# On the optimal use of commitment decisions under European competition law

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**Abstract**

In Europe, competition authorities have the power to close antitrust cases with "commitment decisions" after the concerned firms have offered agreed remedies. We show that the optimal use of this instrument is governed by a tradeoff between deterrence of potentially anticompetitive practices and early restoration of effective competition. We relate the optimal policy to the distribution of firm profit and consumer harm among cases. We find, however, that the optimal policy is generally not enforceable when the authority cannot credibly announce its policy prior to the firms' strategic decisions. The lack of authority credibility may translate into insufficient or excessive use of commitment decisions.

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## 1. Introduction

The enforcement of competition law relies on both formal and informal procedural instruments. Antitrust authorities do not always adopt formal decisions that establish infringements and impose financial sanctions and/or injunctions. They also close cases after the concerned firms have offered an agreed remedy. This is commonly done in the Unites States through consent decrees or consent orders. In Europe, the regulatory framework in force from 1962 to 2003 was silent about this issue and there were relatively few cases settled this way at that time.[1] The modernization of the European legal framework, that occurred in 2003, introduced a formal way to close a case, referred to as a "commitment decision". Under the commitment procedure, a firm suspected of implementing anticompetitive practices may offer to bring them to an end in exchange for fine immunity and the European Commission may formally close the case under investigation:

> "Where the Commission intends to adopt a decision requiring that an infringement be brought to an end and the undertakings concerned offer commitments to meet the concerns expressed to them by the Commission in its preliminary assessment, the Commission may by decision make those commitments binding on the undertakings."
>
> Regulation 1/2003, Article 9(1)

The major innovation compared to the earlier framework is that commitment decisions now render the agreed remedies legally binding on the

[1] A counter-example is the IBM case in 1984, see Scherer [23].

concerned firm, thus "*creating legal certainty and ensuring that effective competition is continuously preserved*".[2] In 2013, the European Commission had the first opportunity to show how seriously it takes the failure to comply with accepted commitments, imposing a €561 million fine on Microsoft on this ground.[3]

In contrast to American consent decrees, commitment decisions do not need a priori validation by an independent court and therefore constitute a powerful enforcement instrument at the disposal of the European Commission. The purpose of this article is to examine the optimal use of this instrument and its interaction with formal infringement decisions. We show that the optimal enforcement policy solves a tradeoff between deterrence of potentially anticompetitive practices and early restoration of effective competition.

We place the emphasis on two issues: the unobserved heterogeneity among antitrust cases; the authority's ability or inability to credibly announce its enforcement policy. We show that the commitment procedure is potentially helpful in screening out heterogenous competition cases and characterize the optimal policy mix when the authority can commit to enforce the announced

[2]Antitrust Manual of Procedures, Chapter 16 §6, March 2012, Internal DG Competition working documents on procedures for the application of Articles 101 and 102 TFEU.

[3]In 2009, Microsoft had committed to offer Internet users a browser choice screen enabling them to easily choose their preferred web browser, and the Commission had made these commitments legally binding on Microsoft until 2014. In March 2013, the Commission has found that Microsoft failed to roll out the browser choice screen from May 2011 until July 2012, thus preventing 15 million users in the EU from seeing the choice screen during this period. (Decision Case AT.39530 of 6 March 2013).

policy. We show, however, that the optimal policy is generally not credible when the authority is allowed to deviate ex post from the announced policy and derive the possible outcomes in this context. We explain the tension between the authority's ex ante and ex post incentives, and illustrate the implied distortions in terms of deterrence, frequency of trials and commitment decisions. Before presenting our findings in greater detail, we explain our main modeling assumptions regarding the concerned practices and the commitment procedure itself.

First, we restrict attention to unilateral practices implemented by firms with strong market power, which have been the main focus of commitment decisions so far. Examples of such practices in recent cases include exclusive supply, tying, target rebates, and various types of vertical restraints.[4] The procedure more rarely applies to multilateral practices and has explicitly been ruled out for secret cartels.[5]

Second, we allow the potential cases to differ in terms of both the incremental profit generated by the practice and its impact on consumers. The heterogeneity across cases reflects all the environmental parameters and market conditions that determine the economic impact of business practices such as the ones mentioned above. We assume that the practice is always prof-

[4] See e.g. *Microsoft* COMP/C-3/39.530 of 16 December 2009, *German Football League* COMP/37.214, of 19 January 2005, *Coca-Cola* COMP/39.116 of 22 June 2005, *Alrosa* COMP/E-2/38.381, decision of 22 February 2006, *Repsol* COMP/B-1/38.348 of 12 April 2006.

[5] Antitrust Manual of Procedures, Chapter 16 §13. Other negotiated procedures apply to secret cartels, such as the leniency and settlement procedures, see e.g. Motta and Polo [17] and Ascione and Motta [1].

itable for the concerned firm but make no assumption on whether the practice harms or benefits consumers for each particular case. More precisely, we allow the practice to benefit consumers in some instances, reflecting the possibility of efficiency gains that may (at least in part) be passed on to them. We assume, however, that enforcement is socially desirable. We do not constrain the correlation between profit gains and consumer harm. Highly profitable practices are not necessarily associated with the highest harm to consumers.[6]

Third, as regards the informational setting, we assume that firms have a better knowledge of the market environment, and hence of the incremental profit to be generated by the practice, than the competition authority. Competition practitioners know how difficult it is to estimate the effect of a business practice, in particular because it requires identifying the counterfactual situation that would have prevailed had the practice not been implemented. Accordingly, we assume that the profit gain and consumer harm due to the practice remain unknown to the enforcers throughout the proceedings. Even though a competition authority or a court can adjust the fine for observed characteristics of the practice, there certainly remains a great deal of unobserved case heterogeneity that cannot be taken into account when setting the fine. In this paper, we do assume that the fine is fixed for a given practice.

Fourth, we summarize the enforcement policy by the probability of initiating the commitment procedure after a potentially anticompetitive prac-

[6]The characteristics of the concerned practices –heterogenous cases, possibility of efficiency gains that can outweigh anticompetitive effects– should lead to evaluate them under the rule of reason rather than prohibit them per se. However, asymmetric information on these characteristics makes the rule of reason unfeasible in our model.

tice has been detected. In practice, the procedure starts when the European Commission informs the defendant firm of its competition concerns by a written document called “Preliminary Assessment”. The concerned firm has one month to formally submit its commitments. The Commission then publishes the proposed commitments in the Official Journal of the European Union, inviting comments from interested third parties –the so-called “*market test*”.[7] We assume that the enforcement policy can depend on observable variables such as the sector or the type of practice, but not directly on the unobserved consumer harm. As regards the commitment procedure, we consider, in line with Article 9(1) cited above, that commitment decisions cannot involve the payment of a fine and that the firm can only offer to bring the practice to an end.[8]

Our findings are threefold. First, we derive the firm's behavior in response to a given enforcement rule. When the commitment procedure is not available or if the authority credibly promises never to use it, the firm faces only the threat of trial (measured by the expected fine) and implements the practice

[7] Third parties have a month to submit observations. See points 4.3 and 4.4 of the Commission notice on best practices for the conduct of proceedings concerning articles 101 and 102 TFEU, OJEU 2011/C 308/06, and chapter 16 of Antitrust Manual of Procedures. See Cook [4]. Most member states of the European Union have set up similar procedures, see Vialfont [29] and Schweitzer [24].

[8] In contrast, American consent decrees may involve partial remedies (United States v. Microsoft Corp., 253 F.3d 34 (D.C. Cir. 2001)). See Furse [9]. In the current paper, we rule out partial remedies, assuming that remedies are indivisible in the sense of Shavell [26] that analyzes a nonmonetary judgment equivalent to an order to do something. Souam and Vialfont [27] considers partial remedies and partial fine reductions.

only when it generates a sufficiently high profit. The level of the fine thus leads to partition the set of potential cases into two groups. The commitment procedure offers a new screening instrument that allows to refine the partition with the creation of a third group: firms that derive moderate gains from the practice engage in it, but offer to end it if they receive a preliminary assessment. We find that the commitment procedure weakens deterrence, and eliminates it completely if commitment decisions are used for all detected cases. Firms are (at least weakly) better off under a higher probability of commitment decisions.

Second, we derive the optimal enforcement policy assuming that the authority is able to credibly announce the frequency of commitment decisions. We show that the optimal policy depends on how the consumer harm varies with the incremental profit generated by the practice. A systematic use of commitment decisions is optimal when the consumer harm weakly increases with the incremental profit, i.e. when the most harmful cases tend to be the most profitable, and hence the most difficult to deter. On the opposite, no use of the commitment decision is optimal when the consumer harm decreases with the incremental profit. When the most detrimental cases are located in the middle of the range of profitability, the authority faces a binary choice: either deterring as many cases as possible or giving up deterrence altogether and ensuring an early termination of the practice. In this case, a higher level of fine makes it more likely that the authority chooses the former option (no use of the commitment procedure). Hence, the availability of the new procedure does not change the usual and intuitive result that a higher level of the fine is associated with greater deterrence. In contrast, when the most harmful cases correspond to extreme values of the incremental profit, the authority may find it optimal to deter low profit cases and use commitment decisions for highly profitable cases. The authority thus faces a continuous choice regarding the deterrence cutoff. Here a higher fine induces the authority to use commitment decisions more often and hence, paradoxically, weakens deterrence. Although more commitment decisions are optimal, the loss of deterrence may translate into more trials at the optimum.

