plaintiff has a credible threat to go to court, the parties settle without the rebate. If the fine is large, introducing the reduction increases the settlement amount: the rebate increases the surplus and at the same time lowers the defendant's marginal cost of settling. Thus, if parties settle without the rebate, its introduction increases the settlement amount. For small fines the rebate has no effect on the settlement amount.

Ex ante the prospect of paying the fine and the settlement potentially deter the defendant. The rebate lowers the fine; at the same time it may have a positive or no effect on the settlement amount. In our set-up the effect of the fine reduction is always stronger than the effect on the settlement—deterrence, therefore, goes down.

Then we look at a leniency applicant under a leniency program. Since the leniency applicant is exempted from the fine, she does not care about the rebate. The rebate reduces deterrence for non whistle blowers. It does not

[9] In Appendix 1 we extend our results to the Nash Bargaining Solution.

affect deterrence for the leniency applicant. The relative incentive to turn the cartel members in, therefore, goes down. Consequently, the overall effect of a rebate on deterrence is negative.

Finally, we extend our analysis to asymmetric information. The defendant knows the realization of damages while the plaintiff does not. The uniformed plaintiff makes a settlement demand that the informed defendant may accept. If the defendant rejects the demand, the plaintiff updates his beliefs about damages and then decides whether or not to take the case to court. We show that our results concerning settlement stimulation and deterrence remain true if the agents have asymmetric rather than symmetric information. Interestingly, the rebate decreases however the number of inefficiently litigated cases.

Rebating fines is thus not a clever idea in our framework. It does not stimulate settlements that would not occur absent the rebate. If parties settle without the reduction, the rebate may increase the settlement amount—however, always at the price of reduced deterrence. Moreover, the rebate makes it less attractive for a cartel member to blow the whistle under a leniency program.

1.1 Related Literature

We are not aware of any formal papers focusing on fine rebates. There is a literature concerning private and public enforcement of antitrust laws.[10] Shavell (1997) analyzes the divergence between the private and social motives to sue. When a plaintiff contemplates litigating, he does neither consider the legal costs incurred by others, nor does he recognize the positive effects on deterrence. Shavell discusses several corrective policies, one of which is to foster settlement over trial. McAfee et al. (2008) show that if courts are accurate, adding private to public enforcement increases welfare; if courts are not accurate, private enforcement increases welfare only if the government

[10] See, e.g., Segal and Whinston (2007) for a survey.

is inefficient in litigation. Bourjade et al. (2009) study antitrust litigation and settlement under asymmetric information. They find that increasing damages induce more private litigation of well-founded cases than reducing filing costs.

Buccirossi et al. (2020) analyze whether private actions for damages may jeopardize leniency programs. The evidence provided by the leniency applicant may be used in the damage action. Moreover, since the leniency applicant typically does not challenge the decision of the antitrust authority, under joint liability she may be the first one to be targeted in a private action.[11] Buccirossi et al. show that damage actions improve a leniency program if civil liability of the immunity recipient is minimized and full access to all evidence gathered by the competition authority is given to the claimants.

There is a fairly large literature on settlement bargaining. It typically finds that with symmetric information parties settle rather than file a costly suit. To generate litigation the literature resorts to asymmetric information. The workhorses are either screening models where the uninformed party screens for private information using the settlement proposals (Bebchuck (1984) and Nalebuff (1987)), or signalling models where the informed party signals private information with the settlement offers (Reinganum and Wilde (1986)).[12] We follow Nalebuff (1987).

The rest of this paper is organized as follows. The next section describes the model. In section 3 we derive our results on settlement and deterrence under symmetric information. In section 4 we discuss the asymmetric information set-up. The last section concludes. In Appendix 1 we derive the

[11] There are, however, exceptions. In the air cargo cartel Lufthansa received full immunity from fines under the European Commission's leniency program because it was the first to provide information about the cartel (europa.eu/rapid/press-release_IP-10-1487_en.htm?locale=en). Nevertheless, Lufthansa filed an appeal "based on legal considerations" (bloomberg.com/news/2011-01-27/japan-airlines-appeals-48-8-million-antitrust-fine-at-eu-court.html).

[12] See, e.g., Kennan and Wilson (1993) or Spier (2007) for surveys.

Nash Bargaining Solution which qualitatively corresponds to the solution of the random offeror game. Appendix 2 contains the derivation of the asymmetric information scenario.

2 Model

A firm has engaged in anticompetitive behavior by, e.g., participating in a cartel. The competition authority has, therefore, levied the firm a fine $f > 0$. After the fine is determined, the victim of the infringement contemplates obtaining damages from the wrongdoer.[13]

The parties first try to negotiate an out-of-court settlement; if successful, the victim gets $S \geq 0$ from the wrongdoer and drops the case. If settlement negotiations break down, the victim/plaintiff can take the firm/defendant to trial. Going to court costs each party to the conflict $c > 0$. The court awards (expected) damages $D > 0$ to the plaintiff. Going to court thus generates payoffs $D - c$ for the plaintiff and $-f - D - c$ for the defendant. Alternatively, the victim drops the case and gets 0 while the firm ends up with $-f$.[14]

The payoffs from the court's decision determine the players' outside options/threat points in the settlement negotiations. The settlement amount S is determined by random offeror bargaining: with equal probability either the plaintiff makes a take-it-or-leave-it demand or the defendant makes a take-it-or-leave-it offer.[15]

The antitrust authority wants to stimulate settlement negotiations. It will

[13] We model private enforcement as an action that follows on a public enforcement decision. Private enforcement can also be a stand-alone action—a civil action brought without any prior finding of competition law violation by an antitrust authority. In most jurisdictions private enforcement is, however, mostly represented by follow-on private actions; see OECD (2015).

[14] The firm made a profit and the victim suffered a loss from the anticompetitive behavior. Yet, these payoffs are sunk for the problem under consideration.

[15] The probability of the plaintiff making his demand in the random offeror game is related to his bargaining power in the Nash Bargaining Solution. In Appendix 1 we fully characterize the Nash Bargaining Solution for any bargaining power.

subtract the fraction $\lambda \in [0, 1]$ of the settlement payment from the fine. The wrongdoer will, therefore, end up with a net fine of $f - \lambda S$ which, however, cannot be negative. Accordingly, her payoff is $-S - \max\{f - \lambda S, 0\}$.

To summarize the game: In the first stage the victim decides about filing the lawsuit. If he does so, in stage two there is settlement bargaining following the random offeror protocol. If the parties do not reach a settlement agreement, in stage three the victim decides about taking the case to court. We focus on subgame perfect equilibria.

3 Results

We solve the game by backward induction. In the third stage, after negotiations have failed, the plaintiff takes the case to court if it has positive expected value, i.e., if $D - c > 0$; this generates payoff $D - c$ for the plaintiff and $-D - c - f$ for the defendant. Otherwise, he drops the case, leading to a payoff of 0 for the plaintiff and $-f$ for the defendant.[16]

Let us now turn to the second—the settlement stage. Consider first the case where the plaintiff goes to court. By settling the parties save the cost $2c$ and generate the subsidy λS. The least the plaintiff is willing to accept is his outside option $D - c$; the most the defendant is willing to pay is S that satisfies $S + f - \lambda S = D + c + f$ or $S = (D + c)/(1 - \lambda)$. The plaintiff when it is his turn, therefore, demands $(D + c)/(1 - \lambda)$ and the defendant when it is her turn offers $D - c$. This yields with equal probabilities of making the offer an expected settlement

$$E(S) = \frac{1}{2}\left[D - c + \frac{D + c}{1 - \lambda}\right] =: \bar{s}. \tag{1}$$

The expected settlement equals $\bar{s}$ as long as the net fine is positive. With a net fine of zero, the most the defendant is willing to pay is $S = D + c + f$ which yields under random offeror bargaining the lower bound on the expected

[16]If the plaintiff is indifferent, he does not go to court nor bring suit.

settlement payment

$$\check{s} = D + f/2. \tag{2}$$

If the plaintiff drops the case, by settling the parties do not save the cost of going to court; the surplus consists only of the subsidy λS. The plaintiff's outside option in the bargaining process is 0, meaning he accepts 0. The defendant's threat point is f. She is willing to pay S up to $S + f - \lambda S = f$ or $S = 0$. The expected settlement is, therefore, $s = 0$.

In the first stage, the plaintiff will bring suit if $s > 0$ or, equivalently, $D - c > 0$; otherwise, he will not try to collect damages.

We summarize our findings in the following Proposition.[17]

Proposition 1: *a) If $D - c \leq 0$, the plaintiff does not bring suit. He expects payoff 0 and the defendant ends up with $-f$.*
b) If $D - c > 0$, the plaintiff files the lawsuit. The parties agree on the settlement payment

$$s^* = \begin{cases} \bar{s}, & \text{if } f \geq \lambda(D+c)/(1-\lambda); \\ \check{s}, & \text{otherwise,} \end{cases}$$

where $\bar{s}$ and $\check{s}$ are given by (1) and (2). The plaintiff expects payoff s^* while the defendant ends up with $-s^* - \max\{f - \lambda s^*, 0\}$.

3.1 Settlement Stimulation

This result has several interesting implications. If $D - c < 0$, the plaintiff will not go to court in the third stage. In the negotiation stage, the threat to go to court is not credible. The solution concept of subgame perfection/backward induction implies that the defendant ignores empty threats and, therefore, does not settle. This result holds for any value of the rebate λ: Even if the full amount of the settlement can be subtracted from the fine (like in

[17] In an earlier version of this paper we show that qualitatively the same results obtain if the parties exogenously split the surplus from settlement. See papers.ssrn.com/sol3/papers.cfm?abstract_id=3527422.

the Israeli case mentioned in the Introduction), there will be no settlement unless the plaintiff indeed takes the case to court.[18] To stimulate settlement negotiations that would otherwise not take place, subtracting the settlement payment from the fine is ineffective. To trigger settlement bargaining, the plaintiff has to be induced to actually take the case to court. This can, e.g., be achieved by increasing D or lowering c.[19]

Consider now the case $D > c$. Here the plaintiff would take the case to court and the parties, therefore, settle. For large fines they agree on the settlement amount $\bar{s} = .5[D - c + (D + c)/(1 - \lambda)]$ which increases in λ at an increasing rate.[20] Thus, if the competition authority wants larger settlement amounts, increasing the fraction λ that can be subtracted from the fine is effective—given the parties engage in settlement negotiations in the first place.

The fraction λ affects the settlement via two channels. First, reducing the fine increases the surplus of not going to court, thus making the pie larger. Second, the higher λ the lower the defendant's marginal cost of settling: for each unit the plaintiff obtains, the defendant effectively only pays $(1 - \lambda)$. For example, in the aforementioned Israeli case where $\lambda = 1$, each Shekel the plaintiff got was entirely subtracted from the fine so that banks' marginal cost was zero.[21] For small fines the settlement amount is actually independent of λ.

To summarize our results so far: The rebate λ does not affect the probability of a settlement. If the parties settle anyhow, introducing the rebate may increase the settlement amount.

[18] For $\lambda = 1$ the defendant is actually indifferent as to s. Yet, with a small bargaining cost $s = 0$ is the unique outcome. If $D > c$, $\lambda = 1$ yields $\check{s}$.

[19] It seems difficult for the competition authority to influence D and c which are after all in the realm of the civil court. The antitrust agency could, e.g., grant access to documents from the antitrust case to the plaintiff, thus lowering c and increasing D.

[20] Formally, $\partial s/\partial\lambda = (D + c)/2(1 - \lambda)^2 > 0$ and $\partial^2 s/\partial\lambda^2 = (D + c)/(1 - \lambda)^3 > 0$.

[21] The two effects are reminiscent of the income and substitution effects in consumption resulting from a price decrease.

3.2 Deterrence

Let us now turn to deterrence. The defendant is deterred by the sum of the fine and damages. We denote this total expected payment which eventually deters by z.