Third, we relax the assumption that policy announcements are credible, allowing the authority to deviate ex post from the announced policy. In practice, it is fair to say that the available guidelines provide little information concerning the Commission's negotiation policy. Once a potentially anticompetitive practice has been detected, the authority may be tempted to use a commitment decision so as to immediately restore effective competition –possibly in contradiction with its policy announcement. To this aim, we assume that firms first decide whether to adopt a practice and the authority, taking into consideration only the cases that come to its attention, then decides whether or not to initiate the commitment procedure. Deterrence concerns are absent at this point and only the consumer harm that can be avoided by commitment decisions matters. Commitment decisions, however, are not necessarily optimal ex post because the practice can benefit consumers in expectation in the relevant cases. We characterize the equilibria of the sequential game, relate them to the shape of the consumer harm function, and provide sufficient conditions for the optimal policy to be credible.

We find that the lack of authority credibility can in theory result in either insufficient or excessive use of commitment decisions. In practice, however, the latter risk is probably dominant if the practice harms consumers in most cases. Furthermore, the absence of credible policy announcement may generate multiple Nash-Bayesian equilibria, sustained by different beliefs about the enforcement rule that will be applied. We find that consumers are better off in equilibria under a lower probability of using commitment decisions while firms always prefer a higher probability. If the authority could to some extent influence the beliefs of firms as regards its policy, it would try to convince them that commitment decisions will be used sparingly.

The early literature on settlement and plea bargaining has put the emphasis on the economies of litigation costs brought about by negotiation (see Landes [14], Gould [11], Posner [18], and Shavell [25], as well as surveys by Daughety and Reinganum [5, 6] and Spier [28]). In contrast, we focus here on the impact of an early termination of certain business practices on the intertemporal welfare of consumers. The benefit for consumers is therefore "decoupled" from the sanction possibly imposed on the firm (in particular, fines are not perceived by consumers but paid to the public revenue department).

The subsequent literature has insisted as we do on the role of asymmetric information in litigation. Contrary to Grossman and Katz [12], uncertainty at the time of the commitment procedure is not about whether the practice has been implemented but how it affects profit and consumer surplus. We derive the optimal policy when the authority can credibly announce its enforcement policy in a screening model à la Bebchuk [2]. Relaxing the credibility assumption introduces a signaling dimension reminiscent of Reinganum and Wilde [22].

Finally, the impact of negotiations on ex ante deterrence has been recognized as a critical issue in settlement analysis. Polinsky and Rubinfeld [20] have examined the issue under symmetric information at the negotiation stage. Polinsky and Che [19] follow the same line of research, introducing punitive sanctions similar to the fine in our paper. Turning to models with asymmetric information, Reinganum [21], Miceli [15], Franzoni [10], Chu and Chien [3] consider deterrence and punitive sanctions in one-period models, but all take the harm inflicted on the victim as a (positive) constant. In contrast, the time dimension in the authority's intervention and the heterogeneity in the consumer harm play a central role in our analysis.

The article continues as follows. We present the model in Section 2, characterize the firm's behavior in Section 3 and derive the optimal enforcement policy in Section 4. Section 5 relaxes the assumption of a credible policy announcement and shows the implied distortion relative to the optimal policy. Concluding remarks follow in Section 6.

## 2. The model

A firm contemplates a profit-enhancing practice that may harm consumers. The incremental profit resulting from the practice is denoted by $\Delta$. We assume that the distribution of $\Delta$, denoted by $\Phi$, admits a positive density $\phi$ on $[0, \bar{\Delta}]$.

We denote the consumer surplus by $S$ when the firm engages in the practice and $S^*(\Delta)$ if the practice is not carried out. Consumer harm is measured by the weighted difference $h(\Delta) = [S^*(\Delta) - S]\phi(\Delta)$, which is assumed to be continuous and once differentiable in $\Delta$. The practice can be harmful ($h > 0$)

or beneficial ($h < 0$) to consumers. Throughout the paper, we assume that enforcement is desirable.[9] To reflect possible tradeoffs between anticompetitive effects and efficiency gains passed on to consumers,[10] we allow the link between the incremental profit and the consumer harm to be non-monotonic.

The authority is assumed to act in the consumers' interests as is the case in most jurisdictions. The first-best optimum is thus given by the sign of $h(\Delta)$: the practice is implemented if and only if it is negative. In practice, however, the first-best optimum is not achievable for informational reasons. Indeed, when the conduct has been detected by the competition authority, the magnitude of the consumer harm depends on the counterfactual value of the consumer surplus, $S^*(\Delta)$, i.e. the surplus that would have prevailed in the absence of the practice. We assume that this value is unobserved by the authority and that the practice is found illegal with probability $\beta \in (0, 1)$ regardless of $h(\Delta)$. The trial threat thus gives rise to under-deterrence when the practice is implemented while $h(\Delta) > 0$ and over-deterrence in the symmetric case. Moreover, when implemented, the trial injunction is an inefficient termination if $h(\Delta) < 0$ and inefficient maintenance in the symmetric case.

The firm and consumer preferences, as well as the enforcement policy, in-

[9]We present in Section 4 the formal condition under which laissez-faire is suboptimal (Assumption 1).

[10] For instance, selective distribution, if it leads to exclude inefficient retailers, makes $h(\Delta)$ decreasing in $\Delta$ and even possibly negative for large values of $\Delta$: when inefficient distributors are numerous, consumers are better off with less competition as valuable services can thus be profitably offered.

volve three time periods, as shown on Figure 1. At the beginning of period 1, the authority announces that, if the practice is detected, the commitment procedure will be initiated with probability $x \in [0, 1]$.[11] After observing $x$, the firm decides whether to engage in the practice. At the beginning of period 2, the authority investigates the sector with an exogenous probability $\alpha \in (0, 1)$. In case of investigation, it learns without error whether the practice has been implemented. In the affirmative, the authority sends a preliminary assessment with probability $x$ or a statement of objections with probability $1 - x$. In the former case, the firm can either commit to end the practice immediately in exchange for full fine immunity, or proceed to trial. In the latter, the case proceeds to court for sure. Trial takes place at the beginning of period 3: with probability $\beta$, the practice is found anticompetitive, the firm pays fine $F$, and receives an injunction to terminate the practice.

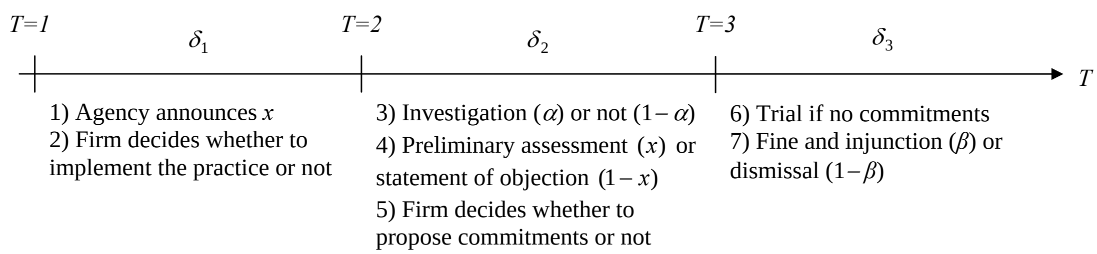


Figure 1: Timing of the game with credible policy announcement

The parameters $\alpha, \beta$ and $F$ are exogenous, common knowledge, and independent of the unobserved variable $\Delta$. They represent respectively the

[11] The probability of initiating the commitment procedure may depend on observed variables, such as the concerned industry and the type of practice.

authority's ability to detect potentially anticompetitive practices, the merit of the case, and the expected fine when the authority finds an infringement of competition law.

The relative length or importance of each of the three periods is represented by a set of discount factors $(\delta_1, \delta_2, \delta_3)$. The parameter $\delta_1$ discounts the time necessary for the authority to order a preliminary investigation after a firm engages in a possibly anticompetitive practice. The parameter $\delta_2$ discounts the time between detection and trial, during which effective competition can be restored by a commitment decision.[12] Finally, $\delta_3$ discounts the time during which an injunction imposed in a formal infringement decision has an economic impact on the market.

For the sake of the exposure, the values of the different strategies are always evaluated at $T = 1$.

## 3. The firm's decisions

We suppose here that the authority has announced its enforcement policy $x$, i.e. the probability of initiating the commitment procedure when the concerned practice has been detected.

First, we consider a firm of type $\Delta$ that has engaged in the practice. If it receives a preliminary assessment at the beginning of period 2, it may either commit to end the practice right away or go to court. In the former case, the firm gives up any future gain $\Delta$ and is granted fine immunity. In the latter

[12] In the Microsoft (tying) case, the immediate benefits that should have accrued to consumers thanks to the commitment decision of December 2009 have not materialized due to the failure to comply with the agreed remedy, as explained in Footnote 3.

case, the firm earns expected incremental profit $I_2\Delta - \delta_3\beta F$, where

$$I_2 = \delta_2 + \delta_3(1-\beta) \tag{1}$$

measures the expected duration of the practice starting from $T = 2$: the firm pockets the incremental profit $\Delta$ in period 2 for sure and in period 3 only if it is not found liable. The net gain is obtained by subtracting the expected fine, incurred at period 3 with probability $\beta$. It follows that the firm offers to end the practice upon reception of a preliminary assessment if $\Delta$ is smaller than $\delta_3\beta F/I_2$. Hereafter, this threshold is denoted by $\Delta^r$.

Next, we consider the decision to engage in the practice. If the firm engages in the practice and offers to end it when receiving a preliminary assessment ($\Delta \leq \Delta^r$), its expected profit is given by $I_1(x)\Delta - \delta_3\alpha(1-x)\beta F$, where

$$I_1(x) = \delta_1 + \delta_2(1-\alpha x) + \delta_3[1-\alpha+\alpha(1-x)(1-\beta)] \tag{2}$$

measures the expected total duration of the practice: the firm pockets profit $\Delta$ for sure during period 1; it continues to enjoy $\Delta$ during period 2 unless the authority investigates and sends a preliminary assessment (probability $1-\alpha x$); it still benefits from $\Delta$ in period 3 if the authority has not investigated or if the case is eventually dismissed in court (probability $1-\alpha+\alpha(1-x)(1-\beta)$). The net gain is obtained by subtracting the expected fine, which is incurred at period 3 with probability $\alpha(1-x)\beta$.

If the firm engages in the practice but does not offer commitments ($\Delta \geq \Delta^r$), it enjoys the same expected profit as if the commitment procedure were not available, i.e. as if $x = 0$, namely $I_1(0)\Delta - \delta_3\alpha\beta F$. The firm's expected profit from the practice may therefore be written as

$$\Pi(\Delta; x) = \max\{\, I_1(x)\Delta - \delta_3\alpha(1-x)\beta F,\ I_1(0)\Delta - \delta_3\alpha\beta F,\ 0\,\}, \qquad (3)$$

the profit in the absence of the practice being normalized to zero by definition of $\Delta$. The expected profit is the upper bound of a family of three affine functions of $\Delta$, and hence is convex in $\Delta$, as represented on Figure 2.

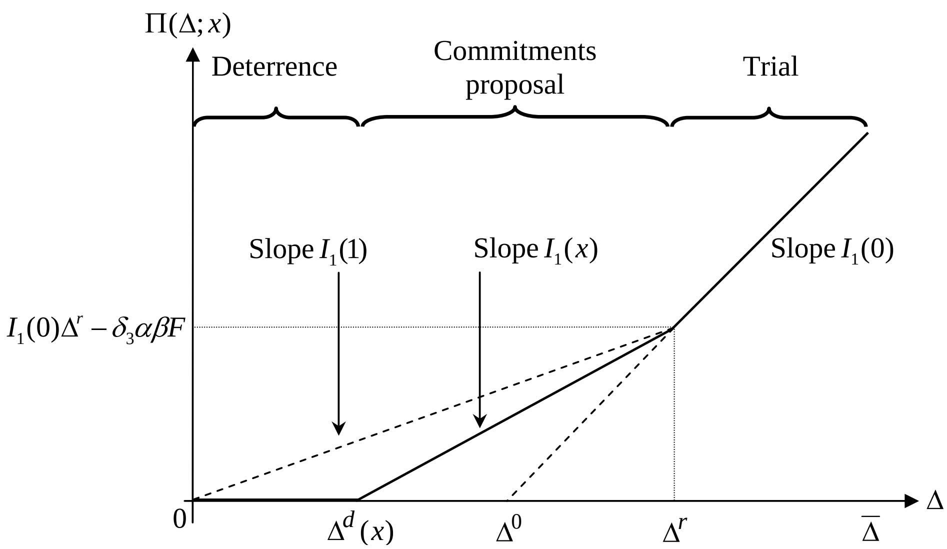


Figure 2: The firm's decisions and expected profit for a given policy rule $x$

The following proposition summarizes the firm's decisions depending on the authority policy $x$.

**Proposition 1.** *For a given enforcement policy* $x \in [0,1]$*, the firm engages in the practice if and only if* $\Delta > \Delta^d(x)$*, with*

$$\Delta^d(x) = \frac{\delta_3\alpha\beta(1-x)F}{I_1(x)}, \qquad (4)$$

*and offers to end it when receiving a preliminary assessment if and only if* $\Delta \leq \Delta^r = \delta_3 \beta F / I_2$.

*Using the commitment procedure more often weakens, and eventually eliminates, deterrence:* $\Delta^d(x)$ *decreases to zero as* $x$ *goes to one.*

The thresholds mentioned in the Proposition are ordered: $\Delta^d(x) < \Delta^r$, as shown on Figure 2. Low types, $\Delta \leq \Delta^d(x)$, that have less to gain from the practice, do not adopt it; intermediary types, $\Delta^d(x) \leq \Delta \leq \Delta^r$, adopt it at $T = 1$ and terminate it at $T = 2$ upon reception of a preliminary assessment; high types, $\Delta > \Delta^r$, that have much to gain from the practice, show no regret for their initial decision, change nothing to their behavior if offered the possibility to do so, and take their chances in court. To concentrate on the most interesting cases, we assume throughout the paper that all $\Delta$-types exist, i.e. $\Delta^r < \bar{\Delta}$. In other words, we assume that the incremental profit from the practice, $\Delta$, can be so high relatively to the fine $F$ that the corresponding types persist in their behavior when offered the possibility to end the practice and save the fine.

As the probability of the commitment procedure rises from zero to one, the deterrence interval $[0, \Delta^d(x)]$ shrinks, the first part of the profit function becomes less steep, and the expected profit increases for $\Delta$ below $\Delta^r$ and remains constant above $\Delta^r$. Deterrence is maximal in the absence of the commitment procedure. We denote by $\Delta^0 = \Delta^d(0)$ the corresponding deterrence threshold. On the other hand, announcing that the commitment procedure will be used with certainty eliminates deterrence completely: $\Delta^d(1) = 0$. Indeed, when the authority always sends a preliminary assessment, all types adopt a "*wait-and-see strategy*" as no fine is expected (see Fenn and Veljanovski [8]).

## 4. The authority's decision

Anticipating the firm's strategy, the authority chooses the optimal policy (the probability $x$) by maximizing the expected consumer surplus. If the practice is not carried out, the consumer surplus is given by

$$cs^d(\Delta) = (\delta_1 + \delta_2 + \delta_3)S^*(\Delta).$$

If the firm has engaged in the practice and offers to end it upon reception of a preliminary assessment (sent with probability $x$), the consumer surplus is $S$ instead of $S^*(\Delta)$ during the practice

$$cs(\Delta; x) = cs^d(\Delta) - I_1(x)\,[S^*(\Delta) - S], \tag{5}$$

where the duration of the practice satisfies (see (1) and (2))

$$I_1(x) = I_1(0) - \alpha I_2 x. \tag{6}$$

Under the enforcement rule $x$, the practice is deterred for $\Delta \leq \Delta^d(x)$; the firm engages in the practice at $T = 1$ and terminates it at $T = 2$ if the commitment procedure is initiated for $\Delta^d(x) \leq \Delta \leq \Delta^r$; the firm engages in the practice and does not change its conduct if it receives a preliminary assessment for higher values of $\Delta$. In the latter case, the presence of the commitment procedure does not affect the firm's behavior and everything is as if $x = 0$. It follows that the expected consumer surplus is given by

$$CS(x) = \int_0^{\Delta^d(x)} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^d(x)}^{\Delta^r} cs(\Delta; x)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^r}^{\bar{\Delta}} cs(\Delta; 0)\,\mathrm{d}\Phi(\Delta). \tag{7}$$

The introduction of the commitment procedure (i) lowers deterrence as $\Delta^d(x)$ decreases with $x$; (ii) shortens the duration of the practice as $I_1(x)$ decreases with $x$; (iii) does not alter the situation of firms having much to gain from the practice, with $\Delta > \Delta^r$, explaining why $x$ is set to zero in the third term above.

When the commitment procedure is unavailable or when the authority announces it will not use it ($x = 0$), the authority can only bring the case to court when it detects the practice, and the expected consumer surplus is $CS(0)$. We assume that this situation is preferable to laissez-faire.

**Assumption 1.** *Enforcement is desirable in the absence of the commitment procedure, i.e. consumer surplus is higher in this situation than under laissez-faire:* $CS(0) > \mathrm{CS}^{\mathrm{LF}} = (\delta_1 + \delta_2 + \delta_3)S$.

It is easy to check that Assumption 1 is equivalent to

$$(\delta_1 + \delta_2 + \delta_3) \int_0^{\Delta^0} h(\Delta)\,\mathrm{d}\Delta + \alpha\beta\delta_3 \int_{\Delta^0}^{\bar{\Delta}} h(\Delta)\,\mathrm{d}\Delta > 0,$$

which reflects the impact of the trial on the firm's conduct, namely deterrence (first term) and, for undeterred cases, termination of the practice during the third period if the firm is convicted (second term). Assumption 1 holds in particular when the practice always harms consumers, $h(\Delta) > 0$ for all $\Delta$, but may also hold when it benefits consumers for some values of $\Delta$.