If $D \leq c$, $s = 0$ and $z = f$: any changes in λ have no effect on deterrence. Consider now the interesting case $D > c$. Increasing λ increases the reduction in the fine, making the surplus from settlement larger. The surplus is shared, implying that not only the plaintiff but also the defendant benefits from a reduction in fine.

Specifically, for large fines $z = f + (1-\lambda)\bar{s} = f + D - .5\lambda(D-c)$; the first term measures public deterrence, the second term private deterrence, and the third term captures the effect of rebate. The total payment decreases with λ.[22] Increasing λ increases $\bar{s}$—the marginal effect on the settlement. However, the fraction the wrongdoer deducts goes up as well and also applies to the inframarginal settlement amount. The effect from reducing the inframarginal units is stronger than the marginal effect: the total payment of a cartel member is lower, the higher the reduction in fine λ.

For small fines the settlement amount is independent of λ. Consequently, for all possible values of f deterrence weakly decreases with λ.

3.2.1 Leniency

Given that the fine reduction weakens deterrence for an "ordinary" cartel member, it is interesting to analyze the effects on a leniency applicant under a leniency program. We consider a program where only the first applicant is entitled to leniency and gets a 100% fine reduction.[23] We use the subscript a for the applicant and no subscript for the other cartelists.

In an early stage, before the cartel is potentially detected, the leniency

[22] Formally, $\partial z / \partial \lambda = -(D-c)/2 < 0$.

[23] There is a fairly large literature on leniency programs; see, e.g., Motta and Polo (2003), Spagnolo (2004), or Chen and Rey (2013). For a survey see Harrington (2017).

applicant decides about blowing the whistle. If she doesn't do so and the cartel is eventually covered up, she pays a fine like all the other cartel members. By contrast, if she applies for leniency, the cartel is detected for sure, but she is exempted from paying the fine. The decision of the applicant is thus affected, among other things, by the total expected payments generated by blowing versus not blowing the whistle.

Suppose the applicant blew the whistle and was granted leniency. Since the applicant's fine is zero, it cannot be reduced in case of a settlement.

Consider now the two cases: If $D \leq c$, the plaintiff does not go to court so that $s = 0$; the applicant's total payment $z_a = 0$. If $D > c$, the plaintiff's threat to sue the applicant is credible. The total surplus from an out-of-court settlement is $2c$, there is no fine that can be reduced. The plaintiff has the outside option $D - c$ and the defendant $D + c$. Random offeror bargaining yields $s = D$ which implies $z_a = D$.[24]

The leniency applicant's total payment z_a is thus either 0 or D. It is independent of λ. It is lower than her colleague's total payment z which is either f or $s + \max\{f - \lambda s, 0\}$. Yet, for $D > c$ the colleague's total payment z decreases with λ, so that the difference $z - z_a$ also shrinks. Consequently, the relative attractiveness of blowing the whistle (alternatively, the loss of being the sucker) goes down with λ. This argument actually holds for any level of liability of the leniency applicant.[25] The fact that she pays no fine that can be reduced drives the result.[26]

With or without a leniency program, rebating the fine thus weakens de-

[24] This result follows from Proposition 1.

[25] For example, in the EU Art. 11(4) of Directive 2014/104/EU provides "that an immunity recipient is jointly and severally liable as follows: (a) to its direct or indirect purchasers or providers; and (b) to other injured parties only where full compensation cannot be obtained from the other undertakings that were involved in the same infringement of competition law." In the US the 2004 Antitrust Criminal Penalty Enhancement and Reform Act eliminates treble damages and joint liability for the amnesty recipient.

[26] Note that we do not answer the general question of whether or not damage actions reduce the attractiveness of leniency programs. This issue is, e.g., addressed in Buccirossi et al. (2020).

terrence. Whether the reduced deterrence is detrimental or not depends on the status quo. If we start out with underdeterrence, rebating the fine may increase underdeterrence. Suppose, by contrast, that the damage awarded by the court reflects the harm to the public. The total payment of damage plus fine exceeds the harm and potentially leads to overdeterrence. In this case, rebating the fine may reduce overdeterrence.[27]

4 Asymmetric Information

To illustrate the effects of a fine reduction under asymmetric information, we have to further specify the set-up, in particular the bargaining process. We follow the framework developed by Bebchuk (1984) and Nalebuff (1987).[28] The defendant has superior information about the damage than the plaintiff.[29] Specifically, the defendant knows the realization D of the damages. The plaintiff only knows that damages are drawn from a probability distribution. In Appendix 2 we consider the general case of log-concave distributions; here we confine our attention to damages being uniformly distributed on $[0, 1]$ so that expected damages $E[D] = 1/2$.

The game proceeds as follows: In the first stage, the plaintiff decides about filing the lawsuit. In the second stage, the uninformed plaintiff makes the take-it-or-leave-it demand S. In the third stage, the informed defendant

[27]For these argument to be valid the firms must have several different possibilities to collude. With only one possibility, charging the monopoly price say, any sanction greater or equal to the harm deters monopoly pricing and there is no overdeterrence. To meaningfully talk about over- or underdeterrence, there must be more than one option to collude; see Emons (2020). For a discussion of sub-optimal cartel fines see, e.g., Bageri et al. (2013).

[28]Bebchuk (1984) assumes that the lower bound of D exceeds c which implies that the plaintiff always goes to court in stage 4. Nalebuff (1987) extends Bebchuk (1984) to possible negative value claims. Since in our set-up $c > 0$ and $D \in [0, 1]$, we follow Nalebuff (1987). The difference between Bebchuk (1984) and Nalebuff (1987) comes to the fore in Proposition 2 b) i). The plaintiff demands a high settlement to commit to go to court should the defendant reject the demand. See Choi and Spier (2018) for a related analysis.

[29]Osborne (1999) presents some empirical evidence that defendants actually do better in predicting court rulings than plaintiffs.

either accepts or rejects the settlement demand. If she accepts, bargaining is over. Otherwise, there is a fourth stage where the plaintiff either drops the case or proceeds to court. We focus on perfect Bayesian equilibria.

If the case has ex ante negative expected value, i.e., $c \geq 1/2$, the defendant will reject any demand S. The plaintiff gets no new information through bargaining. He does not update his expectation and, therefore, does not litigate. This result corresponds to our symmetric information one and holds for any value of λ. Rebating the fine has thus no effect on deterrence.

Let us now turn to the other possibility where the case has ex ante positive expected value. Here we build on Nalebuff's result that in equilibrium the plaintiff always takes the case to court; the proof thereof is relegated to the Appendix.

Suppose the plaintiff demands S. If the defendant accepts this demand, she incurs the cost $S + \max\{f - \lambda S, 0\}$. If she rejects and the plaintiff takes the case to court, her cost is $f + D + c$. Defendants with $D \leq S + \max\{f - \lambda S, 0\} - c - f =: D(S)$, therefore, reject the demand; defendants with $D > D(S)$ accept. Thus, with probability $1 - D(S)$ the defendant accepts the demand S and with probability $D(S)$ she turns it down. If the plaintiff indeed takes the case to court, he expects to get $E[D|D \leq D(S)] - c = D(S)/2 - c$. To commit to go to court in stage 4, the plaintiff has to demand at least $S = \min\{3c/(1-\lambda), 3c + f\}$. The plaintiff picks S so as to maximize his expected payoff $(1 - D(S))\, S + D(S)\,(D(S)/2 - c)$.

The equilibrium depends on the size of the fine. Let us sketch the outcome for a large fine. The plaintiff demands $\bar{S} := (1 - c + 2\lambda c)/(1 - \lambda^2)$ which is increasing in λ. Defendants with $D \leq D(\bar{S}) = (1 - 2c + \lambda c)/(1 + \lambda)$, reject the demand; defendants with $D > D(\bar{S})$ accept. If the plaintiff takes the rejections to court, he expects to get $D(\bar{S})/2$ which exceeds the litigation cost for $c \leq 1/(4 + \lambda)$. The plaintiff, therefore, indeed takes the rejected demands to court.

The general results for uniformly distributed damages are summarized in the following Proposition.

Proposition 2: *a) If* $E[D] - c \leq 0$*, the plaintiff does not file suit. He has payoff 0 and the defendant ends up with* $-f$*.*
b) If $E[D] - c > 0$*, the plaintiff brings suit.*
i) For $1/(4+\lambda) \leq c < 1/2$*, he demands* $S^* = \min\{3c/(1-\lambda), 3c+f\}$*.*
ii) For $c < 1/(4+\lambda)$*, he demands*

$$S^* = \begin{cases} \bar{S}, & \text{if } f \geq \lambda\bar{S}; \\ f/\lambda, & \text{if } \lambda(1-c) \leq f < \lambda\bar{S}; \\ 1-c, & \text{if } f < \lambda(1-c). \end{cases}$$

The plaintiff has expected payoff $S^* - D(S^*)(S^* - D(S^*)/2 + c)$*. Defendants of type* $D \geq D(S^*)$ *get* $-S^* - \max\{f - \lambda S^*, 0\}$ *while defendants of type* $D < D(S^*)$ *end up with* $-D - f - c$*.*

Note that for all possible scenarios the plaintiff takes every rejected settlement demand to court. The parties thus go to court for low D even though this is inefficient—the typical outcome for bargaining under asymmetric information; see Myerson and Satterthwaite (1983).

4.1 Settlement Stimulation

As to settlement stimulation, here the results are similar to section 3.1. The rebate does not affect cases with negative expected value. If the case has small expected value, the settlement and the plaintiff's payoff go up with λ.[30] If the case has large expected value, for large fines the settlement as well as the plaintiff's expected payoff increase due to the rebate.[31] For intermediate

[30] Formally, for large fines $\partial S^*/\partial\lambda = 3c/(1-\lambda)^2 \geq 0$ and the plaintiff's expected payoff equals $S^*(1-2c)$.

[31] Formally, $\partial\bar{S}/\partial\lambda = 2c/(1-\lambda^2) + 2\lambda(1-c+2\lambda c)/(1-\lambda^2)^2 \geq 0$ and the first derivative of the plaintiff's expected payoff is $(1-D(S^*))\partial S^*/\partial\lambda - (S^* - D(S^*) + c)\partial D(S^*)/\partial\lambda$. We show in the next footnote that $D(S^*)$ decreases with λ. Thus, $D(S^*) \leq 1-c < 1$ and the first term is positive. Moreover, $S^* - D(S^*) + c = 2c + f - \max\{f - \lambda S^*, 0\} \geq 0$, thus the entire expression is positive.

fines, the settlement decreases with λ and it is independent of λ for small fines.

Note that $D(S^*)$ weakly decreases with λ: the higher the rebate, the lower the number of cases taken to court.[32] The rebate increases the defendant's acceptance range as well as the plaintiff's settlement demand. The first effect is, however, stronger than the second one so that fewer cases are inefficiently prosecuted.

4.2 Deterrence

Let us now turn to deterrence. If $D \leq D(S^*)$, the defendant rejects, is taken to court, and ends up paying $f + D + c$. This total payment is independent of λ. If $D > D(S)$, the defendant accepts and her total payment is $Z = f + (1 - \lambda)S$. If the case has small expected value, $Z = 3c + f$ which is independent of λ. If the case has large large expected value, for large fines $Z = f + (1 - c + 2\lambda c)/(1 + \lambda)$. This total payment decreases with λ.[33] Increasing λ has two effects. On the one hand, S goes up, resulting in a higher payment for the defendant. On the other hand, a larger share of this payment can be deducted from the fine, decreasing the defendant's net fine. The second effect is stronger than the first one. Thus, the rebate lowers deterrence. The same result holds for medium values of f. For small values of f increasing λ has no effect on deterrence. Consequently, as under symmetric information under asymmetric information deterrence weakly decreases with λ.

Recall that $D(S^*)$ goes down with λ, i.e., fewer cases are prosecuted. This has, however, no effect on deterrence because the defendant of type $D(S^*)$ is indifferent between accepting S^* and going to court.