Differentiating consumer surplus, equation (7), with respect to $x$ yields

$$CS'(x) = I_1(x) h(\Delta^d(x)) \frac{\partial \Delta^d(x)}{\partial x} + \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} h(\Delta)\,\mathrm{d}\Delta. \tag{8}$$

The first term reflects the reduced deterrence. Since the deterrence threshold $\Delta^d(x)$ decreases with $x$, this term is negative if and only if the practice harms consumers for the marginal deterred type. The second term accounts for the shortening of the duration of the practice as $x$ rises. This term is positive if the mean value of $h$ on the set of firms that offer to end the practice is positive. We show in appendix that $CS'(x)$ can be rewritten as

$$CS'(x) = \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} \left[h(\Delta) - h(\Delta^d(x))\right] \, \mathrm{d}\Delta. \tag{9}$$

This expression implies that the authority's tradeoff under asymmetric information only depends on the shape of the function $h$ on the set $[0, \Delta^r]$. A slight increase of $x$ involves a deterrence loss of the marginal type $\Delta^d(x)$, but affects consumer surplus for all $\Delta$ in $[\Delta^d(x), \Delta^r]$. Consumers are better off if and only if the mean value of the consumer harm on this interval is larger than $h(\Delta^d(x))$.[13] The shape of $h$ above $\Delta^r$ has no impact on the optimal policy as these $\Delta$-types always go to court when the practice has been detected.

Propositions 2 and 3 below present environments where the optimal policy rule is deterministic, i.e. $x^* = 0$ or $x^* = 1$. Proposition 4 shows a case where the optimal rule is stochastic, $0 < x^* < 1$.

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[13] Suppose that the authority maximizes total welfare $W(x) = CS(x) + \int_0^{\bar{\Delta}} \Pi(\Delta, x) \, \mathrm{d}\Phi(\Delta)$ rather than consumer surplus. We have:

$$W'(x) = CS'(x) + \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} (\Delta^r - \Delta)\phi(\Delta) \, \mathrm{d}\Delta,$$

which is greater than $CS'(x)$. Indeed, the firm necessarily benefits from a commitment proposal if it decides to do so. If an increase in $x$ benefits consumers, it is necessarily welfare enhancing. The welfare objective thus pushes the authority to use commitment decisions more often than the consumer surplus standard. We thank an anonymous referee for this observation.

**Proposition 2.** *When the consumer harm $h$ is monotonic in $\Delta$ on $[0, \Delta^r]$, the authority plays a pure strategy at the optimum:*

1. *If $h$ is increasing, a preliminary assessment is always sent, $x^* = 1$;*
2. *If $h$ is decreasing, the case always goes to court, $x^* = 0$;*
3. *If $h$ is constant, all policy rules yield the same consumer surplus.*

In case 1, a higher firm's profit is associated to a higher consumer harm. This occurs for instance when the practice allows the firm to reinforce its market power but does not generate any efficiency gains, implying higher prices, poorer quality or reduced choice for consumers. The trial is ineffective at deterring the most harmful cases (because they are also the most profitable ones). It follows that the authority does not insist on deterrence, preferring to interrupt the practice as early as possible. The optimal policy in this case, therefore, is a systematic use of the commitment procedure: $x^* = 1$. The practice is always implemented and there is no trial on the set $\Delta \in [0, \Delta^r]$. Compared to the first-best optimum, deterrence is insufficient for cases with positive $h(.)$, but these cases are interrupted at the beginning of the second period; cases with negative $h(\Delta)$, if any, are not deterred but are interrupted too soon.

In case 2, a higher firm's profit is associated to a lower consumer harm, which may reflect efficiency gains passed on to consumers. The trial is effective at deterring the most harmful cases (because they are also the least profitable ones). It follows that the authority opts for maximal deterrence, by never using commitment decisions: $x^* = 0$. Compared to the first-best optimum, the trial may lead to an inefficient termination of the practice with an injunction if $h(\Delta)$ is negative (which may happen for sufficiently large $\Delta$)

and an inefficient maintenance otherwise. Using some commitment decisions could reduce the number of inefficient maintenances but would weaken deterrence of the most harmful cases and possibly lead to interrupt consumer surplus enhancing practices.

Finally, any probability $x$ is equivalent from the authority's point of view when the counterfactual consumer surplus, $S^*(\Delta)$, is constant in $\Delta$ (case 3). A marginal deterrence loss is exactly compensated by an anticipated termination of the practice (regardless of the sign of $h(\Delta)$). This is no longer true if we take the administrative expenditures into account. Indeed these costs are reduced under the commitment procedure and $x^* = 1$ becomes optimal.

We now investigate two cases where the consumer harm is non-monotonic in the firm's profit gain $\Delta$. We first assume an inverted-U shaped relationship between profit gain and consumer harm, implying that the practice is the most harmful to consumers for intermediate values of $\Delta$, as shown on the left panel of Figure 3.

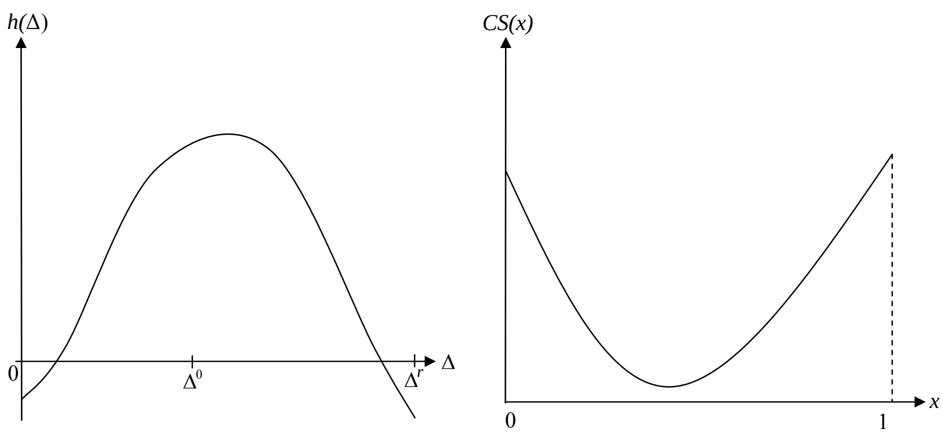


Figure 3: Inverted U-shaped consumer harm and expected consumer surplus

**Proposition 3.** *If $h$ is quasi-concave on $[0, \Delta^r]$ and achieves an interior maximum in this interval, the optimal policy rule is deterministic, i.e. $x^* = 0$ or $x^* = 1$.*

*A marginal increase of the fine $F$ either makes the commitment procedure less attractive or has no impact on the optimal policy.*

When the most detrimental cases are located in the middle of the range of $\Delta$, Proposition 3 indicates that the authority faces a binary choice: either deterring as many cases as possible (i.e. deter all cases with $\Delta$ in $[0, \Delta^0]$), or giving up deterrence altogether and ensuring an early termination of the practice. The authority therefore compares the consumer surplus in these polar configurations, which yields

$$CS(1) - CS(0) = -I_1(1) \int_0^{\Delta^0} h(\Delta)\,\mathrm{d}\Delta + \alpha I_2 \int_{\Delta^0}^{\Delta^r} h(\Delta)\,\mathrm{d}\Delta. \tag{10}$$

The first term represents the cost associated to the total loss of deterrence (all types engage in the practice); the second term reflects the gain from an earlier termination of the practice. It is immediate that $x^* = 1$ is optimal if the practice increases consumer surplus in expectation on the set of potentially deterred types but globally harms consumers on the set $[\Delta^0, \Delta^r]$. This can happen for instance when $h(\Delta^0)$ is small enough as compared to $h(\Delta^r)$. Never using commitment decisions is optimal in the symmetric case, $x^* = 0$. However, the difference in (10) cannot be generally signed.

We show in AppendixC that the sign of $h'(\Delta^0)$ helps to refine the analysis. If $\Delta^0$ belongs to the increasing part of the consumer harm curve (case shown on Figure 3), the most harmful case is not deterred if the authority announces that it will never use the commitment procedure. In this case, $x = 0$ is not always a local maximum and $x^* = 1$ is the optimum. If $\Delta^0$ belongs to the decreasing part of the consumer harm curve, the most harmful case is deterred if $x = 0$ and a marginal introduction of the commitment procedure lowers the expected consumer surplus: $x = 0$ is always a local maximum. Yet, $x = 1$ may be a local maximum.

The second part of Proposition 3 shows how the authority's tradeoff is affected by the level of the expected fine at trial. As the fine $F$ increases, the underlying threat of trial becomes more effective at deterring the most harmful cases –associated to intermediate values of $\Delta$. Intuitively, this should make the "maximal deterrence" option, $x = 0$, more attractive. This is indeed what we find: the difference in (10) weakly decreases with $F$. Hence the commitment procedure is systematically used when the expected sanction in trial is relatively small while $x^* = 0$ is more probable when $F$ is sufficiently high.

Finally, we characterize the optimal enforcement rule for a U-shaped consumer harm function, i.e. when the practice is most harmful to consumers for low and high values of the incremental profit $\Delta$.

**Proposition 4.** *If $h$ is quasi-convex on $[0, \Delta^r]$ and achieves an interior minimum on this interval, the optimal policy $x^*$ may be stochastic.*

*A marginal increase of the fine $F$ either makes the commitment procedure more attractive, or has no impact on the optimal policy.*

Contrary to the configuration of Proposition 3, the most harmful cases now belong to two different groups, the first one associated with low values of $\Delta$, the second one associated with high values of $\Delta$. The authority may find it optimal to treat differently these two groups of cases, specifically to deter cases with low $\Delta$'s and to address the second group of cases with the commitment procedure. Here we find a unique local optimum $x^* \in [0, 1]$.