As to leniency, all of our findings under symmetric information remain

[32] Formally, $\partial D(\bar{S})/\partial\lambda = (3c - 1)/(1 + \lambda)^2 < 0$ since $c < 1/(4 + \lambda)$, $\partial D(f/\lambda)/\partial\lambda = -f/\lambda^2 \leq 0$ and $\partial D(1 - c)/\partial\lambda = 0$. Moreover, $D(S^*)$ is continuous and therefore weakly decreases with λ.

[33] Formally, $\partial Z/\partial\lambda = (3c - 1)/(1 + \lambda)^2 < 0$ for $c \leq 1/(4 + \lambda)$.

true under asymmetric information.

5 Conclusions

In this paper we have analyzed the effects of rebating fines by the redress paid to the victims. This policy turns out to be fairly ineffective, if not counterproductive, in our set-up. It does not stimulate settlements that would otherwise not take place. If parties settle without the reduction, the rebate may indeed increase the settlement amount—however, the rebate always reduces deterrence. Moreover, the rebate makes it less attractive for a cartel member to blow the whistle under a leniency program.

A few remarks are in order. Our results rely heavily on backward induction arguments. If the plaintiff does not take the case to court, he has no credible threat in the settlement negotiations. The defendant, therefore, rejects any settlement demand in the first place, independently of the rebate. Backward induction/subgame perfection is probably the most widely accepted refinement of the Nash equilibrium concept. Any results which are based on empty threats would not seem convincing to us.

For our findings on deterrence the defendant needs to rationally foresee the fine reduction. This applies, e.g., if the rebate is a well established policy of the antitrust authority. This was probably not the case in the Swiss decisions. The Swiss Competition Commission granted the rebate for the first time in 2019. It seems unlikely that the construction companies anticipated the fine reduction when they engaged in bid rigging during the years 2004-2012. If the rebate is an unexpected or a random event like in the EU, it has no or little effect on deterrence.

We have focused on follow-on private actions which is the prevailing form of private enforcement. The analysis of stand-alone private actions raises some additional issues: Are there at all follow-on public actions with a fine that can be reduced? Does the antitrust authority subtract only uncontested redress as in our set-up, or is contested redress also eligible? These questions are left for future research.

Appendix 1

In this Appendix we completely characterize the Nash Bargaining Solution (NBS) which yields a similar solution as the alternating offeror game.[34] In the alternating offeror model s^* is the average settlement amount of two different bargaining games. The NBS is the unique solution of a maximization problem.

The NBS which we denote by s^{NB} yields a reasonable outcome without explicitly modeling the bargaining game. Note that in our set-up the settlement is not only a transfer of surplus from the defendant to the plaintiff; it is also a means to increase the size of the surplus.

Let $\alpha \in (0,1)$ denote the bargaining power of the plaintiff and $(1-\alpha)$ the bargaining power of the defendant. The plaintiff settles if $s \geq \max\{0, D-c\}$. The defendant can at most reduce her fine to zero, i.e., she settles if $s + \max\{f - \lambda s, 0\} \leq D + c + f$.

First, consider the case $D \leq c$. s^{NB} maximizes

$$s^{\alpha}(-s - \max\{f - \lambda s, 0\} + f)^{1-\alpha}.$$

We have $s^{NB} = 0$ which is the same outcome as in the main text. Whenever the plaintiff has a non-credible threat, there is no settlement payment.

Next suppose $D > c$; the plaintiff's threat to sue is thus credible. If the parties settle, the plaintiff gets s and the defendant pays $s + \max\{f - \lambda s, 0\}$. The outside option if bargaining fails are $D - c$ for the plaintiff and $-D - c - f$ for the defendant. s^{NB} maximizes

$$(s - D + c)^{\alpha}(-s - \max\{f - \lambda s, 0\} + f + D + c)^{1-\alpha}$$

which yields the solution

$$s^{NB} = \begin{cases} \bar{s}, & \text{if } f \geq \lambda \bar{s}; \\ f/\lambda, & \text{if } \lambda \hat{s} \leq f < \lambda \bar{s}; \\ \check{s}, & \text{if } f < \lambda \hat{s}, \end{cases}$$

where $\bar{s} := (1-\alpha)(D-c) + \alpha(D+c)/(1-\lambda)$, $\hat{s} := (D - c(1-2\alpha))/(1-\lambda\alpha)$, and $\check{s} := D + c(2\alpha - 1) + \alpha f$.

[34] For more on the NBS see, e.g., Roth (1979). Binmore, Rubinstein, and Wolinsky (1986) analyze the relation between the static NBS and a sequential bargaining model à la Rubinstein (1982).

We have qualitatively similar results as in the main text. For $s^{NB} = \bar{s}$, the settlement increases at an increasing rate in λ.[35] The plaintiff's bargaining power as measured by α determines the distribution of the surplus. The gains of the plaintiff are $\bar{s} - (D - c) = \alpha(2c + \lambda(D - c))/(1 - \lambda)$ and gains of the defendant amount to $(1-\alpha)(2c+\lambda(D-c))$. The plaintiff benefits more from the fine reduction than the defendant if $\lambda \geq (1 - 2\alpha)/(1 - \alpha)$. For α small, a large λ is necessary for the plaintiff to gain more than the defendant; for $\alpha \geq 1/2$ the plaintiff does better for any λ.[36]

In our set-up the plaintiff does not get the share α of the surplus $2c + \lambda s$. λ increases the surplus by decreasing the defendant's marginal cost: for each unit the plaintiff obtains, the defendant only pays $1-\lambda$. The plaintiff's marginal utility is one while the defendant's marginal disutility is only $1 - \lambda$. Whenever parties' marginal utilities differ, the NBS does not yield the distribution $\alpha/(1 - \alpha)$ of the surplus: the party with the higher marginal utility gets more than his/her bargaining power.[37]

Finally, consider deterrence. Here we have $z = f+(D-(1-2\alpha)c)-\lambda(1-\alpha)(D-c)$; the first term measures public deterrence, the second term private deterrence, and the third term captures the effect of rebate. Private deterrence goes up with the plaintiff's bargaining power. The effect of λ on deterrence is negative, yet less so the stronger the plaintiff. A powerful plaintiff gets most of the surplus created by the rebate, resulting in a small effect on deterrence.