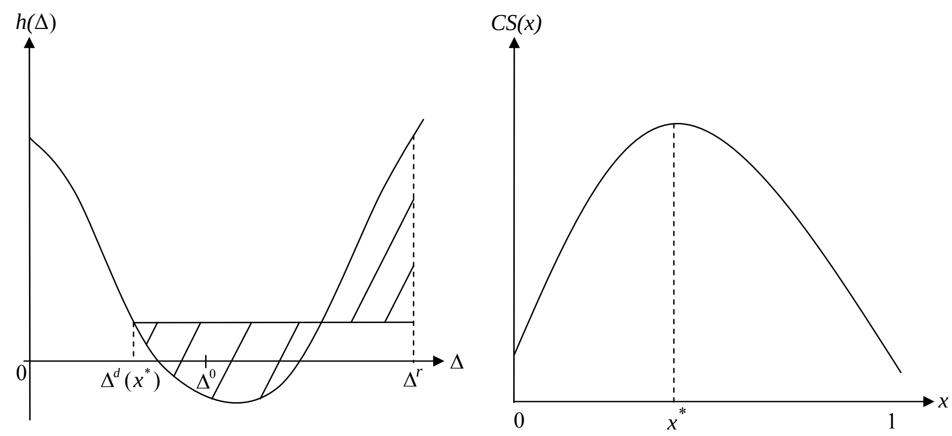


Figure 4: U-shaped consumer harm and expected consumer surplus

When the optimum $x^*$ is interior (case represented on Figure 4), the harm caused by the marginal case $h(\Delta^d(x^*))$ is equal to the average harm caused by the cases concerned by the commitment procedure, i.e. those with $\Delta$ in $[\Delta^d(x^*), \Delta^r]$. In other words, the marginal benefit of an increase in the probability of sending a preliminary assessment is exactly offset by the marginal loss of deterrence.

However, a corner solution is possible. When $\Delta^0$ belongs to the decreasing part of the consumer harm curve, $x^* = 1$ or $x^* = 0$ may be an optimum. When $\Delta^0$ belongs to the increasing part of the consumer harm curve, only $x^* = 1$ may be an optimum. In the former case, the avoidance of inefficient maintenaces may not overcompensate the loss of deterrence with the commitment procedure, and may early interrupt consumer surplus enhancing practices; in the latter at least some commitments are optimal as $h$ strictly increases between $\Delta^0$ and $\Delta^r$.

The second part of Proposition 4 analyzes how the authority's tradeoff is affected by the level of the expected fine in trial. An increase in the fine $F$ moves the deterrence and regret thresholds $\Delta^d(x)$ and $\Delta^r$ to the right, which implies (i) a higher deterrence for a given commitment probability $x$; (ii) for the undeterred cases, a higher propensity to terminate the practice in exchange for fine immunity if a preliminary assessment has been received. Thanks to these two effects, the authority can afford initiating the commitment procedure more often. Hence, contrary to Proposition 4, we find here that $x^*$ increases as the level of the expected fine increases. These opposed results come from the different nature of the authority's choice: binary in Proposition 4, continuous here.

This difference also explains that the optimal enforcement policy does not have the same impact on the frequency of trials. In the context of Proposition 3, a switch from no use of the commitment procedure to a systematic use of this procedure –for instance because of a lower fine level– increases the number of cases as deterrence is eliminated, but reduces the occurrence of trials.[14] In contrast, in the context of Proposition 4, a marginal increase in the optimal probability of a commitment procedure –for instance due to a higher fine level– may imply *more* trials in equilibrium.

[14]Specifically, the number of trials is reduced by $\Phi(\Delta^r) - \Phi(\Delta^0)$ thanks to commitment decisions for cases with $\Delta$ in $[\Delta^0, \Delta^r]$. The switch from $x^* = 0$ to $x^* = 1$ does not change the frequency of trials for other values of $\Delta$ as, in both optima, trial occurs if $\Delta \geq \Delta^r$ and does not occur if $\Delta \leq \Delta^0$.

**Remark 1.** *In the configuration of Proposition 4, a higher fine, by increasing the optimal probability of the commitment procedure, may weaken deterrence and translate into more trials.*

In AppendixE, we consider a consumer harm function and a level of the fine such that $CS'(0) = 0$. For such a value of the fine, the optimal policy is $x^* = 0$. We show that for a slightly higher value of the fine the authority finds it optimal to introduce the commitment procedure with a small probability, which weakens deterrence, i.e. lowers the threshold $\Delta^d$. The marginal introduction of the commitment procedure "mechanically" reduces the number of trials, but also increases the overall number of cases as deterrence is lowered. We check that the mechanical effect dominates the deterrence effect when the density of the incremental profit $\phi(\Delta)$ is nondecreasing on $[\Delta^0, \Delta^r]$. We also check that the opposite result holds if the density is sufficiently decreasing and the distribution is sufficiently concentrated around $\Delta^0$ because the deterrence effect is then magnified. In this case, a marginal introduction of the commitment procedure is optimal but paradoxically raises the probability of trial.

## 5. Optimal policy in the absence of credible policy announcement

In practice, the authority decides whether to use a commitment decision for each case that comes to its attention. When an investigation has been launched and the presence of the practice has been established, the authority may be tempted to use a commitment decision even though it has announced it would not do so. The temptation is particularly strong when the authority believes that the practice strongly harms consumer. In this case, the termination of the practice would indeed benefit consumer from the beginning of the second period.

To assess the importance of the authority's credibility, we suppose in this section that the authority does not announce its policy prior to the firm's decision. Accordingly, we change the order of events as shown on Figure 5. At the beginning of the first period, the firm decides whether to engage in the practice; at the beginning of the second period, the authority investigates with probability $\alpha$, thus detecting without error the practice when it is implemented. If the practice has been detected, the authority decides whether to bring the case to court or to initiate the commitment procedure. The rest of the game, namely the firm's response to the preliminary assessment and the trial, is unchanged. In particular, the firm, when receiving a preliminary assessment offers to end the practice if and only if its type is below the threshold $\Delta^r = \delta_3 \beta F / I_2$.

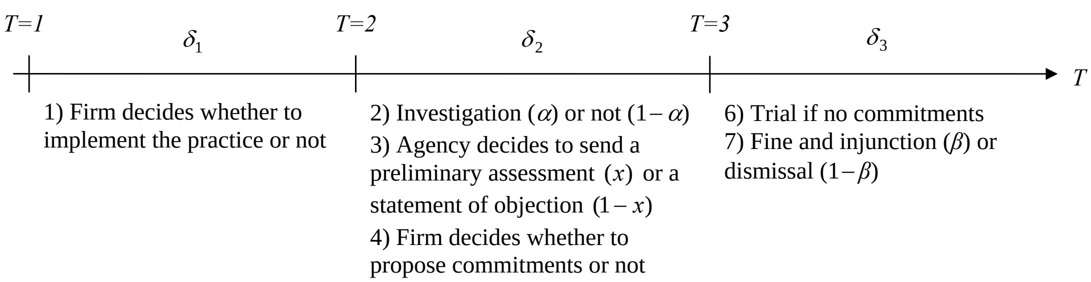


Figure 5: Timing of the game without credible policy announcement

In this setting, the firm and authority's decisions are based on their beliefs about the other player's strategy. Deciding whether to engage in the practice, the firm forms a belief $\tilde{x}$ about the policy to be applied by the authority. Similarly, the authority, after detecting the practice, infers the firm's possible types and bases its decision to initiate the commitment procedure on its belief about the firm's strategy. To simplify the analysis, we assume that the authority believes that the firm engages in the practice if and only if its type is above a threshold $\tilde{\Delta}$. We are looking for Nash-Bayesian equilibria, where the beliefs correctly represent the players' strategies.

The analysis of Section 3 carries over with almost no change. The firm engages in the practice if and only if its type is above the threshold $\Delta^d(\tilde{x})$, where the function $\Delta^d(.)$ is given by (4). In contrast to the analysis of Section 4, however, the authority now takes into consideration only the cases that come to its attention after a practice has been detected. The deterrence threshold $\Delta^d(x)$ in the expression of the consumer surplus, equation (7), must therefore be replaced with the authority's belief $\tilde{\Delta}$, which makes the first term in (7) independent of the policy rule. The authority does not internalize the effect of its policy on the firm's decision to engage in the practice as this decision has already been made.

The expected consumer surplus depends on the policy rule only through the types that have engaged in the practice and offer to end it upon reception of a preliminary assessment, see (5) and (6). Once the practice has been detected, a marginal increase of $x$, $\mathrm{d}x$, reduces the duration of the practice by $I_2 \,\mathrm{d}x = [\delta_2 + (1-\beta)\delta_3]\,\mathrm{d}x$, reflecting the authority's interest for the consumer surplus during the second and third periods. In sum, the authority's objective, given its belief on the firm's strategy, can be written as

$$CS(x|\tilde{\Delta}) = \int_0^{\tilde{\Delta}} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta) + \int_{\tilde{\Delta}}^{\Delta^r} cs(\Delta;x)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^r}^{\bar{\Delta}} cs(\Delta;0)\,\mathrm{d}\Phi(\Delta). \tag{11}$$

This expression is linear in the policy rule $x$, its derivative being given by

$$CS'(x|\tilde{\Delta}) = \alpha I_2 \int_{\tilde{\Delta}}^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta. \tag{12}$$

The above formula differs from (8) or (9) due to the absence of the "deterrence term", namely the term that involves the harm caused by the marginal type, $h(\Delta^d(x))$. From an ex post perspective, the optimal policy is a systematic use of the commitment procedure if the integral in (12) is positive and no use if it is negative. If the integral is zero, the authority is ex post indifferent between initiating the commitment procedure and proceeding to trial.

In equilibrium, the beliefs are correct, i.e. the above optimal policy coincides with the firm's belief $\tilde{x}$ and the optimal threshold $\Delta^d(\tilde{x})$ coincides with the authority's belief $\tilde{\Delta}$.

**Proposition 5.** *When the authority decides whether to initiate the commitment procedure after having detected the practice, three configurations may prevail in equilibrium:*

1. *Systematic use of the commitment procedure and no deterrence (*$\tilde{x}^* = 1$*,* $\tilde{\Delta}^* = 0$*) if and only if* $\int_0^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta > 0$*;*
2. *No use of the commitment procedure and maximal deterrence (*$\tilde{x}^* = 0$*,* $\tilde{\Delta}^* = \Delta^0$*) if and only if* $\int_{\Delta^0}^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta < 0$*;*
3. *Stochastic use of the commitment procedure and intermediate deterrence (*$0 < \tilde{x}^* < 1$*,* $\tilde{\Delta}^* = \Delta^d(\tilde{x}^*)$*) if and only if* $\int_{\tilde{\Delta}^*}^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta = 0$.

Comparing Proposition 5 on the one hand and Propositions 2, 3 and 4 on the other hand shows that the authority's ability to credibly commit to the announced enforcement rule is of critical importance. When the practice is always detrimental, $h \geq 0$, the authority cannot refrain from initiating the commitment procedure: the only equilibrium without authority commitment is $\tilde{x}^* = 1$. When the optimal policy is $x^* = 0$, for instance when $h$ is decreasing (see Proposition 2), the lack of credibility translates into an *excessive* use of commitment decisions and a loss of consumer surplus ex ante.

When the practice can benefit consumers for some values of $\Delta$, there may not exist any equilibrium of the game without authority credibility where the authority plays a pure strategy. This is the case when

$$\int_0^{\Delta^r} h(\Delta)\,\mathrm{d}\Delta < 0 < \int_{\Delta^0}^{\Delta^r} h(\Delta)\,\mathrm{d}\Delta.$$

In this case, however, there exists an equilibrium where the authority plays a mixed strategy. Indeed, by the intermediate value theorem, there exists a value of $\tilde{x}$ between 0 and 1 such that the integral condition in point 3 of Proposition 5 holds. Such a configuration might happen for instance when $h(\Delta)$ increases with $\Delta$, being first negative, then positive as $\Delta$ rises from zero to $\Delta^r$. If the authority can credibly commit to enforce the announced rule, we know from Proposition 2 that the optimal policy is a systematic use of the commitment procedure, $x^* = 1$. In the absence of authority credibility, however, we know from Proposition 5 that the equilibrium probability of the commitment procedure is positive but smaller than one, hence an *insufficient* use of commitment decisions –another instance where the lack of credibility prevents the authority from maximizing the consumer surplus.

More generally, the comparison of the equilibria in the two games implies the following condition for credibility of the authority's announcement.

**Corollary 1.** *A sufficient condition for credibility of the optimal enforcement policy $x^*$ described in Propositions 2, 3 and 4 is that $h(\Delta^d(x^*))$ is negative* *(respectively positive, zero) when $x^* = 0$ (resp. $x^* = 1$, $0 < x^* < 1$). The condition is also necessary for stochastic policies.*

Suppose for instance that the optimal policy is to never initiate the commitment procedure, $x^* = 0$. From Proposition 5, the ex post credibility condition is that the practice globally benefits consumers on $[\Delta^0, \Delta^r]$, which is true, by (9), if $h(\Delta^0) < 0$. Under this condition, the authority does not want to deviate ex post from the announced rule. For stochastic policies, the first-order conditions in the two games are equalities that differ only by the presence or the absence of the term $h(\tilde{\Delta})$ (see (9) and (12)), hence the equivalence stated in Corollary 1.

In general, the equilibrium of the game without authority commitment need not be unique. The following remark shows that the firm and consumers' interests are opposed when more than one equilibrium exists.

**Remark 2.** *When many equilibria coexist, the firm prefers the equilibrium with the highest probability of using the commitment procedure while the authority prefers the equilibrium with the lowest probability.*

We have already seen in Section 3 that the firm is better off when the authority uses the commitment procedure more frequently (see in particular Figure 2). In AppendixF, we show that the expected consumer surplus is higher in equilibria where the probability of using the commitment procedure is lower. More precisely, we consider two equilibria $\tilde{x}_1^*$ and $\tilde{x}_2^*$, with $0 \leq \tilde{x}_1^* \leq \tilde{x}_2^* \leq 1$ and find that $CS(\tilde{x}_1^*) \geq CS(\tilde{x}_2^*)$ with equality if the policy is stochastic at both equilibria.

The examples discussed after Proposition 5 show that the lack of authority credibility may translate into a probability of using the commitment procedure that is too small or too large compared to the optimum studied in Section 4. In practice, however, the main risk is probably on the side of an excessive use of commitment decisions, particularly when the practice tends to harm consumers for most cases, in which case the authority may not be able ex post to resist the temptation of a commitment decision although it is suboptimal from an ex ante perspective. In this context, it is in the authority's interest to convince firms that commitment decisions will not be used too often. Accordingly, Wils [30] insists that "it is essential that the undertakings concerned are not given any right to a commitment decision". Such a statement is also in line with the authority's preferences seen in Remark 2: knowing that many equilibria are possible, the authority prefers the firms to believe that commitment decisions will be used sparingly.

## 6. Conclusion

Under Regulation 1/2003, the European Commission can close an antitrust case if the concerned firm offers commitments that meet its competition concerns. On the one hand, commitment decisions allow to restore effective competition rapidly after a potentially anticompetitive practice has been detected. On the other, the existence of the commitment procedure weakens ex ante deterrence as firms anticipate a reduced probability of infringement decision and hence a lower fine in expectation.

We have examined this tradeoff assuming first that the competition authority is able to credibly announce its enforcement policy. When the incremental profit generated by the practice is relatively homogeneous among the most harmful cases, the authority faces a binary choice between preserving maximal deterrence (no use of commitment decisions) or giving up deterrence altogether (systematic use of commitment decisions). In this case, a higher expected fine at trial makes the former option more attractive. Otherwise, the authority may find it optimal to use commitment decisions stochastically, and a higher expected fine pushes towards more commitment decisions and less deterrence –which may, paradoxically, increase the number of trials.

We have then addressed the credibility issue. We have found that the optimal policy is generally not enforceable when the authority cannot credibly announce its policy prior to the firms' strategic decisions. We have shown that the lack of authority credibility may translate into either insufficient or excessive use of commitment decisions. We have argued that the latter risk is generally more serious, in particular when the practice harms consumers in a majority of cases. We have explained why the authority prefers firms to believe that commitment decisions will be used sparingly.

Two additional considerations are left for future research. First, the commitment procedure has been criticized as promoting a regulatory or interventionist approach (see e.g. Epstein [7]). According to Melamed [16], authorities may be tempted to impose remedies that go beyond what could realistically be achieved through formal infringement decisions. Moreover, one of the purpose of infringement decisions is to clarify the content of the law, thus creating legal precedent and helping firms assess their own business conduct and perhaps avoid future infringements. According to Kovacic [13] and Wills [30], the commitment procedure might in the long run impede this clarification process by reducing the number of formal decisions.

Second, infringement decisions allow the victims to claim reparation in subsequent civil proceedings for damages. Commitment decisions, which do not formally establish liability, make follow-on actions for antitrust damages more difficult, giving the party that caused the damage an extra incentive to propose commitments. The commitment procedure, therefore, should be taken into account when designing an effective system of private enforcement by means of damages actions.

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## References

[1] A. Ascione, M. Motta, Settlements in cartel cases, in: C. Ehlermann, M. Marquis (Eds.), European Competition Law Annual 2008: Antitrust settlements under EC Competition Law, Oxford: Hart Publishing, 2010.

[2] L. Bebchuk, Litigation and Settlement Under Imperfect Information, RAND Journal of Economics, 15 (1984) 404-415.

[3] C. Chu, H. Chien, Asymmetric Information, Pretrial Negotiation and Optimal Decoupling, International Review of Law and Economics, 27 (2007) 312-329.

[4] C. Cook, Commitment Decisions: The Law and Practice under Article 9, World Competition 29 (2006) 209-228.

[5] A. Daughety, J. Reinganum, Economic Theories of Settlement Bargaining, Annual Review of Law and Social Science, 1 (2005) 35-59.

[6] A. Daughety, J. Reinganum, Settlements, in: C. Sanchirico (Eds.), Encyclopedia of Law and Economics, Second edition, Vol. 7: Procedural Law and Economics, Edward Elgar Publishing Co., 2011.

[7] R. Epstein, Antitrust Consent Decrees in Theory and Practice: Why Less Is More, AEI Press Publisher, 2007.

[8] P. Fenn, C. Veljanovski, A Positive Economic Theory of Regulatory Enforcement, The Economic Journal, 393 (1988) 1055-1070.

[9] M. Furse, The Decision to Commit: Some Pointers from the US, European Competition Law Review, 1 (2004) 5-10.

[10] L. Franzoni, Negotiated Enforcement and Credible Deterrence, The Economic Journal, 109 (1999) 509-535.