Appendix 2

In this Appendix, we derive the equilibrium under asymmetric information sketched in the paper for log-concave distributions. The defendant knows the realization of D while the plaintiff only knows its distribution. D is distributed on $[\underline{D}, \overline{D}]$ with density g and CDF G. The density has full support, is differentiable, and log-concave. Moreover, $\underline{D} < c$, i.e., negative value cases are possible. Let D define the defendant's type.

In the first stage, the plaintiff decides whether or not to bring suit. In the second stage, the uninformed plaintiff makes a take-it-or-leave-it demand S. In the third stage, the informed defendant either rejects or accepts the settlement demand. If she accepts, bargaining is over. If she rejects, there is a fourth stage

[35] In the other two cases the net fine is zero.

[36] $\bar{s}$ is a supermodular function in α and λ, thus the effect on $\bar{s}$ from increasing λ is stronger the higher α.

[37] See, e.g., Mas-Colell, Whinston, and Green (1995), p. 842-843 or Osbborne and Rubinstein (1990), p. 18-19.

where the plaintiff either drops the case or proceeds to court. Denote the probability that the plaintiff litigates by η.

If the parties settle out of court, the plaintiff gets S and the defendant pays $Z := S + \max\{f - \lambda S, 0\}$. If the plaintiff litigates, he gets $D - c$ and the defendant pays $D + c + f$. When the case is dropped, the plaintiff gets zero and the defendant pays f.

For all possible values of S we will first derive Nash equilibria for the subgames starting in stage 3. Then we will determine the plaintiff's optimal demand S.

Consider first the defendant in stage 3. A defendant of type $D \geq D(S, \eta)$ accepts the settlement offer S, where

$$D(S, \eta) := \frac{Z(S) - \eta c - f}{\eta}.$$

Next consider the plaintiff in stage 4. Since negative expected value claims are possible, there exists a unique cut-off value $\hat{D}$ where the plaintiff is indifferent between litigating or dropping the case. $\hat{D}$ is defined by

$$\frac{1}{G(\hat{D})} \int_{\underline{D}}^{\hat{D}} x g(x) \, \mathrm{d}x = E[D | D \leq \hat{D}] = c.$$

If $D < \hat{D}$, the plaintiff drops the case, thus $\eta = 0$. If $D > \hat{D}$, the plaintiff litigates, i.e., $\eta = 1$. If $D = \hat{D}$, the plaintiff is indifferent, accordingly, $\eta \in [0, 1]$. The cut-off $\hat{D}$ is independent of S and λ.

We distinguish between two possibilities: the case has a priori negative or positive expected value. Let us start with the easy one where $E[D] \leq c$, i.e., the case has negative expected value. For all possible S, the defendant rejects the demand. The plaintiff learns nothing from the defendant's decision, sticks to his prior, and chooses $\eta = 0$ since $E[D] \leq c$. This result holds for any value of the rebate λ. For negative expected value cases subtracting the settlement payment from the fine is, therefore, ineffective in stimulating settlement negotiations.

Let us now turn to the interesting possibility where $E[D] > c$, i.e., the case has a priori positive expected value. Suppose $\eta = 1$. Then defendants with $D \leq D(S, 1)$ reject the demand. If $\hat{D} \leq D(S, 1)$, or equivalently $E[D | D \leq D(S, 1)] > c$, the plaintiff will indeed go to court. If $\hat{D} > D(S, 1)$, or equivalently $E[D | D \leq D(S, 1)] < c$, the plaintiff will not go to court: a pure strategy equilibrium fails to exist. Therefore, we construct a mixed strategy equilibrium. The plaintiff is willing to mix in stage 4 if $D(S, \eta) = \hat{D}$ which immediately yields $\eta = (Z - f)/(\hat{D} + c)$. Defendants with $D < \hat{D}$ reject S. Plaintiffs are indifferent whether to drop the case or not.

We summarize these results in the following Lemma.

Lemma 1: *Let $E[D] > c$.*

(i) If $\hat{D} \leq D(S,1)$, the plaintiff litigates with $\eta = 1$ and defendants of type $D > D(S,1)$ accept while the others reject;

(ii) if $\hat{D} > D(S,1)$, the plaintiff litigates with $\eta = (Z-f)/(\hat{D}+c)$ and defendants of type $D > \hat{D}$ accept while the others reject.

Lemma 1 establishes for any settlement demand S an equilibrium for the ensuing subgame. The plaintiff thus chooses S so as to maximize

$$(1 - G(D(S)))S + G(D(S))\eta(S)(E[D|D \leq D(S)] - c),$$

where write $D(S)$ instead of $D(S, \eta(S))$.

With probability $(1 - G(D(S)))$ the defendant accepts and pays S. With probability $G(D(S)))$ the defendant rejects the demand. The plaintiff litigates with probability $\eta(S)$ which yields in expectation $E[D|D \leq D(S)]$ at a cost c. With probability $(1 - \eta(S))$ he drops the case and gets nothing.

Rather than solving the plaintiff's problem directly for S, we determine the defendant's total payment Z where $S = \min\{(Z - f)/(1 - \lambda), Z\}$. The plaintiff thus picks Z so as to maximize

$$V(Z) = (1 - G(q(Z))) \min\{\frac{Z - f}{1 - \lambda}, Z\} + G(q(Z))\beta(Z)(E[D|D \leq q(Z)] - c),$$

where $\beta(Z) := \min\{(Z-f)/(\hat{D}+c), 1\}$ and $q(Z) := (Z-\beta(Z)c-f)/\beta(Z)$. $V(Z)$ is continuous; furthermore, it is differentiable except at $Z = f/\lambda$ and $Z = \hat{D}+c+f$.

$V(Z)$ strictly increases if $Z \leq \hat{D} + c + f$: The condition implies the case *(ii)* of Lemma 1, i.e., defendants of type $D \geq \hat{D}$ accept the plaintiff's demand. The threshold type is independent of Z. Therefore, $G(q(Z))$ is constant in Z while all remaining terms increase in Z. Thus, the defendant's minimal payment to the plaintiff is $\hat{D}+c+f$, which is independent of λ. Consequently, the plaintiff always litigates.

The equilibrium payment Z is given by the following proposition:

Proposition 3: *If $\lambda \leq f/(\hat{D} + c + f)$, the defendant pays:*

$$Z = \begin{cases} \hat{D} + c + f, & \text{if } V_1'(\hat{D} + c + f) < 0; \\ Z_1, & \text{if } V_1'(\hat{D} + c + f) \geq 0 > V_1'(f/\lambda); \\ f/\lambda, & \text{if } V_1'(f/\lambda) \geq 0 > V_2'(f/\lambda); \\ Z_2, & \text{if } V_2'(f/\lambda) \geq 0, \end{cases}$$

where $V_1'(\cdot)$, $V_2'(\cdot)$, Z_1, and Z_2 are defined in the proof. Z weakly decreases in λ.

If $\lambda > f/(\hat{D}+c+f)$, the defendant pays:

$$Z = \begin{cases} \hat{D}+c+f, & \text{if } V_2'(\hat{D}+c+f) < 0; \\ Z_2, & \text{if } V_2'(\hat{D}+c+f) \geq 0, \end{cases}$$

where $V_2'(\cdot)$ and Z_2 are defined in the proof. Z is independent of λ.

Proof: Consider first the case $\lambda \leq f/(\hat{D}+c+f)$. We split the plaintiff's problem into two parts:

$$\begin{aligned} &\max_Z V_1(Z) = (1-G(q(Z)))\frac{Z-f}{1-\lambda} + G(q(Z))(E[D|D \leq q(Z)] - c) \\ &\text{s.t. } \hat{D}+c+f \leq Z \leq f/\lambda, \end{aligned} \tag{3}$$

and

$$\begin{aligned} &\max_Z V_2(Z) = (1-G(q(Z)))Z + G(q(Z))(E[D|D \leq q(Z)] - c) \\ &\text{s.t. } Z \geq f/\lambda, \end{aligned} \tag{4}$$

with $q(Z) = Z - c - f$.

We first analyze problem (3) without constraints. The first order condition can be written as

$$(1-\lambda)V_1'(Z) = 1 - G(q(Z)) - g(q(Z))(2c(1-\lambda) + (Z-f)\lambda) = 0.$$

Plugging the first order condition into the second order condition

$$(1-\lambda)V_1''(Z) = -g(q(Z))(1+\lambda) - g'(q(Z))(2c(1-\lambda) + (Z-f)\lambda) < 0$$

and rearranging shows that the second order condition holds if

$$g^2(\cdot)(1+\lambda) + g'(\cdot)(1-G(\cdot)) > 0,$$

which is true for log-concave $g(\cdot)$. Consequently, if it is interior, there exists a unique maximum Z_1.

With the implicit function theorem we derive the sign of $dZ_1/d\lambda$. Since $V_1''(Z) < 0$, the sign is determined by the sign of

$$\frac{\partial^2 V_1(Z;\lambda)}{\partial Z \partial \lambda}(1-\lambda)^2 = 1 - G(q(Z)) - g(q(Z))(Z-f).$$

Plugging in the first order condition shows that this expression is negative if and only if $g(q(Z))(1-\lambda)(-Z+f+2c) \leq 0$; this holds since $Z \geq \hat{D}+c+f \geq 2c+f$. We have thus shown that if the solution is interior, Z_1 decreases in λ, which implies that deterrence goes down with the fine's reduction. The solution is indeed interior if the following two conditions hold: $V_1'(\hat{D}+c+f) > 0$ and $V_1'(f/\lambda) < 0$.[38]

Next consider problem (4). Ignoring the constraints, the first order condition can be written as

$$V_2'(Z) = 1 - G(q(Z)) - g(q(Z))(2c+f) = 0.$$

The second order condition is

$$V_2''(Z) = -g(q(Z)) - g'(q(Z))(2c+f) < 0$$

and plugging in the first order condition and manipulating shows that the condition is equivalent to

$$g^2(\cdot) + g'(\cdot)(1 - G(\cdot)) > 0,$$

which holds for log-concave $g(\cdot)$. Thus, there exists a unique maximum Z_2 which is independent of λ. To have an interior solution, $V_2'(f/\lambda) > 0$.

Finally, consider the case $\lambda > f/(\hat{D}+c+f)$. The plaintiff's problem simplifies to

$$\begin{aligned} &\max_Z V_2(Z) = (1 - G(q(Z)))Z + G(q(Z))(E[D|D \leq q(Z)] - c) \\ &\text{s.t. } Z \geq \hat{D} + c + f. \end{aligned} \tag{5}$$

Problem (5) has the same first order condition for an interior solution as problem (4). The solution does not depend on λ. The maximum is either $Z = \hat{D}+c+f$ or, if $V_2'(\hat{D}+c+f) > 0$, the interior solution Z_2. Thus, whenever $\lambda > f/(\hat{D}+c+f)$, there is no effect on the deterrence. □

When Z equals Z_1 or f/λ, deterrence goes down with the rebate. All other payments of the defendant do not depend on λ. Consequently, deterrence weakly decreases in the fine reduction.

Finally, we analyze how the reduction affects trials. Due to asymmetric information some cases go to court. Only defendants of type $D \geq D(S, \eta)$ accept the settlement offer. The plaintiff's offer S results in a subgame of case (i) in Lemma 1. The plaintiff always litigates when a defendant rejects his offer, i.e., $\eta = 1$. Thus, in the subgame perfect equilibrium, defendants of type $D \geq D(S,1) = Z(S) - c - f$ accept the plaintiff's offer. It follows from Proposition 1 that the defendant's

[38]Note that $q(Z_1)$ also decreases, which implies that more defendants will accept the settlement demand: fewer cases will be taken to court.

payment Z weakly decreases in λ. A reduction in fine encourages out of court settlement, yet only if the plaintiff credibly litigates.