[11] J. Gould, The Economics of Legal Conflicts, Journal of Legal Studies, 2 (1973) 279-300.

[12] G. Grossman, M. Katz, Plea Bargaining and Social Welfare, American Economic Review, 73 (1983) 749-757.

[13] W. Kovacic, Downsizing Antitrust: Is It Time to End Dual Federal Enforcement?,Antitrust Bulletin, 41 (1996) 505-520.

[14] W. Landes, An Economic Analysis of the Courts, Journal of Law and Economics, 14 (1971) 61-108.

[15] T. Miceli, Plea Bargaining and Deterrence: An Institutional Approach, European Journal of Law and Economics, 3 (1996) 249-264.

[16] A. Melamed, Antitrust : The New Regulation, Antitrust, 10 (1995) 13-15.

[17] M. Motta, M. Polo, Leniency Programs and Cartel Prosecution, International Journal of Industrial Organization, 21 (2003) 347-379.

[18] R. Posner, An economic approach to legal procedure and judicial administration, Journal of Legal Studies, 2 (1973) 399-458.

[19] M. Polinsky, Y. Che, Decoupling liability: Optimal incentives for care and litigation, RAND Journal of Economics, 22 (1991) 562-570.

[20] M. Polinsky, D. Rubinfeld, The deterrent effects of settlements and trials, International Review of Law and Economics, 8 (1988) 109-116.

[21] J. Reinganum, The Law Enforcement Process and Criminal Choice, International Review of Law and Economics, 13 (1993) 115-134.

[22] J. Reinganum, L. Wilde, Settlement, litigation, and the allocation of litigation costs, RAND Journal of Economics, 17 (1986) 557-566.

[23] F. Scherer, Thinking about the European Microsoft Case: F.M. Scherer Discusses the Relevance of the IBM Case. Antitrust & Trade Regulation Report, 84 (2003) 65-66. Available at http://www.antitrustinstitute.org/ antitrust/node/10374.

[24] H. Schweitzer, Commitment Decisions : An overview of EU and national case law, e-Competitions, 48150 (2012), www.concurrences.com.

[25] S. Shavell, Suit, settlement and trial: a theoretical analysis under alternative methods for the allocation of legal costs, Journal of Legal Studies, 11 (1982) 55-81.

[26] S. Shavell, Suit versus Settlement When Parties Seek Nonmonetary Judgments, Journal of Legal Studies, 22 (1993) 1-13.

[27] S. Souam, A. Vialfont, Partial Commitments in Antitust, mimeo, Laboratoire d'Economie Industrielle, 2011.

[28] K. Spier, Litigation, in: M. Polinsky, S. Shavell (Eds.), The Handbook of Law and Economics, North Holland, 2007.

[29] A. Vialfont, Le droit de la concurrence et les procédures négociées, Revue Internationale de Droit Economique, 2 (2007) 157-184.

[30] W. Wils, Settlements of EU Antitrust Investigations: Commitment Decisions under Article 9 of Regulation No. 1/2003, World Competition, 29 (2006) 345-366.

## AppendixA. Proof of Equation (9)

We have:

$$CS'(x) = [cs^d(\Delta^d(x)) - cs^c(\Delta^d(x), x)]\phi(\Delta^d(x))\frac{\partial \Delta^d(x)}{\partial x} + \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} h(\Delta)d\Delta,$$

where $[cs^d(\Delta) - cs^c(\Delta, x)]\phi(\Delta) = I_1(x)h(\Delta)$. In addition, using the expression of $\Delta^d$, equation (4), and $I_1'(x) = -\alpha I_2$, we get:

$$I_1(x)\frac{\partial \Delta^d(x)}{\partial x} = I_1(x)\left[-\frac{\alpha\beta\delta_3 F}{I_1(x)} + \alpha\frac{\Delta^d(x)}{I_1(x)}I_2\right] = -\alpha I_2(\Delta^r - \Delta^d(x)).$$

Hence:

$$CS'(x) = \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} \left[h(\Delta) - h(\Delta^d(x))\right] d\Delta.$$

## AppendixB. Proof of Proposition 2

Given that $\Delta^d(x)$ belongs to the interval $[0, \Delta^0]$, we see from (9) that $CS'$ is positive (resp. negative) if $h(.)$ is increasing (resp. decreasing) on $[0, \Delta^r]$. If $h(.)$ is constant, $CS'$ is identically zero, hence $CS(x) = CS(0) = CS(1)$ for all $x$.

## AppendixC. Proof of Proposition 3

The second derivative of the consumer surplus is given by:

$$CS''(x) = -\alpha I_2 h'(\Delta^d(x))\,[\Delta^r - \Delta^d(x)]\,\frac{\partial \Delta^d(x)}{\partial x}.$$

The consumer surplus is convex when $h'(\Delta^d(x)) \geq 0$, concave if $h'(\Delta^d(x)) \leq 0$.

We now characterize the optimal policy. Suppose first that $h'(\Delta^0) \geqslant 0$. Then by quasi-concavity of $h$, $h'$ is nonnegative on $[0, \Delta^0]$ and $h'(\Delta^d(x)) \geqslant 0$

for any $x \in [0, 1]$. It follows that the consumer surplus is convex in $x$ on $[0, 1]$ and achieves its maximum either at $x = 0$ or at $x = 1$.

Next, suppose that $h'(\Delta^0) < 0$. In this case, $h'(\Delta(x))$ is negative (resp. positive) for low (resp. high) values of $x$. It follows that the consumer surplus is first concave, then convex as $x$ rises. Since $h$ is decreasing on $[\Delta^0, \Delta^r]$, we see from (9) that $CS'(0) < 0$, implying that $x = 0$ is a local maximum. This is in fact a global maximum when $CS'(1) < 0$. Otherwise, $x = 0$ and $x = 1$ are two local maxima.

We now examine how the value of the fine $F$ affects the authority's trade-off while choosing $x = 0$ or $x = 1$. We have:

$$CS(1) - CS(0) = -I_1(1) \int_0^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta + I_1(0) \int_{\Delta^0}^{\Delta^r} h(\Delta)\, \mathrm{d}\Delta,$$

which is equivalent to (10). Differentiating with respect to $F$ and using $I_1(0) - I_1(1) = \alpha I_2$ yields

$$\frac{\partial [CS(1) - CS(0)]}{\partial F} = \alpha \beta \delta_3 [h(\Delta^r) - h(\Delta^0)].$$

If $h(\Delta^r) < h(\Delta^0)$, a marginal increase of the fine $F$ lowers the difference $CS(1) - CS(0)$, thus making $x = 0$ more likely to be optimal. If $h(\Delta^r) \geq h(\Delta^0)$, we necessarily have $CS'(0) > 0$; the consumer surplus is increasing and convex on $[0, 1]$ and achieves its maximum at $x^* = 1$. In this case, a marginal increase of $F$ has no impact on the optimal policy.

## AppendixD. Proof of Proposition 4

We start by characterizing the optimal policy. Suppose first that $h'(\Delta^0) < 0$. Then by quasi-convexity of $h$, $h'(\Delta^d(x))$ is negative for all $x$, the consumer surplus is globally concave (see AppendixC), and its maximum is characterized by the first-order condition. The maximum is interior if and only if $CS'(0) > 0$ and $CS'(1) < 0$. Under these two conditions, the optimal policy is stochastic.

Next, suppose that $h'(\Delta^0) \geqslant 0$. Following the same analysis as before, we find that the consumer surplus is first convex, then concave as $x$ rises. Since $h$ is increasing on $[\Delta^0, \Delta^r]$, we see from (9) that $CS'(0) > 0$. It is therefore optimal to use the commitment procedure with a positive probability. If $CS'(1) \geqslant 0$, the optimal policy is $x^* = 1$, otherwise it is stochastic.

We now examine how the optimal policy depends on $F$. When the optimal policy is stochastic, it is characterized by the first-order condition which, using (9), can be written as $\Psi(x, F) = 0$, with

$$\Psi(x, F) = \alpha I_2 \int_{\Delta^d(x)}^{\Delta^r} \left[h(\Delta) - h(\Delta^d(x))\right] \, \mathrm{d}\Delta.$$

By the second-order condition of the authority's problem, the derivative of $\Psi$ with respect to $x$ is negative at $x^*$. The derivative of $\Psi$ with respect to $F$, evaluated at $x = x^*$, is given by

$$\frac{1}{\alpha I_2} \frac{\partial \Psi}{\partial F} = \frac{\partial \Delta^r}{\partial F} \left[h(\Delta^r) - h(\Delta^d(x^*))\right] - \frac{\partial \Delta^d(x^*)}{\partial F} h'(\Delta^d(x^*)) \left[\Delta^r - \Delta^d(x^*)\right].$$

The quasi-convexity of $h$, joint with the first-order condition, implies that $h(\Delta^r) > h(\Delta^d(x^*))$ and $h'(\Delta^d(x^*)) < 0$. Since both the deterrence and the regret thresholds $\Delta^d$ and $\Delta^r$ increase with $F$, we find that the above derivative is positive. We conclude by the implicit function theorem that $x^*$ locally increases with $F$.

Finally, suppose that the optimal policy is deterministic. If $x^* = 0$, an increase in $F$ can only raise $x^*$. If $x^* = 1$ , we must have $CS'(1) \geq 0$. Since

$$\frac{\partial CS'(1)}{\partial F} = [h(\Delta^r) - h(0)] \frac{\partial \Delta^r}{\partial F} > 0,$$

an increase in $F$ at a point where $x^* = 1$ leaves the inequality $CS'(1) \geq 0$ and hence the optimal policy unchanged.