The reduction in fine lowers the defendant's payment Z and thereby incentivizes her to accept the plaintiff's settlement offer. Consider the defendant's expected payment

$$z = \int_{\underline{D}}^{Z-c-f} (D + c + f) \; \mathrm{d}G(D) + \int_{Z-c-f}^{\bar{D}} Z \; \mathrm{d}G(D).$$

Using Leibniz rule we get

$$\frac{\partial z}{\partial \lambda} = Zg(Z - c - f) - Zg(Z - c - f) + \int_{Z-c-f}^{\bar{D}} \frac{\partial Z}{\partial \lambda} \; \mathrm{d}G(D) \leq 0.$$

Similar to symmetric information, the defendant's expected payment decreases in λ—resulting in lower deterrence.

References

BAGERI, VASILIKI, KATSOULACOS, YANNIS, AND GIANCARLO SPAGNOLO. 2013. "The Distortive Effects of Antitrust Fines Based on Revenue," 123 *Economic Journal* 545-557.

BEBCHUCK, LUCIAN. 1984. "Litigation and Settlement Under Imperfect Information," 15 *Rand Journal of Economics* 404-415.

BINMORE, KEN, RUBINSTEIN, ARIEL, AND ASHER WOLINSKY. 1986. "The Nash Bargaining Solution in Economic Modelling," 17 *Rand Journal of Economics* 176-188.

BUCCIROSSI, PAOLO, MARVÃO, CATARINA, AND GIANCARLO SPAGNOLO. 2020. "Leniency and Damages: Where is the Conflict?," 49 *Journal of Legal Studies* 335-379.

BOURJADE, SYLVAIN, REY, PATRICK, AND PAUL SEABRIGHT. 2009. "Private Antitrust Enforcement in the Presence of pre-trial Bargaining," 57 *Journal of Industrial Economics* 372-409.

CARTEL WORKING GROUP. 2019. "Development of Private Enforcement of Competition Law in ICN Jurisdictions,"
ec.europa.eu/competition/cartels/icn/private_enforcement_chapter_en.pdf.

CHEN, ZHIJUN AND PATRICK REY. 2013. "On the Design of Leniency Programs," 56 *Journal of Law and Economics* 917-957.

CHOI, ALBERT, AND KATHRYN SPIER. 2018. "Taking a Financial Position in Your Opponent in Litigation," 108 *American Economic Review* 3626-3650.

EMONS, WINAND. 2020. "The Effectiveness of Leniency Programs when Firms choose the Degree of Collusion," 70 *International Journal of Industrial Organization* Article 102619.

EU. 2006. "Making Antitrust Damages Actions more Effective in the EU: Welfare Impact and Potential Scenarios," Report for the European Commission Contract DG COMP/2006/A3/01228, ec.europa.eu/competition/antitrust/actionsdamages/files_ white_paper/impact_study.pdf.

HARRINGTON, JOSEPH. 2017. *The Theory of Collusion and Competition Policy,* Cambridge, Massachusetts, MIT Press.

KENNAN, JOHN AND ROBERT WILSON. 1993. "Bargaining with Private Information," 31 *Journal of Economic Literature* 45-104.

MAS-COLELL, ANDREU, WHINSTON, MICHAEL, AND JERRY GREEN. 1995. *Microeconomic Theory,* Oxford, Oxford University Press.

MCAFEE, PRESTON, MIALON, HUGO, AND SUE MIALON. 2008. "Private v. Public Antitrust Enforcement: A Strategic Analysis," 92 *Journal of Public Economics* 1863-1875.

MOTTA, MASSIMO AND MICHELE POLO. 2003. "Leniency Programs and Cartel Prosecution," 21 *International Journal of Industrial Organization* 347-379.

MYERSON, ROGER AND MARK SATTERTHWAITE. 1983. "Efficient Mechanisms for Bilateral Trading," 29 *Journal of Economic Theory* 265-281.

NALEBUFF, BARRY. 1987. "Credible Pretrial Negotiation," 18 *Rand Journal of Economics* 198-210.

OECD. 2015. "Relationship between Public and Private Antitrust Enforcement," www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DAF/COMP /WP3(2015)14&doclanguage=en

OSBORNE, EVAN. 1999. "Who Should Be Worried About Asymmetric Information in Litigation?," 19 *International Review of Law and Economics* 399-409.

OSBORNE, MARTIN AND ARIEL RUBINSTEIN. 1990. *Bargaining and Markets,* San Diego, Academic Press.

REINGANUM, JENNIFER AND LOUIS WILDE. 1986. "Settlement, Litigation, and the Allocation of Litigation Costs," 17 *Rand Journal of Economics* 557-566.

ROTH, ALVIN. 1979. *Axiomatic Models of Bargaining,* Berlin, Springer.

RUBINSTEIN, ARIEL. 1982. "Perfect Equilibrium in a Bargaining Model," 50 *Econometrica* 97-109.

SEGAL, ILYA AND MICHAEL WHINSTON. 2007. "Public vs Private Enforcement of Antitrust Law: A Survey," 28 *European Competition Law Review* 306-315.

SHAVELL, STEVEN. 1997. "The Fundamental Divergence between the Private and the Social Motive to Use the Legal System," 24 *Journal of Legal Studies* 575-612.

SPAGNOLO, GIANCARLO. 2004. "Divide et Impera: Optimal Leniency Programmes," CEPR Discussion Paper No. 4840,

cepr.org/active/publications/discussion_papers/dp.php?dpno=4840#.
SPIER, KATHRYN. 2007. "Litigation," in Mitchell Polinsky and Steven Shavell, eds., *Handbook of Law and Economics,* Amsterdam, Elsevier.
WILS, WOUTER. 2009. "The Relationship between Public Antitrust Enforcement and Private Actions for Damages," 32 *World Competition* 3-26.