## AppendixE. Proof of Remark 1

We consider the situation of Proposition 4 and assume that the consumer harm function and the level of the fine $F_0$ are such that

$$CS'(0) = \int_{\Delta^0}^{\Delta^r} \left[h(\Delta) - h(\Delta^0)\right] \, \mathrm{d}\Delta = 0,$$

and hence the optimal policy being $x^*(F_0) = 0$. For a slightly higher level $F$ of the fine, we have, at the optimum

$$\int_{\Delta^d(x^*(F))}^{\Delta^r} \left[h(\Delta) - h(\Delta^d(x^*(F)))\right] \, \mathrm{d}\Delta = 0.$$

The deterrence threshold $\Delta^d$ directly depends on $F$ and indirectly through $x^*(F)$, see (4). Differentiating with respect to $F$ at $F_0$ yields the *total* derivative of the optimal deterrence threshold $\mathrm{d}\Delta^d / \mathrm{d}F$:

$$\left[h(\Delta^r) - h(\Delta^0)\right] \frac{\partial \Delta^r}{\partial F} - h'(\Delta^0) \frac{\mathrm{d}\Delta^d}{\mathrm{d}F} (\Delta^r - \Delta^0) = 0. \tag{E.1}$$

In the configuration of the Proposition 4, we have $h(\Delta^r) > h(\Delta^0)$ and $h'(\Delta^0) < 0$ at the optimum (use Figure 4 with $\Delta^d(x^*) = \Delta^0$). Moreover, we know that the regret threshold increases with $F$. We conclude that the total derivative at the deterrence threshold is negative at $F_0$, hence deterrence is *weakened* following the increase of the fine level from $F_0$ to $F$.

Knowing $\mathrm{d}\Delta^d/\mathrm{d}F$ from (E.1), we get the derivative of the optimal policy $x^*(F)$ with respect to $F$, evaluated at $F = F_0$, by

$$\frac{\mathrm{d}\Delta^d}{\mathrm{d}F} = \frac{\partial \Delta^d}{\partial F} + \frac{\partial \Delta^d}{\partial x}\frac{\mathrm{d}x^*}{\mathrm{d}F}.$$

Noticing that $I_1(x)\partial\Delta^d(x)/\partial x = -\alpha I_2[\Delta^r - \Delta^d(x)]$, the above can be rewritten as

$$\frac{\mathrm{d}\Delta^d}{\mathrm{d}F} = \frac{\alpha\beta\delta_3}{I_1(0)} - \frac{\alpha I_2(\Delta^r - \Delta^0)}{I_1(0)}\frac{\mathrm{d}x^*}{\mathrm{d}F}. \tag{E.2}$$

Trials take place for undeterred cases that are detected and are not closed with a commitment decision. The equilibrium probability of trial is thus given by:

$$\mathbb{P}^t(F) = \alpha\left[\Phi(\bar{\Delta}) - \Phi(\Delta^d(x))\right] - \alpha x\left[\Phi(\Delta^r) - \Phi(\Delta^d(x))\right].$$

Differentiating with respect to $F$ and evaluating the derivative at $F = F_0$ yields

$$\frac{\mathrm{d}\mathbb{P}^t}{\mathrm{d}F} = -\alpha\,\frac{\mathrm{d}\Delta^d}{\mathrm{d}F}\,\phi(\Delta^0) - \alpha\left[\Phi(\Delta^r) - \Phi(\Delta^0)\right]\frac{\mathrm{d}x^*}{\mathrm{d}F}.$$

A marginal introduction of the commitment procedure "mechanically" reduces the number of trial (second term above), but also increases the overall number of cases as deterrence is lowered ($\Delta^d$ decreases with $x$). Replacing $\mathrm{d}x^*/\mathrm{d}F$ with its value from (E.2), we find

$$\frac{\mathrm{d}\mathbb{P}^t}{\mathrm{d}F} = \alpha\frac{\mathrm{d}\Delta^d}{\mathrm{d}F}\left[\frac{I_1(0)}{\alpha I_2}\,\frac{\Phi(\Delta^r) - \Phi(\Delta^0)}{\Delta^r - \Delta^0} - \phi(\Delta_0)\right] - \frac{\alpha\beta\delta_3}{I_2}\,\frac{\Phi(\Delta^r) - \Phi(\Delta^0)}{\Delta^r - \Delta^0}. \tag{E.3}$$

If the density $\phi$ is nondecreasing on $[\Delta^0, \Delta^r]$, the bracketed term is positive and hence the two terms in (E.3) are negative: a higher fine translates into less trials at the optimum. On the contrary, the bracketed term is negative when the density is decreasing and the distribution of $\Delta$ is sufficiently concentrated around $\Delta^0$, i.e. if $\phi(\Delta^0)$ is high enough. If the total derivative of the deterrence threshold is large enough in absolute value,[15] the first term dominates the second in (E.3), and a higher fine translates into more trials.

## AppendixF. Proof of Remark 2

We consider an equilibrium $(\tilde{x}, \tilde{\Delta})$, with $\tilde{\Delta} = \Delta^d(\tilde{x})$. If the authority plays a mixed strategy, $0 < \tilde{x} < 1$, we have

$$\int_{\tilde{\Delta}}^{\Delta^r} cs(\Delta; x)\,\mathrm{d}\Phi(\Delta) = \int_{\tilde{\Delta}}^{\Delta^r} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta),$$

because the average value of $h(.)$ is zero on $[\tilde{\Delta}, \Delta^r]$. It follows that the expected consumer surplus in equilibrium, $CS(\tilde{x}|\tilde{\Delta})$, is given by

$$CS(\tilde{x}|\tilde{\Delta}) = \int_0^{\Delta^r} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^r}^{\bar{\Delta}} cs(\Delta; 0)\,\mathrm{d}\Phi(\Delta), \tag{F.1}$$

which does not depend on $\tilde{x}$. The consumer surplus, therefore, is the same in all equilibria where $0 < \tilde{x} < 1$. For deterministic equilibria, we have

$$CS(0|\Delta^0) = \int_0^{\Delta^0} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^0}^{\bar{\Delta}} cs(\Delta; 0)\,\mathrm{d}\Phi(\Delta)$$

if $(\tilde{x}, \tilde{\Delta}) = (0, \Delta^0)$, and

$$CS(1|0) = \int_0^{\Delta^r} cs(\Delta; 1)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^r}^{\bar{\Delta}} cs(\Delta; 0)\,\mathrm{d}\Phi(\Delta)$$

if $(\tilde{x}, \tilde{\Delta}) = (1, 0)$.

[15] The total derivative $\mathrm{d}\Delta^d/\,\mathrm{d}F$, which is negative, depends on the consumer harm function, as shown in (E.1).

We now compare the value of the consumer surplus at two equilibria $(\tilde{x}_1, \tilde{\Delta}_1)$ and $(\tilde{x}_2, \tilde{\Delta}_2)$, with $\tilde{x}_1 < \tilde{x}_2$, and check that the consumer surplus is higher in the equilibrium with the lowest probability of using the commitment procedure (equilibrium 1). If $0 = \tilde{x}_1 < \tilde{x}_2 < 1$, we have

$$CS(0|\Delta^0) - CS(\tilde{x}_2|\tilde{\Delta}_2) = \int_{\Delta^0}^{\Delta^r} \left[cs(\Delta;0) - cs^d(\Delta)\right] \, \mathrm{d}\Phi(\Delta) > 0.$$

Indeed the average value of $h(.)$ is negative on $[\Delta^0, \Delta^r]$ because $(0, \Delta^0)$ is an equilibrium. If $0 < \tilde{x}_1 < \tilde{x}_2 = 1$, we have

$$CS(\tilde{x}_1|\tilde{\Delta}_1) - CS(1|0) = \int_0^{\Delta^r} \left[cs^d(\Delta) - cs(\Delta;1)\right] \, \mathrm{d}\Phi(\Delta) > 0.$$

Indeed the average value of $h(.)$ is positive on $[0, \Delta^r]$ as $\tilde{x}_2 = 1$ is an equilibrium. Finally, if $\tilde{x}_1 = 0$ and $\tilde{x}_2 = 1$, we have

$$\begin{aligned}
CS(0|\Delta^0) - CS(1|0) &= \int_0^{\Delta^0} cs^d(\Delta)\,\mathrm{d}\Phi(\Delta) + \int_{\Delta^0}^{\Delta^r} cs(\Delta;0)\,\mathrm{d}\Phi(\Delta) \\
&\quad - \int_0^{\Delta^r} cs(\Delta;1)\,\mathrm{d}\Phi(\Delta) \\
&= \int_0^{\Delta^r} \left[cs^d(\Delta) - cs(\Delta;1)\right] \, \mathrm{d}\Phi(\Delta) - I(0) \int_{\Delta^0}^{\Delta^r} h(\Delta)\,\mathrm{d}\Delta \\
&> 0.
\end{aligned}$$

Indeed the average value of $h(.)$ is positive on $[0, \Delta^r]$ and negative on $[\Delta^0, \Delta^r]$, and as $\tilde{x} = 0$ and $\tilde{x} = 1$ both are equilibria of the game. This yields the desired result.